IPCC WGI SR15 Second Order Draft Review Comments And Responses - Chapter 4

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2400					Feasibility assessment tables are a very useful step forward and should in some way reference the emerging risk tables of Chapter 3 - so there is a clear link back to impacts to help the policy makers join the dots. [Debra Roberts, South Africa]	Noted. Link to Chapter 3 provided in 4.5.3.1
5668					This comment concerns supplement 4 A a table on feasibility assessment: This table is a very useful summary and representation of the available data. Missing are: social adaptation beyond education, the power of NGOs and religious communtiies, and indigenous communities. The psychological adaptation issues are also not treated here. Perhaps they are not relevant here, but if they are, they ought to be mentioned? Just asking. [Marion Grau, Norway]	Accepted - we have added in indigenous knowledge which has been added to the overarching adaptation section. We do not assess the role of religious communities though
6428					Low carbon shipping does not necessarily require replacement of the world's 60 000 large vessel. Drop-in biofuels, and with some modifications in tanks and combustors, ammonia, can be deployed on existing vessels. [Cedric Philibert, France]	Accepted: Text changed, Ammonia added.
7408					I miss in this full chapter (except for Box 4.1) a discussion of current policies scenario, which identifies most recent, publicly available official estimates of 2020 and 2030 emissions, considering projected economic trends and current policy approaches. The current policies scenarios are based on multiple studies, including IEA World Energy Outlook, Climate Action Tracker, PBL IMAGE and POLES model, but also on national studies. This has been done in den Elzen et al., 2016, as cited here, and is also done in UNEP (2015-2017). Box 4.1 does present the current policies scenarios. [Michel den Elzen, Netherlands]	Noted. This chapter is about implementing the response. Baselines are assessed in chapter 2.
7688					The structure of this chapter remains very problematic in that it obscures the dominant (if properly assessed) mitigation role of energy efficiency. AR5 WG3 at 136–137 says efficiency can halve mitigation costs; the modeling community broadly agrees (e.g. Kriegler et al 2014, EMF27 2011). IEA's WEO2015 (p 208) relies on efficiency for half its New Policies carbon abatement. During 2014–16, reduced energy intensity was three times as important as decarbonized energy supply in holding global fossil carbon emissions constant (IEA 2017) by offsetting global GDP growth and its 2 GTCO2/y of added emissions. Yet this report, like most IAMs, emphasizes decarbonization far more than efficiency. Readers might be forgiven for supposing that efficiency is only a minor part of the mitigation portfolio. Efficiency is called out as an explicit topic only for Industry (4.3.5.1). In Transport it appears only briefly and indirectly in larger discussions of Urban transport and urban design (4.3.4.3) and on the supply side in 4.3.4.4, but only in the urban context. (Cities are indeed important and getting more so, but apparently the dramatic efficiency opportunities in transporting nearly half of the world's people who don't live in cities nor take airplanes or ships internationally (4.3.2.4) aren't worth discussing, even though they're at the heart of NITI Aayog's 2017– new strategy adopted in India Leaps Ahead (http://niti.gov.in/writereaddata/files/document_publication/RMI_India_Report_web.pdf, cited at 4-26:11–12) and subsequent NITI/RMI copublications.) Buildings too (4.3.4.2) are apparently only urban (though 4-16 mentions them in the context of PV supply). Moreover, these discussions are all derisory in length and detail, and read as if they had not been written by practitioners of energy efficiency. This report's sections on energy efficiency would be far more useful if they quantitatively summarized Chs 8–10 of AR5 WG3, of which in my view Ch 9 (Buildings) is very good, Ch 10 (Industry) quite incomplete but sound as far as it goes, and Ch 8 (Transport) rather outdated but far superior to what's here or in 4.3.4. Unfortunately, most of the IAMs on which this report relies are years behind in even catching up to these 2014 AR5 WG3 assessments, let alone the more-advanced 2018 state of the art. As a general comment, therefore, this report seriously understates the most important mitigation option and the world's largest current source of energy services (reduced intensity since 1990 now avoids more primary energy use than oil supplies). In consequence, this report gives exaggerated relative emphasis to costlier, riskier options; leaves an unwarrantedly pessimistic impression of the feasibility of 1.5C? pathways; and conversely, fails to emphasize AR5 WG3's important discussion of the need to avoid inefficient lock-ins. For further details, kindly see Lovins 2018: "How Big Is the Energy Efficiency Resource?", in review, Envtl. Res. Letters, and 2018a, "Fully Counting Energy Efficiency Potential in Climate Models" [retitled], Clim. Change, invited and in submission. [Amory Lovins, United States of America]	Noted. The discussion on energy efficiency in this chapter is indeed not the most common discussion. While chapter 2 has clearer pointers as to what energy efficiency is needed according to the IAMs, in chapter 4 it is essentially a crosscutting theme across this chapter. Energy efficiency strengthens other emission reduction options, especially decarburization of energy supply. It appears in section 4.2, 4.3, 4.4 and 4.5 in various forms. We discuss options, the role in industrial and urban/infrastructure system transitions, and how it can be promoted by behaviour (4.4.3) and innovation (4.4.4). The issues that prevent energy efficiency options from happening are discussed in section 4.5.2. We feel the option has been given a lot of prominence and are not denying its importance. Also, some of these comments, in the logic of this report, belong to chapter 2. The ERL reference could not be obtained.
12584					Supplementary Chapter 4.B: the table makes no mention in the renewables section of growing biomass for bioenergy, which (I think) makes up the greatest share of global renewables by energy in mitigation pathways. There must be many synergies and trade-offs with adaptation, given the possible impacts (positive and negative) of biomass cultivation on biodiversity and ecosystem services. To ignore these is very surprising. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the synergies and trade-offs of bioenergy have been included in the table.
14180					The FAQ section is extremely useful and, hopefully, helpful to clarify key messages conveyed by the report. [Silvia Serrao-Neumann, Australia]	Noted
36162					The Report cites ending of 'Fossil fuel subsidies' as an effective means of transitioning to a low-carbon future. It needs to be highlighted that only 'inefficient' fossil fuel subsidies need to be abolished as per national circumstances. [India]	Taken into account - in the rewording of the final text
36164					Supplementary Material 4 A Disaster Risk Management Meteorological and remote sensing satellites data are useful in forecasting and also monitoring of cyclones, hurricanes, floods, etc. This advance information helps improving preparatory efforts in minimizing anticipated human, property and ecosystem losses. In the long run attempts may be made to construct, roads, bridges, and buildings which are disaster-resistant. [India]	Accepted - we already have text and references in the examples on the role of early warning and monitoring which draws upon these technologies, and in response to comment explicitly note remote sensing

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7692					This DOD, like the FOD, overlooks highly relevant evidence repeatedly offered. My FOD comments on 4-15:9–14 and :50–52 cited two extremely detailed, rigorous, empirically and economically grounded, and heavily peer-reviewed analyses that detailed how US (Lovins & RMI 2011) and Chinese (ERI 2017) futures respectively reducing 2050 carbon emissions by 82–86% and 42% despite respective 2.6x and 7x GDP growth from 2010, i.e. raising GDP/fossil carbon by respectively 14–18x and 13x, would reduce net-present-value private internal cost, i.e. with no pricing of carbon or any other externality, by USD 5 trillion and USD 3.1 trillion respectively. The US study is on track in the marketplace (2010–16) and the Chinese study is strongly reflected in Chinese national policy. My FOD comments on 4-78–4-79 further noted that extrapolating these findings and similar EU ones (European Climate Foundation 2010) to the other half of the world imply a 2C? trajectory ~USD18 trillion NPV cheaper than business-as-usual, or with reinvestment in natural-systems carbon removal, a 1.5C? trajectory still trillions of USD cheaper than BAU. Of course, pricing carbon would help achieve such outcomes more rapidly and surely, but multi-trillion-dollar savings from deep decarbonization in the two biggest emitting nations even without carbon pricing surely merits discussion. My FOD comments' repeated citations of these basic references and of their summaries in peer-reviewed journals have elicited no indication the authors have read any of them, no citations of any, and no reflection of their findings in this second-order draft. Indeed, that appears to be true of all 22 of the references on energy efficiency (8 in peer-reviewed journals) included in my FOD comments. If correct, that implies a serious weakness in the review process. P 1-52 rightly confirms that this report's sources are dominated by peer-reviewed literature but also permits a modest amount of grey literature. In this case the two key references (Reinventing Fire and Reinventing Fire: China) were published as heavily document-ed technical books far too long to publish in a scientific journal, but were summar-ized in peer-reviewed journals (Price et al 2017, Zhou et al 2016,…); yet neither is acknowledged or apparently read. This seems especially odd because, as my FOD comments on 4-5:50–52 noted, ERI 2017, published by the Chinese government's top energy analytic/policy agency and "reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior [energy] authors of the 13th Five Year Plan, which it strongly informed." To be sure, the full five-volume study was released only in late 2017 (so the English edition, which had to await it, is now in press), but besides the cited sectoral peer-reviewed journal summaries, the official and complete Executive Summary was released at the G20 in autumn 2016. Doesn't this foundational document for China's national energy strategy merit discussion? It will certainly be discussed elsewhere, and its absence here would be hard to explain. [Amory Lovins, United States of America]	Noted. Some references were indeed adopted, thank you for those suggestions. We cannot adopt non-peer-reviewed references, as well as references assessed in AR5. That made the most appreciated comments difficult to implement in full. On the Chinese strategy: if it's available we should assess it but if only an ES is available and we cannot access the full document, we cannot take it on board.
12176					General comment on Chapter 4 - too much of the text isn't a rigorous feasibility assessment. It's a set of generic statements, loosely applied to the broad aspects of decarbonisation, rather than the actual scenarios outlined in Chapter 2 themselves. Moreover the generic statements often lean towards the optimistic side, with no serious attempt to address the substantive challenges that exist [United Kingdom (of Great Britain and Northern Ireland)]	Accept. In the FGD, we have investment yet more in the stronger link with chapter 2, so that the implementation statements in chapter 4 build on IAM results (while nuancing them). See Table 4.1 and the rest of section 4.2. As for the challenges, we have tried to strike a balance, also in the feasibility assessment in 4.5 and the Supplementary Material.
12178					General comment on Chapter 4 - there are a number of apprarent inconsistencies between this chapter and chapter 2. It reads as though the two have been written in parallel, rather than with scenarios from chapter 2 being subject to specific and rigorous analysis in chapter 4. We appreciate that time for analysis has been limited, but greater integration of these two chapters is important. [United Kingdom (of Great Britain and Northern Ireland)]	Accept. Because of the time schedule of this report, and the deadlines for the scenario database, the reality is that they have been written largely in parallel. We have and are still making every effort to get to a good handshake. In the FGD, section 4.2 is the place where this happens. We have also provided clearer links between the sections in 4.3 and 4.4, and chapter 2.
36166					The report cites studies estimating the financial implications of reducing emissions and developing a climate resilient infrastructure/ societies. It should also include assessment/ commentary of how the finance would be sourced/ channelized to achieve the desired results in an effective, equitable and fair manner. Although the report briefly cites general budget, energy or resources taxation, or emission trading schemes as potential sources of finance, however, the statement seems to relieve developed countries from their responsibility of providing financial support to developing countries. [India]	Accepted - Good remark. This has been amended in the next version
12180					Glossary and definition for loss and damage, which is subsequently discussed in this chapter: any definition of LnD should make it clear that this is a political term used in UNFCCC language (as stated in box 4.4). It has no official definition in climate policy (as stated in box 4.4) and neither is it defined in scientific literature. In fact, there are many different viewpoints, as highlighted by Boyd et al. (2017). [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Please note that Xbox 4.4 has now become Cross-Chapter Box 12 in Chapter 5. We now say in the text; "There is no one definition of L&D in climate policy, and analysis of policy documents and stakeholder views has demonstrated ambiguity (Vanhala and Hestbaek 2016; Boyd et al. 2017). ", and state as follows in the glossary: "Research has taken Loss and Damage (capitalized letters) to refer to political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013, which is to "address loss and damage associated with impacts of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change." Lowercase letters (losses and damages) have been taken to refer broadly to harm from (observed) impacts and (projected) risks (see Mechler et al. 2018)."
31562					Given IPCC rule, the IPCC works by assessing published literature and it does not conduct its own scientific research. Therefore, each element of the figures and tables needs to be supported by published literature and all the descriptions and statements in the assessment report should specify the basis of the literature. It needs to be clearly indicated which articles are referred, and what is the level of agreement as well as evidence. In case of low agreement and limited numbers of supporting articles and/or evidence, please specify so with appropriate scale of confidence since IPCC rule reads the IPCC works by assessing published literature. Especially, we request that IPCC reconsider revision of Fig 4.5, Fig 4.6 of page 86, 87 since many elements of these figures are based upon either very limited number or diversity of literature or subjective judgement of the authors. [Japan]	Accept. See the detailed Feasibility analysis presented in 4.5.3.1 and Table 4.12 and the full methodology for the assessment. Also see Supplementary material D for full line of sight for each option assessed, including when low or no evidence is available.
31564					Please specify the basis of the literature regarding Fig4.5, Fig 4.6, Fig. 4.7, Box 4.11, Fig. 4.8, Table 4.8, Table 4.9, Table 4.10, 4.11, Fig. SPM.2, Fig. SPM 3. . It needs to be clearly indicated which articles are referred, and what is the level of agreement as well as evidence. In case of low agreement and limited numbers of supporting articles and/or evidence or subjective judgement of the authors, please specify so with appropriate scale of confidence since IPCC rule reads the IPCC works by assessing published literature. [Japan]	Accept. Fig 4.6, Fig 4.8 and the boxes were removed. For the others, literature references are provided. Please also see the detailed Feasibility analysis presented in 4.5.3.1 for confidence guidance and Table 4.12. Also see Supplementary material D for full line of sight for each option assessed. For the SPM figures, the literature is available in the section that is references in the SPM.
40166					This chapter is challenged in that almost all of the statements in the ES are only supported by medium evidence, while making some pretty definitive statements See P6, line 25 Please take care to match the certainty of statements to the robustness of the evidence. This is done well with the use of the word "may" on P.5 line 54. [Ko Barrett, United States of America]	Accepted. ES modified to match evidence base

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42830					SLCPs should have more attention on their ability to reduce the rate of warming, which could be essential in the near-term for avoiding approaching tipping points that exist about the 1.5ºC threshold (e.g., corals). Furthermore, the benefits from reducing co-emitted species should not be downplayed; in fact, given the thorough discussion on the psychological aspects of climate change mitigation and adaptation, actions are likely to be taken when results can be seen quickly, similarly to how consumers will select the energy efficient appliance that they can witness reducing their bills instead of choosing reducing energy consumption. [Kristin Campbell, United States of America]	Partly taken into account within the space restrictions given. More studies and discussion have been added, while some parts of the text (on geophysics that overlap with ch1 and 2) have been reduced.
42832					The Kigali Amendment should be discussed as an international law and policy success. The creation of the Kigali Amendment represents a number of policy solutions in effect, including: financing mechanism, oversight, and penalties (through trade restrictions with noncompliance). The Kigali Amendment also provides an insightful metaphor for the NDCs and the ability to begin tackling an issue and strengthen along the way. [Kristin Campbell, United States of America]	Accept. Section 4.3.6 and 4.4.1 now cite the Kigali Amendment as an effective agreement.
46484					Chapter length estimate is 53.4 IPCC pages (3.4 over the 50 page limit agreed by the IPCC panel). This estimate does not include figures, tables, references, FAQs, and cross-chapter boxes but does include chapter-boxes and main text and the executive summary. Please find areas of the chapter than can be edited down to reduce the length of the final chapter draft. [Sarah Connors, France]	Noted.
46620					Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Noted. Implemented
54148					As a whole, the chapter is excellent but I must admit I am disappointed by the fact that the NDCs communicated by the Parties have not been leveraged enough as sources when it comes to identifying gaps and needs. The analysis of that remains, in this chapter, too light, in my opinion [Ayman Bel Hassan Cherkaoui, Morocco]	Noted. The NDC box has been revised in keeping with IPCC guidelines on length. As for using the NDCs in the assessment: that would be crossing the line of research rather than assessment.
51170					It is crucial to highlight that there are safer and more sustainable ways of removing CO2 from the atmosphere than through technological means. According to Dooley/Kartha (2018), an amount of 370-480 GtCO2 could be removed through forest ecosystem restoration and, to a lesser degree, reforestation. Other ecosystem restoration, such as moors and peatland, can achieve additional CO2 removal. Such ecological options are low- to no-cost, ready to be deployed, tested and proven, safe, provide for adaptation co-benefits and allow for livelihoods, food and water security to be sustained. Given the SDG context of the present report, these options should receive great attention. [Linda Schneider, Germany]	Noted - however, this section does not only deal with technologies, but also with other options, including afforestation and reforestation and also covers the Griscom et al. (2017) study on natural climate solutions (in as far as it pertains to carbon removal), explicitly mentioning the co-benefits. See also cross-reference to cross-chapter box 7, where land-based CDR is dealt with in the context of chapter 3. There is furthermore no space here to reproduce the assessment of SDG implications of CDR deployment in chapter 5.
53392					In Chapter 4: Supplementary Material 4A (Table 4A). The Option - Disaster Risk Management (DRM) add relevant studies on the risk associated with natural disasters like tropical cyclones for the Indian Ocean region. The references are given below and may be included in this Table 4A. Prasad K. Bhaskaran, R. Gayathri, P.L.N. Murty, Subba Reddy B., and Debabrata Sen (2013). A numerical study of coastal inundation and its validation for Thane Cyclone in the Bay of Bengal, Coastal Engineering, Elsevier, 83, 108-118. Sashikant Nayak and Prasad K. Bhaskaran (2014). Coastal Vulnerability due to extreme waves at Kalpakkam based on historical tropical cyclones in the Bay of Bengal, Int. Journal Climatology, Royal Met. Society, 34, 1460-1471. Murty, P.L.N., Sandhya, K.G., Prasad K. Bhaskaran., Felix J., Gayathri, R., Balakrishnan Nair, T.M., Srinivasa Rao, T., and Shenoi, S.S.C (2014). A coupled hydrodynamic modeling system for PHAILIN cyclone in the Bay of Bengal, Coastal Engineering, Elsevier, 93, 71-81. Prasad K. Bhaskaran., Nitika Gupta, and Mihir K. Dash (2014). Wind-wave climate projections for the Indian Ocean from Satellite observations, Journal of Marine Science Res. & Dev., S11: 005, DOI: 10.4172/ 2155-9910. S11-005. Sudha Rani, N.N.V., A.N.V.Satyanarayana, and Prasad K. Bhaskaran (2015).Coastal vulnerability assessment studies over India: a review, Natural Hazards, 77, 405-428. Bishnupriya Sahoo, and Prasad K. Bhaskaran (2015).Assessment on historical cyclone tracks in the Bay of Bengal, east coast of India. Int. Journal Climatology, Royal Met. Society, 36(1), 95-109. Nitika Gupta, Prasad K. Bhaskaran, and Mihir K. Dash (2015). Recent trends in Wind-Wave Climate for the Indian Ocean. Current Science, 108(12), 2191-2201. R. Gayathri, P.L.N. Murty, Prasad K. Bhaskaran and T. Srinivasa Kumar (2015). A numerical study of hypothetical storm surge and coastal inundation for AILA cyclone in the Bay of Bengal. Env. Fluid Mechanics, Springer,DOI 10.1007/s10652-0. Anindita Patra and Prasad K. Bhaskaran (2016). Trends in wind-wave climate over the head Bay of Bengal region. Int. Journal Climatology, Royal Met. Society, DOI: 10.1002/joc.462. Nitika Gupta & Prasad K. Bhaskaran (2016). Inter-dependency of wave parameters and directional analysis of ocean wind-wave climate for the Indian Ocean. International Journal of Climatology, Royal Met. Society, DOI: 10.1002/joc.4898. P.L.N.Murty, Prasad K. Bhaskaran, R. Gayathri, Bishnupriya Sahoo, T. Srinivasa Kumar, & B. Subba Reddy (2016). Numerical study of coastal hydrodynamics using a coupled model for Hudhud cyclone in the Bay of Bengal,Estuarine, Coastal and Shelf Science, Elsevier, 183, 13-27. R. Gayathri, Prasad K. Bhaskaran and Felix Jose (2017). Coastal Inundation Research: an Overview of the Processes, Current Science, 112(2), 267-278. Sudha Rani, N.N.V., A.N.V.Satyanarayana, and Prasad K. Bhaskaran (2017). Assessment of Climatological Trends of Sea Level over the Indian Coast	Noted - we use only one example per option though, and GLOfs is our example. The articles in question are too specific for a more broader discussion of DRM
54714					start box here and end box here should be omitted from all the boxes [Qudsia Zafar, Pakistan]	Editorial. Implemented
54722					Figures onwards along with figures embedded iin the boxes are not readible [Qudsia Zafar, Pakistan]	Editorial. Implemented
55548					General comment: The topics of chapters 2 and 4 overlap quite a lot. The specific objectives of chapter 4 (compared to chapter 2) are not fully clear to me. [Maryse Labriet, Spain]	Noted. The scope of both chapters is provided in the approved plenary draft. Greater clarity and convergence between both chapters implemented
55892					Can the relative importance given to each assessment in 4.3 be reflected in the 4.5.2 and 4.5.3 figures? Or viceversa? [Debora Ley, Guatemala]	Noted. See the detailed Feasibility analysis presented in 4.5.3.1 and Table 4.12. Also see Supplementary material D for full line of sight for each option assessed

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60648					This chapter relies a lot on literature describing scenarios other than 1.5°C. The authors need to be clear about this and assess whether they expect the finding to be true (or better or worse) in a 1.5°C world. Not clear that a study on impacts in an RCP8.5 world is relevant here. [United States of America]	A range of issues including feasibility have not been addressed in previous IPCC assessments. A strong scientific basis and background is therefore necessary to address these question. Hence the chapter has had to rely on a range of implementation pathways and scenarios. Wherever 1.5C literature is available, they are used. For details see Supplementary material D. The comment on the RCP8.5 impacts is accepted.
60650					This chapter needs a techical editor to tighten it up and reduce the page count, convey the valuable points in a more succinct manner and eliminate the current redundancy, and avoid the excessive use of inside jargon that is not accessible to the general public. In addition, the document needs a proofreader to address the numerous typos and many examples of inconsistency in the citing of documents (e.g., the author is provided but not the date). The structure of this chapter lends itself to redundancy – for example, the costs of adaptation are discussed in multiple places (i.e., page 4-78, line 37; page 4-98, line 38). [United States of America]	Noted. Editorial.
60654					There is limited discussion of energy efficiency and demand side management as a mitigation option beyond the industrial sector treatment. Should be included along with electricity storage technologies as a means of managing a grid with high renewable resources. [United States of America]	Accept, partly. We are emphasising energy efficiency more in the urban/infrastructure transitions where the building and transport sectors are discussed.
54004					ENTIRE CHAPTER:The chapter seems based mostly on referecens and contributions from proponents of geoengineering. Critical views on geoengineering need to be referred to balance the presentation. The proposal to change the name of SRM to RMM seems to be an attempt to manipulate readers and public perception critical to geoengineering, thus should be rejected. For critical references to geoengineering, see: eg ETC group et al, The Big Bad Fix, The case against climate geoengineering., 2017 http://www.etcgroup.org/content/big-bad-fix [Elenita Daño, Philippines]	Noted, thank you for reference, but we can cite only research articles. Our assessment is based on a balance of literature. The name change has been reversed to Solar Radiation Modification as we want to avoid the impression that SRM is easily managed.
60646					The chapter is too long and yet does not cover some of the most important material that should be addressed on the assigned topic. It should be refocused on the core points that are critical for this section of the report to examine, namely an assessment of current and emerging mitigation and adaptation options, and the pace of their development and deployment in relation to 1.5°C. In particular, recommend significantly condensing Section 4.4 and several of the longer case studies, deleting extraneous text, and deferring generic discussion of climate-related topics that is not explicitly and uniquely addressed to 1.5°C pathways to AR6. [United States of America]	Noted. The chapter has roughly stuck to the page limits and is, according to the IPCC rules given to the authors, less than 10% over length. The assessment of options is in the Feasibility analysis presented in 4.5.2 and 4.5.3 and the FGD Tables 4.11 and 4.12. Also see Supplementary material D for full line of sight for each option assessed. Section 4.4 and several cases have been edited for length and relevance.
60652					The chapter focus on adaptation generally addresses solutions that go beyond the energy sector, but does not address it. For example, "hardening" solutions in which stronger transmission or distribution lines/poles are installed to withstand intense winds, or installing flood walls and elevating electricity assets (e.g., substations) is not discussed. Nor are the co-benefits (both mitigation and adaptation) of smart grids, microgrids, distributed energy resources, and battery storage discussed in the context of enhanced resilience and adaptation. And, finally, adaptation efforts completed or planned by utilities are not presented in the chapter. The chapter should enhance discussion around energy sector resilience and adaptation options. [United States of America]	Noted. See revisions in 4.3.1.5. A more extensive discussion is expected in AR6; the SR1.5 is very limited in space and scope.
60656					Per the agreed outline, Chapter 4 was intended to be 50 pages. It is currently 123 pages (not counting the reference list). Suggest that the overall length be shortened through a much greater focus on issues specifically relevant to 1.5°C scenarios rather than broad discussions of behavior and thought processes related to climate change in general. [United States of America]	Noted. The chapter is close to the approved IPCC. Plenary page length, with the caveat that a number of new themes have had to be introduced to respond to SOD comments.
60658					When referencing the Paris Agreement, is it best practice to quote directly from the Agreement so that nothing is lost in translation. Phrases like "According to Article X of the Agreement" give confidence to the reader that the information is exactly as it is presented in the Agreement. Even slight word changes from the exact text of the Agreement can significantly change and inadvertently alter meaning. [United States of America]	Accepted. Implemented
60660					This chapter integrates discussion of response options and the institutional, social, behavior conditions needed to support their implementation. Overall, the chapter adequately addresses key issues, challenges, and opportunities associated with implementation of response options. However, the chapter needs to improve its organizational efficiency. (1) This chapter is very long – the authors should look for opportunities to make the chapter more concise. (2) There is overlap between this and other chapters that needs to be coordinated and streamlined to reduce redundancy and improve the organization of the entire report. Specifically, the chapter presents detailed discussion on the feasibility, implementation, and limitations of mitigation technology options that should be integrated into Chapter 2. (3) Consider to combine Sections 4.2 and 4.3, and keep the discussion of response options at a higher level to highlight their key features and implications for considering implementation challenges and opportunities. (4) There are a number of very long text boxes that are overwhelming to read. Authors should consider ways to improve the text boxes, make them more concise, and highlight key insights and messages. (5) Other than looking for opportunities to make the discussions more concise and reduce redundancy, Sections 4.4 and 4.5 are well articulated and the case studies at various levels are great to illustrate different approaches and opportunities. [United States of America]	Taken into account. See response to Comment 60656 on chapter length. The overlap with chapter 2 has been addressed, hopefully satisfactory. 3) we kept 4.2 and 4.3 separate and reduced 4.2 considerably to avoid overlap. 4) The in-chapter boxes are made shorter (max 0,5 page), the x-chapter boxes are kept at their prescribed length. 5) Thank you.
60666					Did the authors consciously decide not to include off-shore wind in their analysis of the feasibility of the required energy transition (Chapter 4, page 83)? This would be a major failing. Off-shore wind has become a cost-competitive resource in many markets. [United States of America]	Accepted: Text and assessment in 4.5 changed.
60674					The Chapter toggles back and forth between references to Solar Radiation Management and Radiation Modification Measures. The discussion should be made consistent within the report. [United States of America]	Accepted. We use Solar Radiation Modification (SRM), please refer to chapter 1 and the glossary.
60676					Chapter 4 should provide more consistent discussion of the cost-effectiveness of various options (in USD/CO2e), to provide a basis for comparing options and identifying the least-cost abatement options. See, e.g., discussion of HFCs at page 4-35, lines 3-9. [United States of America]	Noted. Chapter 4 uses a multi-dimensional feasibility assessment framework, of which cost-effectiveness is one of the indicators for the mitigation options, see table 4.11. A full, more quantitative assessment will be part of AR6.
60678					In general, Chapter 4 would benefit from more discussion of several critical issues – the pace of deployment of key technologies (4.3), lock-in/stranded assets, spillover effects, enabling environments (4.4 and 4.5) – and less discussion of philosophical issues which are not unique to the very pointed question of how to evaluate 1.5°C pathways as distinct from less ambitious ones. [United States of America]	Accepted. Deployment is in 4.2. New material added to relevant sections including on synergies & trade-offs. See 4.3.4 and Supplementary material E2

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60662					In, Chapter 11 of "Demystifying Climate Risk Volume II: Industry and Infrastructure Implications," Dr. Carole LeBlanc purports that big or small, local or international, companies are and will continue to be impacted by attempts to mitigate climate risks. These impacts may not always be substantial, but they need to be addressed to control costs, regardless of the enterprise's sector. Climate-related developments in both public and private sectors are examined, including: energy, labor, agriculture, insurance, and finance. This paper provides (1) the scientific and cost-based evidence to promote corporate leadership in relevant environmental matters, and (2) a strong case for action to present to corporate executives where that leadership may be lacking. The objective is to foster better understanding of the underlying principles of climate science among business professionals to help them communicate the potential impacts of climate-related developments to their colleagues. In doing so, enterprises will be (1) better prepared with the best options for making decisions and managing risks for the short- and long-term future, and (2) better informed to help ensure that the costs of mitigating climate change are equitably shared. The author demonstrates that the benefits of climate change action outweigh the costs and delineates the lessons learned from the Montreal Protocol. The paper concludes with both general and specific options for businesses (22 in all). While these recommendations are U.S.-based, their application on a worldwide basis could be consequential for strengthening and implementing the global response to the threat of climate change. [United States of America]	Noted. This looks like an interesting book but unfortunately we have to prioritise citing peer-reviewed papers.
60664					The authors should be commended for the attention paid to indigenous knowledge and heritage, particulary as it may foster effective adaptation. However, this chapter is missing recognition and discussion of the history and heritage of non-indigenous communities and how that history and heritage might be engaged to improve adaptation and mitigation approaches. This includes the rise of the current social/technical/economic system features that have lead to modern climate change, so understanding how non-indigenous individuals and communities understand and value their history should be considered as part of efforts to address, among other things, the inertias described in Chapter 1. The 2016 National Park Service Cultural Resources Climate Change Strategy (https://www.nps.gov/subjects/climatechange/culturalresourcesstrategy.htm) emphasizes that all kinds of heritages host diverse information and can spark inspiration and importance of place. If no sources suitable for this IPCC report can be found, it would be helpful for this gap to be noted. [United States of America]	Noted. This is explored in more detail in case studies from non-indigenous regions
60668					In general, this chapter falls short of what would be useful to address the question of how well the world is "strengthen[ing] and implement[ing] the global response to the threat of climate change" and which specific sectors or measures are on track and which would need the most attention to achieve a 1.5°C target and adapt to that level of warming. [United States of America]	Noted. The chapter reports a multi-dimensional feasibility assessment of mitigation and adaptation options (4.5) across different system transitions to achieve 1.5C. We also discuss enabling conditions (4.4) to implement these options. If we would address the question of what would need most attention, we would be prescriptive. if we would address precisely where we're at for each option, we would be stealing AR6's thunder.
60670					Chapter 4 should be organized so as to track the sectoral assessments in Chapter 2. For example, such a scheme might include parallel or related sections addressing the following sectoral issues: (1) Energy supply – with subsections on fuel mix, renewable energy, nuclear power, energy storage, linkages between the power sector and other sectors (e.g., electrification of transport and industrial processes), carbon capture and storage, adaptation of the energy supply; (2) Energy demand – including subsections on buildings, industry, transport (light duty vehicles, freight, aviation, marine, other mobile equipment), urban systems; (3) Land use – including subsections on forests and ecosystems, agriculture and food, etc.; (4) Carbon capture and storage (CCS) and carbon dioxide removal (CDR) – including subsections on geographic availability, applications in various sectors, state of technological advancement and specific needs to support commercialization and deployment, costs and cost-effectiveness; (5) Short-lived climate pollutants (SLCPs) – with subsections on each major SLCP; (6) Resilient infrastructure – with subsections addressing progress on adaptation of different types of infrastructure (industrial, urban systems, transport, power sector, water, etc.); (7) Resilient ecosystems – with subsections on different types of ecosystems, including oceans; (8) Solar radiation management; and (9) Systemic and cross-cutting issues. Some of these issues are not well addressed in Chapter 4 (e.g., REDD+, freight transport). [United States of America]	Noted. All these sectors have been addressed under system transitions (4.3), but indeed using a different outline. We decided for the systems transition approach because of its ability to address both adaptation and mitigation options.
60672					Chapters 2 and 4 should be more closely integrated. It would help if they could follow a similar organizational scheme. Recognizing the challenges of writing chapters in parallel, there is nevertheless an important potential synergy between the pathways discussed in Chapter 2 and the bottom-up assessment of the state of technology, human and institutional behavior, and systems that should be a core part of Chapter 4. This assessment of "how we are doing" and what concrete changes in current pathways are needed to meet the 1.5° pathways as distinct from the 2°C pathways should be among the core elements of the full report. As it currently stands, Chapter 4 does not build sufficiently on the basis established by Chapter 2, and thus leaves the reader with little concrete sense of the achievability of the pathways described in Chapter 2 or of what concrete measures would be required to achieve them. [United States of America]	Accept. The writing process of this report has been one large attempt to implement what is suggested. With every draft, we get a step further. The character of the two chapters is quite different as per plenary-approved outline, so a similar organisational scheme would be difficult to fit. The point of integration between chapters 2 and 4 is table 4.1. In this table, chapter 2 reports on its findings for sectoral targets, which allows Chapter 4 to focus on the feasibility of options, not of pathways.
60680					The authors appear to be of the opinion that poverty eradication and reducing inequality should be one driving goal of climate policy. To ask that climate policies fix often unrelated multi-contextual problems is unfair. While poverty eradication is a very admirable goal and the coordination of policies across multiple outcomes an ideal, it is not the goal of the UNFCCC or the Paris Agreement. It is also not within IPCC's mandate to apply such a broadening criteria to climate policy. The authors are urged to reduce the chapter's focus on poverty eradication as a guiding goal. The authors should focus on the available literature to support the intersection between 1.5°C impacts and pathways on poverty, in all countries. [United States of America]	Noted. The mandate of the SR is to examine the delivery of climate outcomes in the context of sustainable development and poverty reduction. Hence, the convergence between climate policy and these goals are important, as the literature in the AR5 and earlier assessments suggests. It is especially important to adaptation action and in addressing energy poverty issues that cut across IPCC regions
37112		10	92	20	Adaption in agriculture may also need to take into account trade of food from excess supply countries to excess demand countries through regional and international trade (see Egbendewe et al. 2017). Egbendewe, Y. G A., Kounagbè Lokonon, O., N. Coulibaly, and C. Atewamba (2017), "Can intra-regional food trade increase food availability in the context of global climatic change in West Africa?", Climatic Change. 145 (1-2):101–116 [aklesso Egbendewe, Togo]	Noted. This is an area for further examination in AR6, but this chapter unfortunately has very limited space to deepen this discussion.
37104		22	17	35	Ss the need of producing more batteries grows, attention has to be paid to the effets of resources exploitation in developing countries, specifically in Africa, where institutions are weak and resources are taken almost freely letting vulnerable villages into poverty and high local environmental degradation. Effort are to be made in that regard to avoid collaterale damages. [aklesso Egbendewe, Togo]	Noted: Assessment shows this capacity issue.
37106		22	17	35	As we countinue pushing for more electrical vehicules (EVs), it worth mentionning that the use of EVs has to go hand in hand with increase capacity in renewable energy production or we may run into a risk of charging our Evs with high carbon emission energy sources such coal. [aklesso Egbendewe, Togo]	Noted. The text already contains the sentence "Cities have begun unlocking synergies between low carbon electricity supply, electric vehicles and information technology that supports mobility and reduces congestion". We have added the recent paper by Kennedy et al which addresses the relationship between electrification and mobility within cities.
37108		30	46	55	The effectiveness of governance in developing countries that receives international resources requires that govenments are not the main actors but intead Universities and civil socities. There must be a way to make sure that finding goes effectively the where the need is for adaptation. [aklesso Egbendewe, Togo]	Accepted - text added on the role of civil society
37110		30	95	31	The citation year is missing. [aklesso Egbendewe, Togo]	Noted. This was a paper under review. It is now published and the date has been added.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9436					In this chapter, many approaches and methodologies to respond to climate change are presented. Some general statement on the feasibility of 1.5C limit covering all aspects is needed. [Russian Federation]	Noted. Chapter 2 addresses the feasibility of achieving 1.5 C. Chapter 4 focuses on the assessment of the multidimensional feasibility of both mitigation and adaptation options. The ES provides a high level overview via headline comments
10044					All executive summary statements describe "medium evidence". In contrast, section 4.5.1 later has documented a lot of knowledge gaps and key uncertainties regarding processes and impacts related to 1.5c warming that through great doubts about the level of evidence and agreement expressed in the executive summary statements. [Saudi Arabia]	Accepted. ES modified to match evidence base
10558					The chapter is too long. Many parts of the text can be shortened without any effects on the richness of the information. [Hong Yang, Switzerland]	Accepted. We continue to try. It is roughly within the allocated page limits.
6114					The Chapter is above the page limit and would benefit from significant shortening and from a clearer storyline and structure. Some sections (especially on mitigation) primarily rely on mono-referenced statements, which is contrary to standard IPCC practice. The content and messages are very generic and difficult to pull out of the various sections. There is a general need for cross-checking messages across sub-sections of the chapter, where information seems contradicting in some cases. Section 4.3 has very limited quantitative information regarding the potential contributions of the current and emerging adaptation and mitigation options. Also very limited information on the costs of various options. Much of the information comes across as a generic overview of adaptation and mitigation options, rather than a focused and structured assessment of the feasibility of the emissions reductions required and the adaptation needed under a 1.5 degree pathway. [Anne Olhoff, Denmark]	Accepted and noted. The Chapter is close to its allocated page limit, we are working on reducing it further. We are working on a better implementation of the structure. Literature on 1.5 C relevant themes on some themes are thin, that we expect this to improve during the AR6 cycle, this is especially true of quantitative estimates that do not come from IAMs and costs, especially of adaptation measures. We are working on better policy actionability. The feasibility of emission reductions is in chapter 2; of individual options in section 4.5. The selection of the options reveals the 1.5C-focus.
8362					1. Chapter 2 of this report makes a quantitative analysis of 1.5? in terms of carbon budget, and emission reduction pathway and rate based on the models and assumptions. In this chapter, it is necessary to make a quantitative assessment of the contribution by sector, field and key technology to the 1.5?-based emission reduction based on the available research literature, and make an analysis of sectors for a substantial and rapid emission reduction in terms of technical feasibility and socio-economic costs, stating the feasibility, difficulty and challenge of achieving 1.5? in an objective way. 2. This chapter should highlight the differences between 1.5? and 2.0? in adaptation and mitigation measures. For example, Table 4-1 provides a quantitative comparison of energy demand. It is suggested that a similar approach be used to make a quantitative comparison of major policies and concrete measures for adaptation and mitigation, or give an indication whether the available studies are ready to inform an assessment. [China]	1. Taken into account. The sectoral contributions are in chapter 2, and in Table 4.1. We conduct a multi-dimensional feasibility assessment (4.5) building on quantitative estimates made in chapter 2; .2. Limited underlying peer-reviewed literature available to make an informed assessment. We rely on chapter 2 for this which was unable to provide those numbers.
10572					The whole chapter used an exceptionally large number of references. Many references cited are inserted in the middle of the sentences, affecting the smoothness of the reading. Some general statements may not need references. Also, it would reduce the interruption of the flow of the sentence when the references are places at the end of the sentences. [Hong Yang, Switzerland]	Reject. We were asked to assess the literature as robustly as possible. Sometimes we have to support partial statements in sentences by literature references, We continue to try to keep the chapter readable.
10594					4.4 Implementing 1 far-reaching and rapid change and 4.5 Integration and enabling transformation need to be streamlined for concision and clarity. They are very long but have no clear key information in the text. [Hong Yang, Switzerland]	Noted. Relevant sections tightened and key messages presented In the ES
17908					Despite some exceptions, this whole chapter remains very vague and mainly qualitatively. Substantial policy indicators are missing, e.g. the level of the required CO2 price; the level of investment needs; the level of change seen historically. Sometimes it reads more like wishful thinking rather than scientific substance. [Brigitte Knopf, Germany]	Taken into account. The 1.5 C specific quantitative literature is thin. The chapter attempts to close this using a wide range of sources including investment estimates. See Box 4.8 Table 1. We expect this to improve over the AR6 cycle For CO2 abatement costs, see chapter 2.
18540					GENERAL COMMENTS TO CHAPTER 4: CDR technologies are no longer referred to as geoengineering, but as 'mitigation measures' and they are renamed 'RMM' Radiation Modification Management (chapter 4; section 4.3.9, p 42). This is potentially misleading as mitigation measures urgently need to be stepped up whereas CDR technologies remain doubtful (see CBD TS reports 66 https://www.cbd.int/doc/publications/cbd-ts-66-en.pdf) Chapter 4.4 of the report describes 'implementing far-reaching and rapid change". Figure 4.7 shows the 'feasibility assessments" of 1.5°C relevant adaptation options. Energy system transition very correctly features high. Agroforestry, biodiversity management, ecosystem restoration, Green Infrastructure & ecosystem services, health, DRR feature equally high, so these actions would deserve equal political weight. The FAQ section at the end of chapter 4 should be highlighted (also to be included in the SPM ?). [Andrea TILCHE, Belgium]	CDR in IPCC was also not referred to as geo-engineering in the AR5, so we are consistent. CDR is indeed classified as mitigation, but RMM or SRM is something else and is not qualified as mitigation. See Supplementary material D for details and line of sight for the multidimensional adaptation feasibility assessment. The consistency with the SRCCL is a point of attention.
18542					General comment: Certain sections of this chapter require re-examination together with the relevant sections of Ch2 & 3. In particular: - how to distribute/link material related to mitigation & adaptation between Section 4.3 and the relevant parts of Ch 2 & 3; - how to tie some of the more general messages more closely to pathways consistent with 1.5°C & 2°C. [Andrea TILCHE, Belgium]	Accept. This is implemented to the degree possible in the FGD. The feasibility assessment framework provides the connection between Chapters 1.2, 3 and 4. Table 4.1 provides the linkage to Chapter 2 for various 1.5C scenarios. .
18544					General comment: The Chapter is above the page limit and would benefit from significant shortening and from a clearer storyline and structure. Some sections (especially on mitigation) primarily rely on mono-referenced statements, which is contrary to standard IPCC practice. The content and messages are very generic and difficult to pull out of the various sections. There is a general need for cross-checking messages across sub-sections of the chapter, where information seems contradicting in some cases. Section 4.3 has very limited quantitative information regarding the potential contributions of the current and emerging adaptation and mitigation options. Also very limited information on the costs of various options. Much of the information comes across as a generic overview of adaptation and mitigation options, rather than a focused and structured assessment of the feasibility of the emissions reductions required and the adaptation needed under a 1.5 degree pathway. [Andrea TILCHE, Belgium]	Noted. See response to Comment 6114
24106					Few quantitative and economical evarluations on how much are the avoided disadvantages of adaptation in case of 1.5 ? compareter to 2.0?.. [Shuzo Nishioka, Japan]	Noted. There is limited 1.5C relevant literature on this question. This is identified as a knowledge gap
29560					While discussing bioenergy, please, consider that in some regions of the world bioenergy production is based on industrial sidestreams or different wastes and residues. For example side streams of food manufacturing industry, municipal wastes or pulp and paper industry are used for producing bioenergy. A wide range range of technologies are available for generationg heat, power or transportation biofules from different wastes, residues and sidestreams. [Finland]	Taken into account - Even though space constraints keep us from going into details, we have added a qualifying statement saying that the carbon intensity of bioenergy depends on the considered feedstock. Please note that the bioenergy section has moved to the energy section (4.3.1.2).
30538					Correct typo : 1.5°C and not 1.5C [France]	Noted
31002					The Chapter examines how to strengthen climate policies in order to meet the goals of sustainability, equity and justice. In my opinion, this objective is not well clear throughout the Chapter. Actually, mitigation and adaptation policies are effectively reported and, in some extent, explained; however, I miss how the Chapter aims to reinforce their applcation [alberto fichera, Italy]	Noted.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
31004					Some concepts recurr often in the paper. To avoid such a redundacy, I would have preferred to have a differente framing within the Chapter. As an example, why not consider to develop the report by sectors, e.g. the assessment of adaptation and mitigation options, implementation of change and integration of transformation for the energy sector, for land and ecosystems, for industrial systems and so on? [alberto fichera, Italy]	Noted. The chapter follows the Plenary approved outline. Sector related concerns are sought to be addressed within these sections. We feel that for 1.5C, systems transitions are needed, which go beyond sectors. The AR6 will, again, have a sector focus.
31014					Generally, the Chapter is intended for planners. Other stakeholders may find some difficulties in identifying key aspects of mitigation and adaptation measures in cities, indifferently from the analysed sector. [alberto fichera, Italy]	Noted. The primary audience is the IPCC members, but we have also included sections on urban transitions precisely for the reason of addressing other audiences.
33944					Supplement document 4 A a table on feasibility assessment: This table is a very useful summary and representation of the available data. However, some aspects are perhaps missing: social adaptation beyond education, the power of NGOs and religious communities, and indigenous communities. The psychological adaptation issues are also not treated here. Perhaps they are not relevant here, but if they are, perhaps they could be mentioned. [Norway]	Accepted - we have added in indigenous knowledge which has been added to the overarching adaptation section. We do not assess the role of religious communities though
34248					Supplementary Material 4.A - Table 4.A Feasibility assessment of overarching adaptation options. In the examples column for Financial options - Catastrophe bonds, it uses the example of the Caribbean Catastrophe Risk Insurance Facility. It is correct that the CCRIF has indeed issued one cat bond for $30million, however this has only generated a portion of the financing for the facility. The example discusses the overall results from the CCRIF but this gives the misleading impression that they are all attributable to the cat bond revenues. CCRIF is still a good example to use, but it would be good to clarify that it was only partially funded by a cat bond. For more, see: http://treasury.worldbank.org/bdm/pdf/Case_Study/CCRIF_CatBond_2015.pdf [Joe Thwaites, United States of America]	Accepted - correction made emphasizing the CCRIF only partially funded
45642					I suggest replacing in this chapter the term 'conservation agriculture' (CA) by the term 'agroecology' (AE) (i.e. the ecological study of agricultural systems; Altieri, 1995), which understands agriculture from a holistic perspective considering both environmental and social components. CA is as well included in AE. CA is based on three principles: minimal soil disturbance or no-till; continuous soil cover (with crops or residues); and crop rotation (FAO, 2015), which are too narrow and restrictive for specific agroecological conditions (Giller et al., 2015; Beyond Conservation Agriculture). Conservation Agriculture, but also Integrated Soil Fertility Management (ISFM), Integrated Weed Management, Integrated Pest Management (IPM), and others as agroforestry could be included under the term 'Agroecology' (Gangaiah 2017) that gives special importance to local conditions and is based on localized agronomic knowledge production. As Altieri and Nicholls concluded in 2009 "Humanity needs an alternative agricultural development paradigm... with more ecologically, biodiverse, resilient, sustainable and socially forms of agriculture. The basis for such new systems are the myriad of ecologically based agricultural styles". As Olivier De Schutter (United Nations Special Rapporteur on the Right to Food 2008-2014) stated in the report A/HRC/16/49 of the Humans Right Council, Agroecology is the way to improve the resilience and sustainability of food systems, and is supported by an increasingly number of scientific experts but also by international agencies and organizations, as FAO, UNEP and Biodiversity International. In the same line, Hilal Elver (the current United Nations Special Rapporteur on the Right to Food since 2014) declared in 2016 that "in this time of climate change, agroecology is almost the only important way to get away from relying on excessive uses of chemicals and fossil fuels" [Adela M Sánchez-Moreiras, Spain]	Noted - Conservation agriculture is an adaptation option discussed in AR5 (Chapter 14, Adaptation needs and options). For the 1.5 report, adaptation options have followed AR5 WGII nomenclature.
45662					I find necessary to address not only carbon and energy-price policies in this chapter but also policies related to the price of water. [Adela M Sánchez-Moreiras, Spain]	Taken into account indirectly when the new phrasing points out the importance of prices other then the only energy prices
50600					My take away of this chapter is that it is framed in an interesting way in line with the overall spirit of the report and indentifying all aspects of mitigation and adaptation issues. However there is one point which is not strongly developed within this chapter, that is to say, the role of carbon pricing and the potential for carbon pricing policies cooperation between countries. Yes, this issue is not completely absent of this chapter, but could have be enhanced a little more. Why ? First because the challenge fo reaching a target close to 1,5°C deserves that we explore what are all the potential to reduce the costs of mitigation/adaptation, in the spirit of Article 3 of the Climate Convention (1992). Second because UNFCCC ongoing process is looking in details at the rules which will be attached to the implementation of Article 6 of the PA. At last there is relevant scientific litterature which deserves to be quoted in this chapter. In that respect, I am proposing a few changes in one part of the chapter (see below) where some incorrect writing is employed and a short add on paragraph which discusses this economic potential, together with references. [Jean-Yves CANEILL, France]	Accept. Carbon prices and other policy instruments are addressed in a more extensive way in section 4.4.5.
54084					The general assessment of the Chapter that there is a need to strenghten and speed up transitions is well grounded in the reviewed literature and there are numerous exampleas that substantiate the argument. Howver, the Chapter is heavily biased towards raising the positive opportunities and reflects only to a limited extent on how the needed tramsitions can be achieved and what conflicts a speeding up of the processes of transformation will incur. Especially the executive summary sweeps the tensions and conflicts related to transitions under the carpet for many of the actiosn. A greater recognition of the tensions and conflicts would be in order.This is essential since the chapter "discusses opportunities and challenges associated with accelerating the redirection of the world economy." (p. 9). The following comments provide more detailed reflection on what a recongnition of tensions and path dependences would mean in practice. [Mikael Hildén, Finland]	Noted. It is indeed the intention to give a balanced account and to be helpful in terms of also outlining the many challenges to systems change (e.g. in section 4.3) and the ways to address them (in 4.4).The feasibility assessment, (4.5) moreover, attempts to address the speed and scale question within the bounds of available literature.
57312					Several terms and key concepts need to be explained/specified. [Hans Poertner, Germany]	Noted. See the Glossary for detailed explanations and definitions of terms
57314					Generally good use of uncertainty language, but in some sections it still needs to be applied. [Hans Poertner, Germany]	Noted.
57316					Several sections are not 1.5 specific [Hans Poertner, Germany]	Accepted. The 1.5 C specific quantitative literature is thin. The chapter attempts to close this using a wide range of sources that are 1.5C-relevant rather than -specific (and this is included in the mandate of the report).
57318					There is a lack of assessment of regionally varying feasibilities and implementation of mitigation and adaptation options; the synthethis sections 4.4. and 4.5 are very generalised [Hans Poertner, Germany]	Accepted. The mandate of the chapter is global not regional. We have, in section 4.5 (tables) included determinants of contexts which is often regionally specific. For details see section 4.5 and Supplementary material 4.D.
57320					There is too little discussion of synergies and trade-offs of adaptation and mitigation in the synthesis sections 4.4 and 4.5 [Hans Poertner, Germany]	Accepted. New material added to relevant sections including on synergies & trade-offs. See section 4.5.4 and Supplementary material 4.E
57764					Chapter 4 appears as a great development from the last version. [Hans Poertner, Germany]	Thank you.
58268					The chapter is an impressive and exhaustive study of the breadth of policy implications for mitigation and adaptation relevant for a 1.5 C world. What I miss, however, throughout the chapter is a clear assessment and message about how current technology and policy advances fall short of what is required for 1.5 C, in scope, ambition, and speed. It would be helpful to add in brief assessments throughout the chapter to continually reinforce this message. [Andrew Prag, France]	Noted. See revisions in the ES. Also, see the x-chapter box on NDCs (Cross-chapter box 4.1). The limited page length makes in-chapter repetition of messages difficult to operationalise. Also, pinpointing might quickly become policy-prescriptive.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
50238					Overall, I find the report completely underestimates the seriousness of global warming, and will in my opinion, will be detrimental. We can keep going with out current plans and will be greeted by decision makers with a sigh of relieve. This work is only comparable to the western world underestimating the rise of Hitler in the 1930's and will be considered so, in my view, by later generations. There is a reliance on climate models to give precipitation forecasts, and it is well known and accepted that climate models get rainfall wrong (e.g. up to 2m precipitation a year for the Indian monsoon, (e.g. Latham et al, 2012 , d.o.1. 10.1098/rsta.2012.0086 but also many others). Amazingly, the role of clouds and atmospheric convection hardly make an appearance in this document. This reliance of climate models as the truth, especially regarding precipitation is hugely detrimental to the quality of this report. Climate models are wrong with rainfall over a large fraction of the planet. This particularly affects Chapters 3, 4 and by implication Chapter 5. There is strong evidence that climate models are in accurate for anything but temperature. (e.g. precipitation, ice cover). Why has all the work of Peter Wadhams, an eminent expert on polar ice (and an author of "Farewell to Ice") been ignored and not referenced. His work, in several papers, suggests a much more serious impact on Arctic Ice than is represented here. In my view this is reprehensible and demeans the report. In section 3.7, of the SPM "Issues related to governance and ethics, public acceptability and impacts on sustainable development could render solar radiation management economically, socially and institutionally infeasible.", is in my view not justified. It may be correct, BUT by omission of the discussion of other science which contradicts this view is reprehensible. Economically, the costs of "Marine Cloud Brightening" geoengineering, is the cost of running one large warship. This report only represents a conclusion based on a biased selection of the science discussed in the chapters by authors who do not represent or cover the whole subject area. My specific comments relate only to chapter 4, and if not found below. Specific comments I will refer only to the section in geoengineering, which appears in chapter 4, where the subject of geoengineering is discussed. None of the lead authors has done any noticeable work on geoengineering. None of the contributing authors has any experience of geoengineering. Only one of the contributing authors on the x-chapter boxes has any experience of geoengineering (and he is opposed to the concept). Thus I find the whole section biased and does not represent the subject area. This report is biased, just as the press barons who control the press and media in the western world would give a good and comprehensive discussion if the advantageous of running the world on socialist lines. The lack of anyone of these 50 authors who has any experience or a positive view that geoengineering should be discussed and considered in a less than negative light is reprehensible. Also this section of the report document is totally biased, and ignores work done on the subject by for example, Stephen Salter and Peter Wadhams, to mention just two names. There is no reference to their work. This is also is reprehensible and will be noted when the report is published. There is a reliance on climate models to give precipitation forecasts, and it is well known and accepted that climate models get rainfall wrong (e.g. up to 2m a year for the Indian monsoon, (e.g. Latham et al, 2012 , d.o.1. 10.1098/rsta.2012.0086 but also many others). As a meteorologist, and user of climate models, the reliance on climate models in the report is unjustifiable in the sense that these models do not represent many of the physical processes going on in the real world and atmosphere. Section 4.3.9.2 This section discusses the cost of geoengineering, with reference to the sulphur injection, and puts the cost as USD 1-10 billion per annum. This is a reasonable estimate for the sulphur scheme. However, why is there little discussion of the side effects (e.g. Tilmes et al, 2008 , Science 320, 1201-4) who showed that there and significant issues with ozone depletion. There are other consequences of geoengineering which should be mentioned, if this were to be a robust study. All these issues should be discussed. No mention is made of the costs for Marine Cloud Brightening geoengineering. These costs for ~ the same radiation reduction (1-2 Watts) are less than 300 million USD per annum. This section assumes no work has been done on this and that is not true. Salter et al, 2008 , Philosophical Transactions of the royal society, A, doi:10.1098/rsta.2008.01.0136 , is also a paper that I mentioned in my first set of comments and has not been referenced. This is not defendable (at one stage this paper had the highest number of citations ever, in this journal). This paper above provides costs and so does Salter et al, 2014, Royal Society of Chemistry, doi:1039/9781782621225-00131 . Other work by Salter, has provided more details on cost and governance, but I	Taken into account partly, we included reference to MCB (Latham et al, 2012) and revised text where it was possible. Salter et al. 2008 was also added to Table 4.7. We didn't mention costs for Marine Cloud Brightening geoengineering, because there is just a few papers on this topic and this costs assessment can't be compared in one line with SAI cost assessment which is more detailed (but still not full), also we have strong space limit and can't add any explanations about the degree of knowledge about the cost of the MCB. We are not quite sure which papers by Peter Wadhams reviewer wants us to add, in respect that we have strong word count here we have not added those references.
58580					Some terminology should be clarified and used with care. In particular transitional vs. transformational (when is something transformational - if change rates exceed some percentage number? Or does it also depend on the type of measures considered to induce these changes? Or is it even a label for one approch vs. another?) and "in line with 1.5°C / consistent with 1.5°C" (how is this defined for a single option or local action?) [Elmar KRIEGLER, Germany]	Accepted. See Glossary for details. See revisions to 4.4.5.2
58596					Comparisons between 1.5°C and 2°C should be made in a way to avoid the false impression that while 1.5°C needs immediate action, 2°C would not. Already 2°C is very challenging and needs deep mitigation action. [Elmar KRIEGLER, Germany]	Noted. See revisions to 4.4.5.2 and 4.2. We sure don't want to make that impression, and neither does chapter 2.
50956					Why in SOD Chapter 4 disappeared the paragraph "4.3.4.2 Sustainable and Resilient Transport systems" present in FOD? In SOD, some consideration regarding transport are present in paragraph "4.3.2.4 International transport options" and paragraph "4.3.4.3 Urban transport and urban design". But in this way it is easy to lose the perception of the fundamental role of decarbonizing road transport as a key to achieve the 2°C and 1.5°C scenarios target. In this sense I'm referring to references already present in Chapter 4: IEA "ETP" (2017) and IEA-EVI-CEM "Global EV outlook 2017 - Two million and counting report" (2017). I suggest to re-insert the paragraph Sustainable and Resilient Transport systems in which summarize the total expected contributions from transport sector to achieve the 1.5°C Scenarios target. I warmly suggest to include in this summary, or wherever you consider it more appropriate to do so, also a new reference from the Hydrogen Council "Hydrogen scaling up - A sustainable pathway for the global energy transition" (2017), <http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-Scaling-up_Hydrogen-Council_2017.compressed.pdf >. In November 2017, at COP 23, the Hydrogen Council presented "Hydrogen, Scaling up" a study developed with McKinsey that outlines a comprehensive and quantified roadmap to scale deployment and its enabling impact on the energy transition. According to this study Hydrogen – abundant, versatile, clean, and safe – can play seven vital roles to meet the challenges of the transition: Enabling large-scale renewable energy integration and power generation; Distributing energy across sectors and regions; Acting as a buffer to increase energy system resilience; Decarbonizing transportation; Decarbonizing industrial energy use; Helping to decarbonize building heat and power; Providing a clean feedstock for industry. Overall, the study predicts that the annual demand for H2 could increase tenfold by 2050 to almost 80 EJ meeting 18% of total final energy demand in the 2°C scenario and hydrogen technologies have the potential to create opportunities for sustainable economic growth. Deployed at scale, by 2050 hydrogen could reduce annual CO2 emissions by roughly 6 Gt or 1/5 of the abatement required to limit global warming to 2°C. On the demand side, among other sectors, the study underline that decarbonizing road transport is a key to achieving the 2°C scenario and hydrogen and fuel cells are critical elements to do that. In the transportation sector, hydrogen-powered FCVs could complement Battery EVs to achieve a deep decarbonization of all transportation segments. To realize the Hydrogen Council vision, 1 in 12 cars sold in California, Germany, Japan, and South Korea should be powered by hydrogen by 2030, when sales start ramping up in the rest of the world. The potential for H2 is to power about 10 to 15 million cars and 500,000 trucks by 2030 and more than 400 million cars, 15 to 20 million trucks, and around 5 million buses in 2050 with results of 20 million barrels of oil replaced per day and 3.2 Gt CO2 abated per year. [Mario Valentino Romeri, Italy]	Noted. The transport commentary has been enhanced in this "urban" section so as to include ports and stations, and is covered in other sections of the chapter.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
58578					I commend the authors for their comprehensive assessment of content relating to Chapter 4. I think the Chapter would further benefit from making the assessment more explicit in several places (e.g. Section 4.2.2). A lot of literature and relevant findings are provided, but sometimes it is bit unclear what such individual findings mean for the assessment of strengthening action in the context of 1.5°C (e.g. for example the fact that a lot of things are happening on the ground vs. the question whether this has brought us anything closer to implementing deep mitigation). If possible, it would be good to be more selective in the assessment, e.g. focusing more on clear questions with a robust body of literature to meaningfully assess them. [Elmar KRIEGLER, Germany]	Accepted. See revised 4.2 as well as 4.5.2 and 4.5.3 and related supplementary material for fill line of sight
58582					Where possible, the assessment should be made more quantitative: deployment and phase out rates, investment needs, emissions reduction rates, demand levels, electricity and fuel shares etc.are all good candidates here. Numbers pulled from Chapter 2 could be used a bit more as benchmarks (particular Section 4.2.2, but also Section 4.3), with three questions: What are current trends in comparison, is a strengthening of action to reach these benchmarks conceivable - and how -, and can even higher levels / rates as the benchmarks be conceived? [Elmar KRIEGLER, Germany]	Accept. We hope to have made some headway on this in section 4.4.5 (on investment needs) in collaboration with chapter 2. The level of assessment in chapter 2 and the current literature did not allow for the detail suggested in this very good comment.
10342					General comment: Despite the uncertainties and complexity, it would be useful to compare the costs of current mitigation actions with the expences of future adaptation measures. Many states may consider that the costs of immediate actions and measures are too high, but if we compare them with the costs of inaction, it may turn out that the urgent, immediate action is much better than to delay and adapt to later, stronger effects. This issue is particularly important because we are already very close to the 1.5 °C global warming, in Hungary the temperature rise has already exceeded 1 °C. [Hungary]	Noted Literature limitations unfortunately do not permit much more than a qualitative analysis, because of significant gaps in the literature. It would also depend on the country.
16436					Please review the sections describing land-based options for mitigation and assessing their feasibility. Chapter 2 indicates that the mitigaiton approaches modelled in chapter 2 are discussed in detail in chapter 4. This is not the case. Greater consistency with chapter 2 is required, particularly with respect to bioenergy . It is unclear why there is so much emphasis on adaptation (section 4.5). [Australia]	Accept. Both CDR options and bio-energy are now discussed in detail in chapter 4, both in section 4.3 and in 4.5.
28430					We acknowledge the difficult task faced by the authors of Ch 4, and commend the considerable effort that has gone into compiling and structuring a large amount of evidence from very diverse sources. However, we are very concerned that the analysis in Ch 4 is currently not delivering on its main task, providing information on options to strengthen and implement the global response (in line with a 1.5°C T goal). We would have expected this chapter to complement the analysis provided in Ch 2 with bottom-up information and assessments of "what works" and where the greatest barriers and potentials lie for implementing pathways compatible with 1.5°C, including instruments and measures, and would still prefer to see an analysis structured this way. We have two main concerns regarding the overall chapter: the first is with the "feasibility assessment" presented in Sections 4.3 - 4.5: While we understand the general approach, we are deeply concerned about the implementation as it currently stands does not fulfil scientific standards of the IPCC. The feasibility assessment is intransparent regarding the assessment criteria and mechanism (what is the assessment based on) as well as the process (who's performing the assessment). It is not clear from neither the chapter text nor the Annex how the overall judgment in Figure 4.5/4.7 has been derived. We are aware that expert judgment is part of any assessment, however it has to be done in a very structured, transparent and open way in order to be defensible. Unfortunately it is our impression that in this analysis, especially in the outcome in Figure 4.5, the limits of scientific integrity are being overstepped, and we doubt that Figure 4.5 and the underlying approach is adding value to the complex discussion at hand. We therefore strongly recommend that the authors reconsider their decision to frame the material in sections 4.3-4.5 in this way. The second comment is more specifically on section 4.3: The evidence base presented in Section 4.3 appears incomprehensive, sometimes arbitrary and is of very varying quality. Even without the difficult feasibility framing, current section 4.3 needs considerable revision. It is vital that the selection of options have to be clearly marked as examples in order not to be policy-descriptive. See also our more detailed comments on some of the subsections of chapter 4.3. [Germany]	Accepted. We appreciate your understanding. On comment 1: Accept. See our revisions to 4.5.2 and 4.5.3 and for the full bottom up line of sight for the multidimensional feasibility assessment, see supplementary material D. We have made the assessment more robust, more transparent and more contextual. On comment 2: Accept as well. The options are indeed a selection, also determined by what is already in AR5 and what is particularly 1.5C-relevant. Language has been added to clarify this.
28432					The chapter would benefit greatly from a more structured representation of policy measures and instruments, especially short-term entry points. This is particularly true for (but not limited to) carbon pricing, which is treated rather cursory with statements scattered throughout the Chapter. While Chapter 2 clearly states that carbon pricing is a central - albeit not stand-alone - instrument to reach transformational change, Ch4 is not taking up the question in a clear and accessible fashion. This is also reflected in weak and partly inconsistent statements on carbon pricing in the SPM. We'd like to encourage the authors to give some room to a substantial discussion of carbon pricing instruments, including taxes and implicit prices via regulation: what works, what doesn't, and what complimentary measures will work best to address those areas where a price system does not work. Some of this information can already be found in the chapter, but much would be gained by a more coherent structure and clearer linkages to chapter 2 and 5. [Germany]	Noted. See revisions in the ES and 4.4.5 on carbon pricing. The SPM was also enriched with a statement on this. The linkages on this point between the sections have also been improved.
28434					In the current draft chapter 4 lacks both a) a central narrative (apart from the flawed feasibility concept) that the chapter follows and b.) actual ideas on how to strengthen global response to climate change. At this stage chapter 4 is compilation of possible technologies and measures, supplemented by options that are not implementable on a larger global scale. While the chapter could and should provide guidance on how to strengthen and implement a global response, until now it only gives an overview on existing or theoretical possible options. This is not too much corresponding to the chapters title and outline, as it does not provide the reader with an idea on how to actually strengthen global response. Considering this rather loose compilation of options, the chapter would highly benefit from a narrative within the chapter that provides a rough idea where to start when approaching a 1.5°C world. In this context the chapter would benefit from a more detailed description of possible short-term-entry-points. [Germany]	Noted. We have improved the narrative and outline it in section 4.1, and again at the start of each section. For the feasibility assessment of options, see revisions to 4.5.2 and 4.5.3 and the ES that has headline statements that address these concerns.
28436					While urban and subnational climate action is increasingly important, it does not become clear why Ch 4 does to some extent focus on urban infrastructure and repeatedly underline its importance. Particularly regarding the need for immediate climate action to reach 1.5 °C, urban infrastructure does not appear as the policy area to solely focus on, as its GHG potential will mostly be realized after 2030. [Germany]	Noted. A significant share of the incremental but also absolute global emissions may come from rapidly urbanising regions, and urban areas have specific vulnerabilities and potential adaptation strategies. As articulated in AR5 a pre-emptive focus on buildings and urban infrastructure, including in transport, could have a significant impact of emissions pathways, decarbonisation and reducing vulnerability that would strengthen resilience and adaptation measures.

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28438					Given the overall importance of finance for reaching a 1.5°C world, the topic is dealt with in a poor fashion regarding the positioning in the report, the detailedness and also the structure. It might merit a section at the level of 4.x Splitting the finance issues up into three different parts (4.4.2.3 and 4.4.6 and 4.5.3.3) is not very helpful for understanding. For instance, it leads to redundancies (see more specific comment below). Please consider to bundle all finance issues into one strengthened finance sub-chapter. We'd recommend to revisit the of Ch 4 structure to improve readability and reduce overlap between the sections. In particular, readers might expect that "starting points" (4.2) and "assessment of current and emerging […] options" (4.3) deal with quite similar issues. Also, the differentiation between "implementing far-reaching and rapid change" (4.4) and "[...] enabling transformation" (4.5) is not evident. Again, readers would expect similar issues in both subchapters (transformation is a far-reaching change?). [Germany]	Accepted, though we're not following the recommended outline fully. See revised sections on Finance in the ES and in 4.4.5 specifically Box 4.8. In addition, we have revised section 4.2 with financing transformations in mind. Section 4.5 is now more on integrating earlier findings and enabling the transformation, which is quite different from implementing it.
32096					The framing of the chapter is problematic in that mitigation and adaptation are often considered simultaniously when in may cases these need be differentiated. The fact that limiting warming to 1.5C leads to less adaptation needs than for higher levels of warming is mentioned a few times but is not taken into account in most of the text and framing of the chapter. [Jamaica]	Noted. Though indeed the mitigation challenge is higher in for 1.5C and the adaptation challenge lower (but still present), and the changes for limiting global warming to 1.5C are systemic (so going across and beyond adaptation and mitigation) we made an effort to discuss both alongside in the context of urban/infrastructure system transitions, land, energy and industrial transitions.
32098					The chapter is weak in discussion of response options. Additional discussion of the sectoral policy implications from pathways consistent with 1.5C needs to be included in the overview and for individual response options. For example, the important option of upscaling renewable energy, making use of recent developments in cost reduction, storage, grid and demand management technology, as well as sector coupling with electrification of transport and building sectors, is not reflected with a chapter in the executive summary. [Jamaica]	Noted. See the revised ES. We have included more from Table 4.1 in there and try to link it with the mitigation and adaptation options, however, not always is the literature available to make the link.
32100					Transformational change is a key term in the chapter but there is no clear definition provided and very limited engagement with the latest literature that seeks to define it. The discussion on how transformation can happen is limited and not well structured. Transformational change is an aspect that could usefully inform both mitigation and adaptation but these links are not considered. [Jamaica]	Noted. Defined in the Glossary
32126					The assessments of 'feasibility' provided in this chapter in 4.5.2 are inadequate and in stark contrast to the literature base and findings in other Chapters such as Ch 02 (i.e. ranking CCS and PV in the same economic category). These signficant issues need to be either rectified or assessments of feasibility deleted throughout the chapter, including in Box 4.10 and Fig. 4.5. [Jamaica]	Accepted. The robustness has been significantly improved in the FGD, with a better line of sight, a transparent and multiple-reviewed process. See section 4.5 and Supplementary Material 4.D.
32134					Very little discussion is provided for renewable energy or electricity storage, despite the dynamic development in these areas and the well substantiated key role of these technologies for achieving the Paris Agreement temperature goal. [Jamaica]	Accepted: Section expanded. Page limits prevent more.
33078					The opening paragraph of the chapter (page 9, lines 8-9) states that the chapter looks at how to strengthen climate policies in a way that is synergistic with the goals of SD, equity and justice. However, equity and justice are not dealt with consistently throughout the chapter. The chapter refers to the equity dilemma between generations (page 9, lines 20-21) but does not point out the ways in which climate policy can meet current and future needs as the chapter progresses (i.e. as it unpacks mitigation and adaption actions). There is a strong focus in the paper on governance and on institutions to enable an effective transition – and on the need to engage stakeholders and for multilevel governance and integration of climate and development policy – but human rights are rarely explicitly mentioned. There are only rare mentions of the gender differentiated aspects of climate action and nothing at all on gender responsive climate policy. There are only two mentions of human rights in the chapter – one related to feasibility of carbon dioxide removal (page 41) and the other in relation to watershed management (page 50). The risks identified that are associated with a 1.5 pathways do NOT include risks to human rights - the risks to human rights of 1.5 pathways need to be addressed in this chapter. [Tara Shine, Ireland]	Taken into account, though not in chapter 4. Rights based approaches, equity, gender and justice are dealt with in greater depth in Chapter 5
36462					The framing of the chapter is problematic in that mitigation and adaptation are often considered simultaniously when in may cases these need be differentiated. The fact that limiting warming to 1.5C leads to less adaptation needs than for higher levels of warming is mentioned a few times but is not taken into account in most of the text and framing of the chapter. [Snaliah Mahal, Saint Lucia]	Noted. Though indeed the mitigation challenge is higher in for 1.5C and the adaptation challenge lower (but still present), and the changes for limiting global warming to 1.5C are systemic (so going across and beyond adaptation and mitigation) we made an effort to discuss both alongside in the context of urban/infrastructure system transitions, land, energy and industrial transitions.
36464					The chapter is weak in discussion of response options. Additional discussion of the sectoral policy implications from pathways consistent with 1.5C needs to be included in the overview and for individual response options. For example, the important option of upscaling renewable energy, making use of recent developments in cost reduction, storage, grid and demand management technology, as well as sector coupling with electrification of transport and building sectors, is not reflected with a chapter in the executive summary. [Snaliah Mahal, Saint Lucia]	Noted. See the revised ES. We have included more from Table 4.1 in there and try to link it with the mitigation and adaptation options, however, not always is the literature available to make the link.
36466					Transformational change is a key term in the chapter but there is no clear definition provided and very limited engagement with the latest literature that seeks to define it. The discussion on how transformation can happen is limited and not well structured. Transformational change is an aspect that could usefully inform both mitigation and adaptation but these links are not considered. [Snaliah Mahal, Saint Lucia]	Noted. Defined in the Glossary
36492					The assessments of 'feasibility' provided in this chapter in 4.5.2 are inadequate and in stark contrast to the literature base and findings in other Chapters such as Ch 02 (i.e. ranking CCS and PV in the same economic category). These signficant issues need to be either rectified or assessments of feasibility deleted throughout the chapter, including in Box 4.10 and Fig. 4.5. [Snaliah Mahal, Saint Lucia]	Accepted. The robustness has been significantly improved in the FGD, with a better line of sight, a transparent and multiple-reviewed process. See section 4.5 and Supplementary Material 4.D.
36500					Very little discussion is provided for renewable energy or electricity storage, despite the dynamic development in these areas and the well substantiated key role of these technologies for achieving the Paris Agreement temperature goal. [Snaliah Mahal, Saint Lucia]	Accepted: Section expanded. Page limits prevent more.

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55482					The chapter in my view remains wholly inadequate in how it reflects the literature on mitigation options in agriculture. The SPM and chapter 2 make clear that mitigation of non-CO2 gases is a crucial part of 1.5 degree pathways, and agriculture is a major source of non-CO2 emissions. Livestock is the biggest emission source within agriculture. And yet, livestock are not mentioned at all in the body of the chapter in the context of mitigation, and only two fleeting references to livestock in tables 4.5 (on manure management, which causes only about 10% of total methane emissions from livestock), and table 4.7 (methane "controllers"). There is ample literature at global, regional and local level about mitigation options through increasing productivity and efficiency of livestock systems (e.g. reports by Gerber et al, Opio et al, country case studies) that are ignored entirely and yet perfectly demonstrate transition and transformation pathways consistent with 1.5 degrees and sustainable development. The complete exclusion of this information is simply not tenable for this chapter. Plus a host of literature on more technological mitigation options, including those on the horizon with proof of concept (methane inhibitors; Hristov et al 2013), methane vaccine, nitrification inhibitors, biological nitrification inhibitors, role of crop and forage crop breeding (including gene editing) to deliver mitigation as well as productivity gains. There is at least one entire section missing from section 4.3.3, otherwise this chapter is simply not consistent with its outline and general IPCC charge to provide a comprehensive and unbiased assessment. [Andy Reisinger, New Zealand]	A livestock section was added to section 4.3.2 on page 23 which discusses GHG emissions and mitigation actions in the livestock sector, adaptation interventions such as feed management, variety changes; as well as a discussion on changing mixed crop-livestock systems. Synergies and trade-offs in the livestock sector are discussion in Section 4.5.4 and Supplementary Materials E1 and E2.
2402	1		119		Check entire chapter for consistency in use of current global population figures. [Debra Roberts, South Africa]	Noted
54816	1		1		Supplementary material 4.A., Table 4.A.: I notice that all adaptation options have medium to very limited feasibility. This needs to be clearly reflected in the text related to this table, making clear that CO2 emissions reduction should be an absolute priority. Policy makers and other stakeholders should not understand from this report that the prospects for adaptation are such that the intensoty of efforts on prevention and CO2 emissions reduction can be lifted/alleviated. [Marine Gorner, France]	noted - the feasibility assessments have been slightly changed since SOD, reflecting new scholarship, also emphasizing that this table only focuses on overarching adaptation options.
54818	1		1		Supplementary material 4.B., Table 4.B.: "Sustainable and resilient transport systems", right hand side column: this seems somewhat unrelated to transport systems. A point on densification is already being made in the "sustainable land use and planning" cell, so the point density and informal settlements made under "Sustainable and resilient transport systems", right hand side column, should be made under"sustainable land use and planning" instead . [Marine Gorner, France]	Accepted - this option has been moved to the Synergies and Trade-Offs table related to mitigation options.
54820	1		1		Supplementary material 4.B., Table 4.B.: "Disaster risk management": "Post disaster recovery can be an opportunity…": This phrasing conveys the message that the disaster itself is an opportunity. Disasters should be prevented by all means, and resilient and sustainable rebuilding after a distaster should be messaged as an obligation and not just an opportunity. I recommend not to use the term "opportunity" in this context. [Marine Gorner, France]	Accepted - the word 'opportunity' has been removed.
1626	1	1	95	9	The linkage between Chapter 2 and Chapter 4 on different sectors/key technologies should be strengthened. [Wenying Chen, China]	Accepted. We have worked on better linkages and improving the references back and forth.
1666	1	1	95	9	Unbalabce in different sections with some sections are too detail while others are too simple (for example Building section). [Wenying Chen, China]	Noted.
1668	1	1	95	9	There are too many box in Section 4.4 and 4.5. [Wenying Chen, China]	Noted. Boxes are mainly in section 4.4 and represent case studies which were a request of the IPCC members in the plenary-approved outline.
1670	1	1	95	9	The whole chapter should focus on 1.5DS. Currently many sections' discussions seem to be not 1.5DS specific. [Wenying Chen, China]	Accepted. The 1.5 C specific quantitative literature is thin. The chapter attempts to close this using a wide range of sources that are 1.5C-relevant rather than -specific (and this is included in the mandate of the report).
8012	1	1	122	50	Many, many instances where words are all crammed together. Please have someone check throughout, I will no longer mark. [Christopher Bataille, Canada]	Noted. Editorial
8022	1	1	122	50	To the CLAs and LAs, this represents a lot of work in a short itme, congratulations on a big jump up in quality from Round 1. [Christopher Bataille, Canada]	Thank you.
43078	1	1	190	4	SLCPs should have more attention on their ability to reduce the rate of warming, which could be essential in the near-term for avoiding approaching tipping points that exist about the 1.5ºC threshold (e.g., corals). Furthermore, the benefits from reducing co-emitted species should not be downplayed; in fact, given the thorough discussion on the psychological aspects of climate change mitigation and adaptation, actions are likely to be taken when results can be seen quickly, similarly to how consumers will select the energy efficient appliance that they can witness reducing their bills instead of choosing reducing energy consumption. [Durwood Zaelke, United States of America]	Partly taken into account within the space restrictions given. More studies and discussion have been added, while some parts of the text (on geophysics that overlap with ch1 and 2) have been reduced.
45390	1	1		1	suggestion to increase accessibiity: provide a chapterv glossary at the beginning of each chapter. [Veryan Hann, Australia]	Rejected. A Glossary is provided for the report not each chapter.
43080	1	1	190	4	The Kigali Amendment should be discussed as an international law and policy success. The creation of the Kigali Amendment represents a number of policy solutions in effect, including: financing mechanism, oversight, and penalties (through trade restrictions with noncompliance). The Kigali Amendment also provides an insightful metaphor for the NDCs and the ability to begin tackling an issue and strengthen along the way. [Durwood Zaelke, United States of America]	Taken into account. The Kigali Amendment is discussed in chapter 2 and in section 4.3.6 (SLCFs). We agree it's very important to 1.5C, but the challenges for CO2 and methane emission reductions are different and the Vienna Convention/Montreal Protocol/Kigali Amendment design does not work for an international climate change agreement.
61958	1	1	150	60	Congratulations for the quality of the second order draft of the chapter, and for almost (+7%) respecting the target length. I have three main concerns. 1/ Sections or subsections do not have clear conclusions. As a result, it is not trivial to relate key findings in executive summary statements to the corresponding assessment of literature. The same issue arises for section 4.5 which also provides assessments of feasibility but without traceable account to the previous sections. 2/ Most of the chapter boxes (often case studies) are not explicitely related to 1.5°C but to the ongoing transformation. It is difficult to understand why these examples have been chosen, what are the conclusions, and why these examples are specifically relevant for this special report (they could easily be in the AR6 WGII or WGIII reports). 3/ There is a lack of coherency / integration between chapters 3 and 4, especially regarding the interplay between confidence associated with regional / sectorial projected impacts for 1.5°C warmer worlds. As a result, the work of Schleussner et al (2016) is often used as the single source of information, while it may be complemented with the outcome of the assessment in chapter 3 to enhace cross-chapter integration building on multiple studies. [Valérie Masson-Delmotte, France]	Accepted/taken into account. 1) We have included small summaries at the start of each section (4.x). 2) We could not locate any 1.5C-specific literature that would allow for case studies. Hence this solution of having 1.5C-relevant cases in boxes that talk more about the potential for transformative change. 3) We have made as good as an attempt as we could to repair this. The significant changes in chapter 3 made it hard, though.
61960	1	1	150	60	The chapter is refering at multiple places to indigenous and sometimes indigenous and local knowledge. For information, SROCC authors decided to use ILK (indigenous and local knowledge). Harmonization would be appreciated. [Valérie Masson-Delmotte, France]	Accepted. Will be implemented.
61970	1	1	150	60	I did not find where emissions associated with building city infrastructure associated with urbanisation are addressed (emissions from cement). My understanding is that city infrastructure to be built corresponds to a large share of the remaining carbon budget for 2°C, if cities are built in the future as they were built in the last decades. [Valérie Masson-Delmotte, France]	Taken into account, the topic of emissions and carbon budgets are in chapter 2, section 2.4.3.1.
61972	1	1	150	60	Aspects related to access to information on climate change, perception of climate change, education, training, learning is dispersed into several sections, while it is also mentioned that information and knowledge is important for behaviour change and for the implementation of transitions. I suggest to highlight more explicitely these issues in the Executive Summary of the chapter and in a visible place in the chapter as well. [Valérie Masson-Delmotte, France]	Noted. See revisions to ES and also in sections 4.4.3 and 4.3.5.

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61984	1	1	150	60	It is often difficult to understand what is new compared to what was assessed in the AR5 or the key findings of AR5. [Valérie Masson-Delmotte, France]	Noted.
63104	1	1	190	60	In chapter 4, page 5 (4-5), sentences 3-19 describe governance approach with "upscaling and accelerating the implementation of far-reaching, multi-level and cross-sectoral climate mitigation and adaptation actions, integrated with sustainable development initiatives." For this purpose, necessary institutional arrangements include robust legal and regulatory frameworks, trustworthy and equity-enhancing financial institutions, alignment of government and business institutions, transparent and accountable monitoring processes, and collaborative transnational networks across scales and regions." In 4-12, 1-7 describe the decision-making approach to deal with distributional implications; feedback and transdisciplinary knowledge systems to integrate mitigation with adaptation in the context of sustainable development. In 4-45, 30-44 describe the importance of multi-level governance related to institutions and their capacity to invoke far-reaching and rapid change. In 4-46, the SOD describes international governance as supranational authorities and treaties that can strengthen policy implementation with international organisations, treaties and conventions. Mitigation tends to be global by its nature and it is based on the principle of the climate systems as a global commons. Adaptation has traditionally been viewed as a local process, involving local authorities, communities, and stakeholders. In 4-48, 8-17 describes inclusion of community and local governance. In 4-48, 34-45 describe interactions and processes for multi-level governance as drivers of mitigation and adaptation plans. In 4-51, 24-55 describe to enhance institutional capacities for policy design and implementation. In 4-55, 4-10 describe importance of the effective co-operative institutions and social safety nets in helping to energy access, adaptation, as well as distributional impacts during the transition to low-GHG emissions societies and enabling sustainable development, but not all countries have the institutional capabilities to design and manage these. Social capital for adaptation (in the form of bonding, bridging, and linking social institutions) has proved to be very effective in dealing with climate crises at the local, regional, and national levels. These good things need to be promoted with sociological and anthropological perspectives so that it can get societal acceptability. Otherwise, it can raise concerns over acceptability of policy and system changes mentioned in 4-64, sentences 52-55. [Mohammad Anwar Hossen, Bangladesh]	Noted. See revisions in appropriate locations, in particular in section 4.4.2 and 4.3.5.
63106	1	1	190	60	Based on the governance approach, it is important to raise who are the major stakeholders and is there any space for local communities to develop the SOD and related regulatory framework. NGOs do not represent local communities; they represent interests of corporate elites. To ensure community participation, it is important to ensure participation of 'real' representatives who are not part of corporate power structure. Only this approach can address local issues and concerns like agricultural practices for effective adaptation strategies and biodiversity conservation. In 4-6, 54-55 emphasize on "changing agricultural practices using principles of conservation agriculture, efficient irrigation, and mixed crop-livestock systems are effective adaptation strategies." In 4-7, 1-4 suggest that mixed crop-livestock production systems can be cost effective adaptation strategies. In 4-33, sentences 3-8 describe population health and health system adaptation options that are connected with socio-economic factors determining the magnitude and pattern of climate-sensitive health risks related to safe water and improved sanitation, enhancing access to essential services such as vaccination, and developing or strengthening integrated surveillance systems. [Mohammad Anwar Hossen, Bangladesh]	Noted. No revisions requested.
63108	1	1	190	60	To develop this approach, community voices are essential as they are main target groups of people. I believe the past failures to do so raise the question of effectiveness and the SOD recognize it; in 4-9, sentences 2-7 describe "opportunities and challenges associated with accelerating the redirection of the world economy and socio-ecological systems towards a 1.5°C world." Based on 4-16, the SOD sentences 39-45 describe the renewable energy options that include solar energy, wind energy, hydropower, geothermal energy, tidal and wave energy and osmotic energy." These options can be major foundation for opportunities by overcoming the challenges if the adaptation policy incorporates community voices and ecocentric approach. Still the challenges are very much visible described in 4-28: sentences 28-35 inform us that "industrial systems consume about one third of global energy and contributes, directly and indirectly, about one third of global GHG emissions." [Mohammad Anwar Hossen, Bangladesh]	Noted. No revisions requested.
63110	1	1	190	60	To reduce these emissions and their effects, the SOD describes some major points in pages 20-24; land and ecosystem transitions in the context of agriculture and food, food production and quality, conservation agriculture, irrigation efficiency, climate services, food wastage, bioenergy, forest management, wetland management, and indigenous knowledge systems. In 4-81, 1-11 describe knowledge gaps and key uncertainties in reaching the goals of addressing ecosystem based climate change adaptation. For this purpose, the SOD in page no 32 and sentences 27-35 emphasizes on education and learning for developing participatory action research and social learning processes through community-based platforms, international conferences, and knowledge networks. My point here is the concern of exclusion of local knowledge in reducing the gap and learning outcomes. The acceptability of the SOD depends on addressing this concern. On the contrary, the SOD focuses more on international acceptability in place of local community acceptability: page no 43 and sentences 21-28 describes social acceptability and ethics in terms of international responsibilities for implementation, financing, and compensation for negative effects. The procedural justice raises the questions of who is involved in decisions related to privatisation and patenting, informed consent by affected publics, intergenerational ethics. The level of exclusion can be increased when the SOD describes the importance of enabling climate finance for innovating technological options emphasized in 4-77, sentences 7-13. [Mohammad Anwar Hossen, Bangladesh]	Noted, and thank you for the extensive explanation. We have attempted to address this point in section 4.3.5 and in various places in section 4.4. and 4.5.
4396	1	2	1	2	In the "Supplementary Material 4.B" - "Table 4.B Select adaptation options with mitigation synergies and trade-offs identified," it should be stressed that "Ecosystem restoration and avoided deforestation," in particular related to REDD+, have the potential to promote sustainable development activities through the cash-flow from donors/international funds to local forest stakeholders, as decribed in: "West TAP, 2016, Indigenous community benefits from a de-centralized approach to REDD+ in Brazil. Climate Policy 16, 924-939." [Thales A. P. West, Brazil]	Noted – however, the table has been redesigned to focus on synergies and trade-offs between adaptation and mitigation and co-benefits for sustainable development are exclusively assessed in Chapter 5.
32946	1	2			[Renewable energy] The inclusion of aquavoltaic as an example of renewable energy seems too selective. This is an interesting and innovative technique of using floating photovoltaic panels in reservoirs, which can produce important benefits, including reducing the water loss of the reservoirs by evaporation; however, it can also have unpredictable consequences in terms of impact on zooplankton fauna and on nutrient cycling by aquatic organisms, particularly the flora of algae. Other more established technologies, such as the use of biomass for energy generation, or even biofuels, should also be highlighted, because given their importance in mitigating greenhouse gas emissions and synergies. [Brazil]	Accepted - this has been removed.
32948	1	2			The examples deal primarily with the urban issue and overlook the land use component. Relevant synergies between agricultural and forest systems, as well as the implementation of the Brazilian Forest Code, such as structuring of ecological corridors and agricultural systems integrating conservation as no-tillage and integrated management incorporating forests like the ILPF (Integrated Crop Livestock Forest Systems) were not mentioned with synergistic strategies. Other examples that should also be incorporated are the integrated management of the landscape as an instrument of public policy. The Brazilian case of ZEE (Ecological-economic zooning) is a very relevant example in this sense. [Brazil]	Accepted, additional synergies for agroforestry have been added
40368	1	2			4.B /// correct spatial planning [Jonathan Gómez Cantero, Spain]	Accepted - editorial

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4322	1	3	1	24	I have been working on the design of engineering hardware for John Latham's proposal for marine cloud brightening since 2004 but recognize only one name, Piers Forster, in the IPCC author list. His name was on a paper doi:10.5194/acp-13-10385-2013 which attacked marine cloud brightening because of coagulation of spray drops. This ignored our proposal for giving drops an electrostatic charge. I spoke to Robin Stevens, the lead author of this paper who said that one electron on each drop would reduce coagulation probability by 1%. We can easily have 100 electrons on each drop. We also want to use mono-disperse spray so that adjacent drops will have the same response to local turbulence. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Aside from Piers, we have a researcher on the team who got involved later in the SRM topic than some of the core names. No peer-reviewed literature given so we cannot take this comment into account.
61956	1	10	1	24	One single list of contributing authors for the chapter ; add country for Solecki (USA) [Valérie Masson-Delmotte, France]	Accepted.
14138	2				It is better to adjust the adaptation and mitigation options structurally. The chapter 2 indicates industry, building and transport are three top sectors in terms of emission. The options presented in chapter 4 should be in line with these sectors through further being classified under them. In this way readers are abler to directly recognize the corresponding solutions. For example, 4.3.2.4 international transport options can be categorized under transport sector (this secotr should be independently listed); the renewable energy, electricity storage and carbon dioxide capture can be classified under power sector. [Yi-Chieh Chan, China]	Noted. In this chapter we have not taken a sectoral approach, instead a system transitions approach, see section 4.2. This indeed makes us complementary to chapter 2, which is bound by the way integrated assessment models work. Those work in sectors, not systems. In section 4.3, international transport is discussed in the Urban & Infrastructure system transitions (4.3.3), while renewable electricity and CCS are in the power sector in the Energy systems transition section (4.3.1). CCS in industry is also discussed in section 4.3.4.
28440	2	1	8	22	There is no cross-reference to the sections 4.3.1 and 4.5.4 in the executive summary. [Germany]	Accept. Both sections have been removed.
28444	2	1	8	22	Adaptation and mitigation should be represented in a balanced manner in the ES according to their relevance in the entire Ch 4 and its outline. [Germany]	Accepted
28446	2	1	8	22	The summary remains quite descriptive, in particular the topical sentences printed in bold. For a chapter titled "Strengthening and implementing the global response" it would be a real asset to offer more constructive proposals and discuss the options how the strengthening and implementing of the global response could be achieved. In many cases this could simply be achieved by changing the order of statements in the ES, highlighting the solution-oriented parts and then underpinning it with the descriptive part. This may also help the development of clearer messages for the SPM. [Germany]	Noted. Suggestion implemented
28442	2	1	8	22	The structure of the executive summary of Ch 4 does not follow the structure of the chapter. Nearly all paragraphs provide cross-references to different sections in chapter 4. At the same time many of the sections of the chapter are referenced at many different parts of the executive summary. Please try to give a clearer structure to the summary, where the themes are better grouped. It might be necessary in addition to revise the structure of the underlying chapter. Also, section 4.3 (Assessment of current and emerging adaptation and mitigation options) is given considerably more space and more detail compared to other sections. Please rebalance the different sections and their treatment in the summary. [Germany]	Accepted. ES structure modified to better match Chapter structure, Overall narrative remains relatively unchanged
32950	2	2			[Green infrastructure and ecosystem services]There is only mention to the urban environment again. The ecosystem services that the sustainable management of the agricultural sector can generate for society are tremendous: conservation of biodiversity; soil management; conservation of river sources and beds; improvement in the humidity of microclimate; rainfall and local temperature; construction of ecological corridors, carbon stock and conservation of genetic resources, etc ... [Brazil]	Taken into account. This comment is covered in other options under land and ecosystem transitions. It is also covered under mitigation option "sustainable intensification for agriculture".
16438	2	16	2	51	The structure of this chapter may not adequately allow for the assessment of adaptation and mitigation options. In grouping together issues as broad transitions, there is value in trying to capture issues at a high level and leave room for more detail in a land special report. However, this style has potentially caused gaps to occur and the choices of topics needs to be reexamined. For example, the potential for mitigation in livestock management is not adequately covered. Furthermore, there are broader mitigation practices available than just conservation agriculture. This approach also contradicts the approach later of very specific detail on biochar as a method for improving soil carbon while neglecting many other areas that enhance soil carbon. The wetlands section under ecosystem transition is effective but the seagrass/blue carbon focus on page 41 is very specific and neglects other forms of blue carbon (mangroves and tidal marshes). [Australia]	Accepted. See revisions in 4.3.2
32952	3	2			A topic on data analysis and on the importance of information management in the decision-making process need to be included. Currently there are several computational and meta-data analysis techniques that can aid the decision-making process. An analysis considering synergies and trade-offs should not be dispensed in such important topic. [Brazil]	Noted. Though indeed an interesting topic, and touched upon in section 4.4.4, it is not directly 1.5C-relevant enough to warrant specific treatment.
17916	4		8		The ExecSum remains very general and the specific needs for 1.5°C compared to 2°C do not at all become clear. The statement always reads: "this and that is important for 1.5°C". But is it equally important for 2°C? And for 3°C? What makes the difference? And how do different measures compare, e.g. how important is carbon pricing compared to behavioural change? Do we need everything? Is there a sequence? How can policy makers be guided by this? [Brigitte Knopf, Germany]	Noted. Many of the issues that are important for 1.5C are also part of a global response to 2C. Chapter 2 provides ab assessment of what options are more significant for 1.5C compared to 2C. The enhanced Feasibility assessment, analysis of enabling conditions in Chapter 4 provide an understanding on what makes a difference and how.
32954	4	2	4	3	It is important to consider as "useful governance elements" the active participation of the centre of government institutions (understood as the institution, or the group of institutions, which provides support to the head of government, including technical and political coordination of governmental actions, planning, monitoring and communication) within governance structures to enhace climate action. [Brazil]	Noted. We could not locate literature that makes this point.
4274	4	14	5	16	…better insights in synergies….. I have read 3 times this sentence and I am still unable to grasp the meaning or the conveyed key message. Highly rethoric. Delete? [Abanades Carlos, Spain]	Noted. Editorial changes made.
32706	4	17	4	23	This para focusses too much on technological change so that the reader my think that achieving 1 .5°C were achievable by technological change alone. However, in the sections below it is clearly elaborated that for example carbon prices are also needed to address the rebound effect. In some sectors, particularly international shipping and aviation, technological change alone will not suffice to decarbonize the sector. The demand for their services needs to be reduced as well. I suggest to in-cluded "…carbon-neutral technologies" [and reduce demand for carbon inducing products or services] "as long as the market continues to prefer …" to reflect the discussion in the sections below. [Martin Cames, Germany]	Accept. Text is revised as suggested.

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7750	4	31			Motor-system savings in industry are indeed conventionally 20¬–25% from better motors run at variable speed. The actual potential encyclopedically documented in 1989 (Lovins et al, The State of the Art: Drivepower. Rocky Mountain Institute / Competitek, incl 2-page supplementary scoping calculation “Potential Savings in U.S. Drivepower (1986)”; summarized in Drivepower Technology Atlas, 1993 and later online editions, www.esource.com) with broad concurrence from EPRI (Fickett et al 1990, Efficient use of electricity, Sci. Amer. 263(3):64–74 (Sep), www.nature.com/scientificamerican/journal/v263/n3/pdf/scientificamerican/0990-64.pdf) is ~2x larger and severalfold cheaper because it integrates not two but 35 improvements of which the first 28 are free byproducts of the first 7. Nearly all these opportunities are missing from standard assessments such as Napp et al. (2014)’s Table 8, and this report gives no hint that they exist, even though motors use ~60% of the world’s electricity. This drivesystem efficiency potential does not count often-larger downstream improvements in the driven machines, such as the pumps and fans that use half of motor power, nor the pipes and ducts whose friction consumes most of that power. Optimizing the friction in pipes and ducts by making them fat, short, and straight rather than the standard practice (thin, long, and crooked) can cut that fluid-handling energy use by an order of magnitude, with typical paybacks <1 y in retrofits and <0 in newbuilds. Sequence matters: first minimize flow and friction, shrinking the pumps and fans, therefore shrinking the motors and inverters and electricals, thus saving more capital. Furthermore, reversing the ~10x compounding losses from power-plant fuel to fluid flow can then save ~10x as much CO2 at the power plant as the energy saved in the pump or fan. Please see Lovins (2018) and Fickett et al 1990 cited above. Bottom line: even such careful conventional sources as AR5 WG3 Ch 10 seriously understate industrial efficiency potential, as my team has confirmed empirically in >$40b worth of new and retrofit plant designs for major firms. We typically found energy savings ~30–60% in retrofits, paying back in a few years, or ~40–90+% in newbuilds, with nearly always lower capital cost. These savings are severalfold larger and cheaper than those typically described, e.g. by Napp et al. 2014. Thus, rather than concluding at 4-31:7–8 that “Low awareness and competition from other investments limit the feasibility of such options,” I’d rephrase to say that such obstacles present a major business opportunity for alert competitors and a largely untapped public-policy opportunity for governments eager to boost both wealth and climate protection. The obstacles are real, but each creates its own opportunity. [Amory Lovins, United States of America]	Taken into account in the section on motors and other non-energy-intensive industry text in section 4.3.4.1.
6116	4	42	4	43	Does the chapter support this statement, or does it need to be qualified in terms of the magnitude of emissions reductions that can be achieved through reducing SLCPs (and aren't already included in the IAM's/NDCs)? Confer text on page 10, lines 43-46. [Anne Olhoff, Denmark]	Accept. 'rapid' removed and replaced by 'significant', which is supported by the text in section 4.3.6 and chapter 2.
46462	4	46	4	47	what is the rationale for not including off-shore wind in the assessment of options? This seems to be a significant omission. For example, IRENA's 2016 innovation outlook on offshore wind sees a potential offshore wind capacity of 100 to 280 GW by 2030, significant cost decreases etc. (http://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Innovation_Outlook_Offshore_Wind_2016_summary.pdf?la=en&hash=CA570FBCB3E3C737C9D6729545B43C6A740151AF); IEA sees a potential of several hundred GW for offshore (https://www.iea.org/publications/freepublications/publication/Wind_Roadmap_targets_viewing.pdf) ; similarly Concentrated Solar Power is also not assessed [Sven Harmeling, Germany]	Accepted: Text changed.
32956	4	49			In the text "... can enhance future mitigation" This formulation mistakenly and inadequately addresses consequences of behavior change. My recommendation would be [...] to enhance adaptation and future mitigation potential]. [Brazil]	Accepted. Text changed. There is an established role for behavioural change in the literature that is presented in 4.4.3.
32958	4	50			The word "that" is repeated [Brazil]	Editorial. Text changed
32960	4	54			I do not have a comment on the topic addressed in this item, however, I highlight the fact that the document deals specifically with the benefits of adopting specific technologies for the potential adaptation of agricultural systems, but does not deal with structuring bottlenecks that make difficult or even impossible the efficient adoption of those technologies in developing countries. Bottlenecks such as the lack of investment in research for the development of models; infrastructure for climate data collection, training and structure for data series maintenance; lack of long-term experimental fields, and difficulties in disseminating information are concrete examples of factors that hamper the adoption of technologies in developing countries. These fragilities will have their effect worsened by the increased effects of climate change which will widen the gap of the field production conditions between developed and developing countries. [Brazil]	Taken into account. Key themes in the comment have been addressed in 4.4 (in particular in 4.4.2) and in the governance and "multiple examples" sections of the ES.
17910	5				What is exactly meant by "transformations adaptation"? A clear definition is missing, it sounds very political and not scientifically [Brigitte Knopf, Germany]	Noted. Changed to 'Transformational adaptation' defined in the glossary
48652	5		8		Highly recommend including a paragraph on the need to enhance institutional capacities which is well described later in teh core text [Yamina Saheb, France]	Accepted. Text changes made
3292	5	1	8	21	1-2 sentences is recommended to add to SPM, in order to emphasize the importance of technology development for 1.5? scenario. [Xiu Yang, China]	Noted Will be suggested for the SPM but may need to be balanced by other Report-wide considerations
5000	5	1	8	21	Other than my comment on the framing for the chapter, I'd like to complement the authors on virtually all of the points included in the Executive Summary--generally quite well stated. [Michael MacCracken, United States of America]	Noted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
4998	5	1	8	21	As an overall comment on the Exeuctive Summary and how the discussion is presented, I was troubled in two ways by the overall framing of saying 'transition to a 1.5 C world' as it sounds as if we want to be going up from a 1 C world to a 1.5 C world and that we want to be doing this. My first concern could be helped by making the point right at the front of the Executive Summary that the world, even with Paris Accord and assuming the INDCs are met, are on track to becoming a 3 C world (or worse) and that, due to the very serious consequences that would result, as explained in IPCC assessments, the Paris Accord set the aspirational goal of limiting the increase and so transitioning to a world with a peak warming of 1.5 C, and this chapter is about what would be required to accomplish this, and doing so in a way that would promote the SDGs (so seeking to greatly reduce human-induced climate change and in a way that also makes the world better for its people). My second concern is that there seems to be this unevaluated acceptance that limiting the warming to no more than 1.5 C and sustaining it at that level indefinitely into the future (perhaps with an overshoot and coming back to 1.5 C) is acceptable in a scientific/expert sense based simply on the fact that the negotiation process led to the desire to limit peak warming to 1.5 C--I would argue that there has been no scientific acceptance of this at all and that the impacts associated with a 1.5 C world are very consequential (very clearly, for sea level rise, the paleoclimate derived equilibrium sensitivity being something like 20 meters per degree C in global warming over the past 20ka when coming out of the last glacial maximum, and looking further back, being perhaps 15 meters per degree for warmer conditions (so total loss of the two ice sheets by 5 C global warming, at equilibrium). What is thus missing from this report is a consideration of what level of warming should be the long-term goal, and I think scientists need to report that this value is likely near zero to less than 0.5 C so that Africa can have a strong agriculture enterprise, to that the subtropics are not expanded, so that sea ice forms in polar regions and the regions serve as the planetary air conditioner, so tropical cyclones and other storms are not so intense, etc. At 1.5 C, some areas of the world will not be livable outdoors during some seasons--this and the other impacts will lead to generation of tens to hundreds of millions of environmental refugees, destabilizing many areas, etc. When the negotiators said 1.5 C, that was their choice on what they hoped would be achievable in terms of emissions cuts (that island nation leaders somehow saw such a value as survivable given sea level sensitivity I assume is a result of the scientific community not forthrightly expressing itself or just all they could get at that point). I just don't think that scientists should, with that, stop forthrightly saying that 1.5 C will be very, very disruptive for the planet and the aim must be, in addition to staying below 1.5 C as the peak, getting back to near 0 C as soon as possible if we really have an interest in providing future generations viable options for the higher populations ahead. And, it seems to me that if we can phase up to keep the warming from exceeding 1.5 C, continuation of that level of effort would have us on a track to get back to lower levels of warming. So, in this Executive Summary and the chapter, I would not be using phrases like 'transitioning to a 1.5 C world' but instead be talking about limiting peak warming to 1.5 C and then lower levels thereafter--it just seems to me in reading through the Executive Summary, it sounds as if getting to 1.5 C is all we should be aiming for and it can be worked out when we really don't want to be that high at all. And indeed, I think we'd all be delighted were Nature to happen to provide an ongoing series of modest volcanic eruptions to keep the warming below 1.5 C, so shaving peak warming, and need more serious consideration of climate intervention approaches to accomplish this if Nature turns out not to play the role that we hope she would. [Michael MacCracken, United States of America]	Noted. The chapter attempts to outline the evidence available in the literature in response to an IPCC plenary approved outline, on the global response. The framing, for instance of the important issues that the reviewer raises, is part of Chapter 1. The SPM seeks to address a range of cross-chapter questions, such as the ones mentioned in the comment.
11054	5	1	8	22	CCS (including its role in CDR) is critical to the delivery of 1.5C, yet its implementaion is slow compared to other technologies (e.g. solar PV). Therefore, the Executive Summary should highlight the needs of CCS in a specific paragraph, rather than the brief mentions it gets throughout the summary [Wilfried Maas, Netherlands]	Noted. We are extremely limited in space in the Executive Summary, which cannot exceed 1900 words. We agree CCS is important and has implementation challenges, but we are not devoting specific paragraphs to specific technologies (with the exception of SRM, which is a special case and cannot be fitted elsewhere). CCS is integral to the energy and industrial transitions as well as to CDR so already gets significant attention.
13380	5	1	8	22	An overview of loss and damage should be included in the Executive Summary and not only included in the Cross-chapter Box [Grenada]	Noted. The Loss & Damage box has been moved to Chapter 5
24342	5	1	8	21	A key aspect of the 1.5°C pathways assessed in Chapter 2 is the importance of energy demand reductions. While several supply side options are highlighted and put in a wider context in the Chapter 4 ES, the issue of the demand side, and its feasibility aspects are not as clearly presented. Maybe the Chapter 4 ES can also highlight some of the systemic insights of pathways, i.e. to rely less on CO2 removal, more efforst to limit energy demand are important. If both aspects are assessed to be difficult to achieve in the real world, there is a problem for 1.5°C pathways, if one of them is hard to achieve (e.g. CDR) and the other is largely underestimated in IAMs (energy demand and behavioural change) then the jury is still out, but at least decisionmakers have a better idea on where to focus. [Joeri ROGELJ, Austria]	Noted. The chapter attempts to outline the evidence available in the literature in response to an IPCC plenary approved outline to address questions of scaling up implantation. This question is better addressed in Chapters 1 and 5. Economic development is noted as a key factor in this chapter
30554	5	1			Non-energetic emissions of industry, also refered to as "process emissions" are not addressed in this summary. It may be useful to add a reference to it. [France]	Accept. "including in process emissions" added in the energy transition/industry paragraph in this ES (page 6 line 42 in SOD)
32194	5	1	8	22	An overview of loss and damage should be included in the Executive Summary and not only included in the Cross-chapter Box [Jamaica]	Noted. The Loss & Damage box has been moved to Chapter 5
36560	5	1	8	22	An overview of loss and damage should be included in the Executive Summary and not only included in the Cross-chapter Box [Snaliah Mahal, Saint Lucia]	Noted. The Loss & Damage box has been moved to Chapter 5
39216	5	1	8	21	What is missing is mention of 'economic growth and population growth, which the AR5 states is the main driver of CO2, and how these, coupled with levels of consumption unprecedented inhuman history, are critical to strengthening and implementing a global response. [Lindsey Cook, Germany]	Noted. The chapter attempts to outline the evidence available in the literature which largely indicated medium evidence or confidence as 1.5 C relevant research is relatively limited in spite having grown significantly since the Paris Agreement. The ES outline attempts to provide a high level narrative across key chapter themes. It may not be advisable to privilege some plenary approved sections. See also response to comment 10044.
60682	5	1	8	21	There are very few summary points made that are labeled with 'high confidence' or 'high evidence'. In general, when a bullet point has a level of agreement and evidence associated with it, is it possible that part of that point is more certain and could be split out from the rest so the reader can discern which parts are most well understood? Also, could it be advantageous to make those points that can be made with most confidence first in the summary? [United States of America]	Noted. The chapter attempts to outline the evidence available in the literature which largely indicated medium evidence or confidence as 1.5 C relevant research is relatively limited in spite having grown significantly since the Paris Agreement. The ES outline attempts to provide a high level narrative across key chapter themes. See also response to comment 10044.
60684	5	1	8	21	The Executive Summary should include the important point on page 4-12, lines 33-37, on the limits of adaptation (e.g., to address coral reef decline). [United States of America]	Agreed. The importance of Adaptation limits is highlighted in a headline statement. The ES typically does not take particular examples, including key systems at risk like coral reefs. This is addressed via case studies in the chapter and more specifically in Chapter 3 that is focussed on impacts.
61962	5	1	8	21	Please check that IPCC calibrated language is italized and that traceable accounts are provided (the same key findings should appear in chapter subsections so that one can understand the reasoning from the assessment of literature to the assessment of confidence / uncertainty and conclusion from each section. [Valérie Masson-Delmotte, France]	Noted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
28448	5	3	5	5	The fact that for mitigation the challenges are higher for 1.5°C than for 2 °C while for adaptation it is just the opposite should become more clear in this introductory sentence (e.g. "The transition to a 1.5C world would especially require upscaling and accelerating the implementation of far reaching, multi-level and cross-sectoral climate mitigation actions, integrated with sustainable development initiatives"). We suggest that adaptation should be dealt with in a separate sentence. [Germany]	Noted. Changes are made to clarify this point. Adaptation challenges could also be significant depending on the scale and length of potential overshoot. Hence, its more appropriate to keep the linkage between mitigation and adaptation. It would also lead to a very long headline statement
28450	5	3	5	30	The information of these paragraphs related to a 1.5°C world would equally apply to 2°C. It should be made more explicit throughout what is the additional benefits and challenges are for a 1.5 °C world compared 2 °C. [Germany]	Noted. This page primarily responds to implementation challenges for a 1.5C. Similar interventions would ne necessary for 2C but at changed speed, scale and enabling conditions. Special emphasis on 2C is made in relevant paragraphs but is less the focus of chapter 4. See also response to comment 17916
28452	5	3	5	9	The first sentences is already included in the SPM (SPM Page 20, Line 9-13). It should be added: This "will require a greater scale and pace to be transformational. Current national pledges on mitigation and adaptation are inadequate to stay below the Paris Agreement temperature limits and achieve its adaptation goals." Added sentences point out the need for more ambitious action as well as the need for transformational change. [Germany]	Accepted. Current NDCs are inadequate to address both mitigation and adaptation goals of the Paris agreement as outlined in Chapters 2 and 3 (as referenced in Para 1 and Para 3). Hence both systems transformation and acceleration implementation is necessary. Text suitably modified, and more detail on systems added.
31492	5	3	5	5	The first sentence "...adaptation to a 1.5°C world would require upscaling and accelerating the implementation of far-reaching, multi-level and cross-sectoral climate mitigation and adaptation actions..." is misleading because adaptation for 2°C or higher temperature targets must require higher degree of adaptation efforts. Therefore, modification is recommended so as to clarify the differences in effort (both mitigation and adaptation) between 1.5°C and 2°C (or higher temperature targets). Furthermore, for each paragraph, if possible, please present a level of confidence, evidence, or agreement in the text. [Japan]	Noted. See response to Comment 28448
32106	5	3	5	9	This is currently unclear and needs to be rephrased for clarity. [Jamaica]	See response to Comment 28452
33526	5	3	5	5	This is the first statement in chapter four and it is really not punchy or easy to follow. [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Strengthened with a short and stronger statement upfront.
36472	5	3	5	9	This is currently unclear and needs to be rephrased for clarity. [Snaliah Mahal, Saint Lucia]	See response to Comment 28452
60686	5	4	5	19	The blending of the discussion of mitigation and adaptation is confusing and results in a loss of clarity and precision. Holding warming to 1.5°C requires a much more aggressive mitigation effort, but would make adaptation less challenging. [United States of America]	See response to Comment 28452
1842	5	6	5	7	This sentence is not clear. The difference between transitional and transformation requires more clarity (the second word of this paragraph is also 'transition'). Perhaps indicate that the transitional change is underway in a variety of countries, and a 'greater pace' is needed for the transformation to have global effects? [Willem Pieter Pauw, Germany]	Accepted. Text modified
33528	5	6	5	7	here, and throughout the report "land-use change" should be hypenated as it is a compound adjective. And in e.g p4-20 line 25 "land use" when alone should not be hypenated. [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
48646	5	6	4	6	Energy efficiency and carbon intensity are misleading indicators to asses changes. I suggest replacing thme by energy demand and carbon emissions [Yamina Saheb, France]	Reject. These are the indicators that chapter 2 is using.
58586	5	6	5	7	The definition of and difference between transitional vs. transformational is unclear. The sentence is therefore hard to understand. [Elmar KRIEGLER, Germany]	See response to Comment 1842
60688	5	6	5	9	Transpose the order of sentences 3 and 4; more impact and would read better. [United States of America]	Accepted. Text modified
11056	5	7	5	7	is underway, it will require a greater scale and pace of those and specifically lagging mitigation technologies (like CCS, sustainabile biofuels, coal to gas switching) to be transformational. [Wilfried Maas, Netherlands]	Accepted. Text modified
16440	5	7	5	8	The final sentence of this paragraph should be reformulated to remove the reference to national pledges for adaptation. There is no obligation under the Paris Agreement or the UNFCCC for countries to make national adaptation pledges. To imply that there is, suggests that there is comparable information available on parties adaptation efforts to that available on mitigation efforts, which is not the case. It is possible for example to aggregate the expected mitigation impact of Parties NDCs, and compare that with the abatement required to acheive the Paris Agreement temperature goal. Adaptation is not a mandatory component of NDCs, so the same analysis can not be done to assess progress towards the Agreement's adaptation goal. Suggested revision "Current national pledges on mitigation and adaptation actions are inadequate to stay below the Paris Agreement temperature limits and acheive its adaptation goals." [Australia]	Accepted. See Comment 16440
31494	5	7	5	9	We would suggest to change "(…) are inadequate to saty (…)" to "(…) are not enough to saty (…)" from the context of this text. [Japan]	Accepted. See Comment 16440
32102	5	7	5	9	Incorrect statement: "Current national pledges on mitigation and adaptation are inadequate to stay below the Paris Agreement temperature limits" Suggestion: "and adaptation" needs to be deleted. [Jamaica]	Accepted. Text modified
36468	5	7	5	9	Incorrect statement: "Current national pledges on mitigation and adaptation are inadequate to stay below the Paris Agreement temperature limits" Suggestion: "and adaptation" needs to be deleted. [Snaliah Mahal, Saint Lucia]	Accepted. Text modified
36956	5	7	5	9	Should be changed from "(…) are inadequate to saty (…)" to "(…) are not enough to saty (…)" or to "(…) are insufficient to saty (…)". [Keigo Akimoto, Japan]	Accepted. See Comment 16440
39056	5	7	5	9	Incorrect statement: "Current national pledges on mitigation and adaptation are inadequate to stay below the Paris Agreement temperature limits" Suggestion: "and adaptation" needs to be deleted. [Grenada]	Accepted. Text modified
51936	5	7	5	9	Adaptation does not prevent warming, it makes us better prepared to deal with the temperature that we hit. This sentence needs to be changed to reflect that. This is sloppy language. [Jason Donev, Canada]	Accepted. Text changes made
51938	5	7	5	9	To remove any ambiguity, I would explicitly state that 'are inadequate to stay below the Paris Agreement temperature limits of 2C, let alone 1.5C'. [Jason Donev, Canada]	Accepted. See Comment 16440
4488	5	11	5	12	The expression here is quite abstract. For example, what does climate resilient society mean? Does it mean that temperature increase stay below 2 degree or 1.5 degree? In the last paragraph of page 7 of this chapter, it says that, though CDR for 1.5 degree world is technically feasible, it faces environmental, economic, institutional and social feasibility contraints. This point is described more in detail after page 35 of this chapter. Without massive CDR technologies, 1.5 world would not be feasible. Under those situation, we are not convinced that climate-resilient, inclusive, prosperous and healthy societies are possible. Please give reasons here. [Mitsutsune Yamaguchi, Japan]	Accepted. Society changed to community. The chapter presents evidence of feasibility of 1.5 C relevant mitigation and adaptation options and enabling conditions
7368	5	11	5	12	I believe the statement is overly positive in light of the reserach assessed, and I do not think there is medium agreement that there are numerous examples that it is possible to combine all the mentioned goals and stay in line with 1.5C. It is not sufficient to refer to a few success stories - it needs to be demonstrated that this is feasible at a sufficiently large scale involving system transformation. As I read it, the rest of the report does not back up the first statement. [Steffen Kallbekken, Norway]	Taken into account. The operative word is possible. The first sentence is only about the "multiple examples" and is strongly qualified by the second one. The uncertainty guidance will be checked.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10038	5	11	5	13	The examples cited are general and not 1.5c-specific. Hence, the agreement and the amount of evidence available do not necessarily inform the transition to or remaining below 1.5c world. [Saudi Arabia]	Noted. Multiple regions of the world are experiencing 1.5 and even higher warming at various part of the year (Chapter 3). This provides us some literature on the potential challenges and pathways to implement pathways towards a 1.5C world. The literature in this space is growing rapidly since AR5 but is still nascent hence the medium evidence. The point here is to show that 1.5C-consistent communities exist.
14234	5	11	5	11	word 'from' should be remomed from the sentence [United Republic of Tanzania]	Accepted. Text changes made
31496	5	11	5	12	1) “Climate-resilient society” and “healthy societies” are ambiguous and difficult to understand. In Glossary, the definition of “climate-resilient pathway” is written, but there is no explanation on “climate-resilient society”. 2) This sentence says that such societies are possible but there is no description on what conditions (in 1.5 ° C world or generally warming-mitigated world) such societies are possible. 3) As a large amount of CDR is required to achieve the 1.5°C target (page 35 of this chapter) and "a prominent CDR options in 1.5°C pathways are technically feasible but face environmental, economic, institutional and social feasibility constraints " (page 7 L 51 – 52), achieving 1.5°C target cannot always lead to climate resilient society. On above three points, more clear descriptions are requested. [Japan]	Accepted. Text changed to communities. Universal health and prosperity are in line with the SDGs.
31710	5	11	5	19	Point should end with semicolons [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
36054	5	11	5	19	This bullet may be divided into two parts. The first part about climate resilience and second about low carbon dimensions. [India]	Noted. We considered this but feel that there is value in looking at climate-resilient (so both adapted to climate change and low-carbon) societies in combination.
51940	5	11	5	11	Resilience, inclusivity and prosperity are all admirable qualities to strive for, but they aren't the same as a 1.5C goal. That's a climate change goal, or a global warming goal, while the prosperity and so forth are actually societal goals. The SDGs are not the same as the goals of temperature limits, and while tightly related, must remain differentiated throughout this document. [Jason Donev, Canada]	Noted. Climate is integrated into the SDGs via SDG13. The SR1.5 C is specifically mandated to examine 1.5C in the context of the sustainable development and poverty alleviation.
58584	5	11	5	13	What does it mean for a city, business or a community to be in line with a 1.5°C pathway? If the Chapter 4 wants to make use of such a concept, it would need to make an effort to define and motivate it (as it is not obvious; e.g. it cannot be directly deduced from the 1.5°C pathways in Chapter 2). [Elmar KRIEGLER, Germany]	Noted. This chapter assesses the potential to strengthen the global response to 1.5C. Hence, in a strict sense responses at a national and local level are less relevant. The literature however indicates that multi-level implementation and governance is a enabling condition for this. A range of local governments (e.g., Oslo) and communities within them and firms (members of the UN Global Compact) have made the commitment to and are monitoring their progress to 1.5C goal
1844	5	12	5	13	I would change the order from larger to smaller: countries, regions, cities, communities and businesses [Willem Pieter Pauw, Germany]	Accepted. Text changes made
60690	5	12	5	13	The sentence implies that there are very few cites, regions, etc., that are truly in line with a 1.5°C pathway at scale. No examples are provided that reinforce this point. The sentence should be revised to convey that, while there is progress, no entity is on target to achieve the 1.5°C target from a mitigation or adaptation perspective. [United States of America]	Accepted. Text changes made
1846	5	16	5	17	What is an 'equity' enhancing financial institution? In finance, equity is a category of finance (where investors become shareholders, e.g. through bonds). I would put 'equity' or 'taking account of the poorest and most vulnerable' rather under what governments need to do? [Willem Pieter Pauw, Germany]	Accepted. Text changes made
32860	5	16	5	18	These sentences talk about ‘necessary institutional arrangements’. Consider also to talk about ‘transformations in institutional arrangements’ to emphasise the need for transforming the existing ones, not only to achieve those mentioned in the summary. [J. David Tabara, Spain]	Accepted. Taken into account later in the sentence, and text revised
60692	5	16	5	19	Overly broad, non-specific phrases like "equity-enhancing" institutions and "alignment of government and business institutions" should be deleted. [United States of America]	See Comment 1846
1848	5	17	5	17	I would use 'cooperation' instead of 'alignment'. Who aligns to whom? [Willem Pieter Pauw, Germany]	Accepted. Text changes made
1850	5	21	5	23	Although I agree to most of this statement, one could argues that some ambitious countries' NDCs (e.g. Morocco) as well as countries that are currently net CO2 sinks because of their forest stocks do not have to raise their level of ambition. They would still need to do all the other things mentioned, however. [Willem Pieter Pauw, Germany]	Accepted. Text changes made
33080	5	21	5	30	references to support this point: Robinson, M. & Shine, T. (submitted) Achieving a climate justice pathway to 1.5oC. Nature Climate Change. Mary Robinson Foundation – Climate Justice (2015b). Zero Carbon Zero Poverty the Climate Justice Way: Achieving a [Tara Shine, Ireland]	Reject. No references included in the ES.
33530	5	21	5	24	why does this statement (and some others in the executive summary) not have a agreement / evidence assessment? [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Typically headline statements use this language
36056	5	21	5	27	The report cites that all countries would be required to raise ambitions, finance and efforts for implementation of global responses to climate change. While doing so, the report does acknowledge the support required by developing countries for achieving the same, but refrains from assigning a specific role to developed countries in scaling up their support for the global climate response. Further, in asking 'all countries' to raise finance and other efforts, the report drifts away from the agreed and established principles of 'Common but Differentiated Responsibilities' (CBDR). This needs to be addressed in the report. [India]	Accepted, text has been changed appropriately: in the second para of the FGD ES, the point of international support is made.
53132	5	21	5	30	The chapter never sufficiently defines "transformational adaptation." [Westphal Michael, United States of America]	Accepted. Defined in the Glossary
60694	5	21	8	21	The chapter summary is very generic and almost entirely qualitative and does not give the reader the kind of blended quantitative and qualitative sector-by-sector assessment that would be desirable given the subject of the chapter. For example, if valid, the results in Table 4.1 on page 4-11, outlining policy targets consistent with 1.5°C, should be pulled forward into the chapter summary and combined with an assessment of how close these various end use sectors are to meeting the targets, and what kinds of measures (and costs) would be needed to achieve them. [United States of America]	Accept. If this table can be redeveloped into a form that is policy-relevant enough for the ES, it can be included (in wording as tables in the ES are not allowed).
60696	5	22	5	23	It is not clear how "address equity across and between generations and regions" relates to 1.5°C mitigation and adaptation pathways. [United States of America]	Noted. Implementing 1.5C mitigation and adaptation pathways that are compatible with Sustainable Development, implies convergence between SDG 13 (Climate) and SDGs 5 (gender equity) and SDG 10 (inequality)
908	5	23	5	23	including in using' delete 'in' [Robert Shapiro, United States of America]	Editorial
8066	5	23	5	23	Indigenous : Does its importance for global GHG emission reductions justifies its appearance here? I doubt so [Quentin Perrier, France]	Noted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9586	5	23		24	Indicating that countries need to build capabilties in using traditional, Indigenous and local knowledge is an important point, but it must also be recognized that Indigenous knowledge is not a neatly packaged, easily definable, tangible add-on that can be applied to existing processes as an afterthought. Furthermore, this point puts the focus on building capabilities of states, rather than supporting capacity building of Indigenous peoples. The paragraph that follows this point has no further explanation of what building capabilities of in using IK means and this is problematic as it may promote unethical practices that do not respect or properly understand Indigenous rights in relation to Indigenous knowledge and data. The importance of Indigenous knowledge in implementation of global responses should be its own point and further elaborated on. [Joanna Petrasek MacDonald, Canada]	Noted.
60698	5	24	5	27	This statement should not single out developing countries, and should be revised to be applicable to all countries. [United States of America]	Noted. Text changes made
60700	5	26	5	27	Overly broad phrasing leads to inaccuracy in this case. It is not that there are "insufficient" resources, but that existing resources would need to be mobilized to achieve different or additional objectives than they currently do. [United States of America]	Accepted. Text changes made
51942	5	27	5	27	Medium agreement'? Seriously? Who's disagreeing with this, the evidence is high, what is the disagreement? [Jason Donev, Canada]	Accept. Changed to high confidence.
32862	5	29	5	29	the expression 'multinational networks' is used in the executive summary but not in main text. In contrast, in the main text, the term used is that of 'transnational networks'. In my view, the use of the expression 'transnational networks' is more adequate in governance discussions - given that in complex interactions as those the characterise current global systems are not constrained to national level or agents but between and across multiple levels -, while the term 'multinational networks' tends to be related or reserved to large companies and corporations –as it has been rightly put in the main text. [J. David Tabara, Spain]	Accepted. Text changes made
9412	5	32	5	35	Is this a question of timing - In the long-term, adaptation reed will be less with 1.5deg but in the short-term the need will be the same given the changes that are already in motion and the similarity in scenarios until mid century? [Sharon Smith, Canada]	Noted. Not necessarily so. Adaptation needs are linked to impact, which in turn is linked to the particular pathway that is under consideration.
10040	5	32	5	35	Are there enough studies on 1.5c and 2c at the global level to qualify the "medium evidence" that Adaptation needs are lower with 1.5c compared to 2c? And if so by how much are they lower, e.g. by 1% or by 10%? [Saudi Arabia]	Noted. Primary evidence provided in Chapter 3
33082	5	32	5	35	add a reference to the impacts of exceeding 1.5 on human rights [Tara Shine, Ireland]	Noted, issues of rights and climate justice are discussed in Chapter 5, so the chapter 4 ES is not the place. We only flag it in the knowledge gaps section.
38594	5	32	5	32	This first sentence "Adaptation needs…" sounds a bit obvious. Can it be linked to some further statements or more specific information? [Jan Fuglestvedt, Norway]	Noted. This statement is not self-evident to many policymakers
49716	5	32	5	35	It is suggested that the sentence of 'While transformational adaptation is necessary under currently (~1.5°C) warming conditions in some regions, adaptation limits are expected to be exceeded in multiple systems and regions in a 1.5°C world, putting large numbers of poor and vulnerable people, systems and regions at risk' is changed as 'Transformational adaptation has been applied under currently (~1°C) warming conditions in some regions, in the future in a 1.5°C world as the adaptation limits are expected to be exceeded in multiple systems and regions then putting large numbers of poor and vulnerable people, systems and regions at risk, transfomational adaptation would be more widely applied' . [Yinlong XU, China]	Reject, the suggestion does not clarify much. The sentence has ben changed in any case making this comment obsolete.
49732	5	32	5	32	It is suggested that the sentence of 'Adaptation needs will be lower in a 1.5°C as compared to 2°C world' is changed as 'Though adaptation pressure is lower in a 1.5°C as compared to 2°C world, while the adaptation needs in 1.5°C world is almost the same as in 2°C world'. [Yinlong XU, China]	Reject. There is no literature in Chapters 3 or 4 that supports this revised statement.
51944	5	32	5	35	Which part of the preceding statement is only 'medium evidence'? What's the agreement for this statement, that should probably be explicit here. [Jason Donev, Canada]	Noted. The second sentence
10560	5	33	5	35	… adaptation limits are expected to be exceeded in multiple systems and regions in a 1.5C world….'. The meaning is not clear. What are 'adaptation limits'? [Hong Yang, Switzerland]	Taken into account. The term is defined in the Glossary.
30540	5	33	5	34	The notion of "adaptation limits" is important but would deserved to be clarified (cf Box 4.4, p.117, line 42). [France]	Taken into account. The term is defined in the Glossary.
1852	5	34	5	35	This reads (even if it isn't meant this way) as if developed countries might be exempt from the impacts of a 1.5 degree world, which I think is not true [Willem Pieter Pauw, Germany]	Rejected. "in some regions, adaptation limits are expected to be exceeded in multiple systems and regions in a 1.5ºC world, putting large numbers of poor and vulnerable people, systems and regions at risk" does not imply this
13140	5	37	5	37	Delete the text "innovative". [Eleni Kaditi, Austria]	Rejected. Innovative financing practices are required to address the challenges of financial inclusion, informality, gender equality and other commitments to leave no one behind
33084	5	38	5	40	adaptatation should also protect the rigts of vulnerable people and communities [Tara Shine, Ireland]	Accepted. Text changes made
12182	5	40	5	42	Would benefit from commenting on 'readiness for finance', i.e. countries' ability to plan for and absorb finance. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text amended and reference to 4.4.2 added.
30542	5	41	5	41	The term "insufficient" is scientifically difficult to be measured. [France]	Accepted. Text changes made
10042	5	44	5	52	How rates of change of emissions for remaining below 1.5c have been observed historically agree with the following statement that the scales required are larger and have not been observed before? [Saudi Arabia]	Taken into account. We separate speed and scale, see reply to comment 60702.
32104	5	44	5	52	This summary misses the important conclusion from 4.2.2.1 that "Energy transitions are associated with wider socio-economic transformations that are generally not represented in models, which gives reason to believe that energy transitions could proceed much faster" (See page 13 lines 40-42). Suggestion: include reference to this conclusion here as well. [Jamaica]	Accept. Text revised.
36470	5	44	5	52	This summary misses the important conclusion from 4.2.2.1 that "Energy transitions are associated with wider socio-economic transformations that are generally not represented in models, which gives reason to believe that energy transitions could proceed much faster" (See page 13 lines 40-42). Suggestion: include reference to this conclusion here as well. [Snaliah Mahal, Saint Lucia]	Accept. Text revised.
49034	5	44	5	52	While this paragraph is correct that major, transformational change is needed, it does not reflect the substantial opportunities to achieve change that are reflected throughout Chapter 4. This paragraph should highlight that those opportunities are present in many sectors. [David Waskow, United States of America]	Taken into account. The paragraph does highlight the main areas of opportunity in 4.4.
58588	5	44	5	45	To be checked. Global emissions reduction rates in many 1.5°C pathways are beyond what has been seen on the national level (e.g. in France or Sweden), if war times are excluded. Rather I think the message is that the rates of change we are looking at in 1.5°C pathways are unprecedented. [Elmar KRIEGLER, Germany]	Partially accept. The rates of change of emissions have been observed but only in times of economic downturn (like the reforms in the Soviet Union. The point of 4.2.2.1 is mainly about technologies. Text revised.
58590	5	44	6	1	Sentence hard to understand. Governance compatible with 1.5°C would certainly need to enable mitigation and adaptation, but how is it to be aligned with political economy considerations? Also - would the assessment not have to be the other way around? What governance structures are needed to enable 1.5°C. [Elmar KRIEGLER, Germany]	Accepted. Text changes made
60702	5	44	5	45	Clarify how this was observed historically so it is more clear how this sentence fits with the second sentence. [United States of America]	Accept. Sentence "For mitigation towards 1.5C, both speed and scale of the transitions need to be enhanced" added.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
39204	5	46	5	47	This statement on lack of documented historical precedents may be untrue. Britain during 1939-45 has well documented transitions on energy, land, urban, industrial and diet changes with quite profound results, including a reduction in inequality, increase in dietary health, and sense of pride in citizens that their behavior change would help ensure the healthy future of their children. While a war-time scenario, the emergency humanity is facing at present has similar implications if we 'lose' the chance to ensure a healthier future. We can learn from these war examples, without fear. [Lindsey Cook, Germany]	Noted. Text removed
28454	5	47	5	52	While "planning" and "coordination " are important mechanism required in the context of a whole system transformation, the economic literature also highlights the important role of efficient markets and institutions and adequate price-signals for CO2. Please consider to add these points to the statement, and strengthen the underlying chapter accordingly. If these issues cannot be addressed in the SR1.5 due the lack of the scientific evidence this should please be clearly stated. [Germany]	Noted. Text modified in 4.4.5
30544	5	47	5	48	This would deserve to be better emphasized. [France]	Noted
60704	5	50	5	52	Strike "fiscal" or change to "fiscal OR financial arrangements." The report does not provide a basis for concluding that new fiscal arrangements are necessary or that success "depends on" this separate from other financial arrangements. Alternatively could change "depends" to "could be accelerated / supported / driven" by ... [United States of America]	Accepted. Changes made in text
48648	5	51	5	51	Please clarify to which innovation you ar erefrring to: technology, governance, policy and financial instruments? [Yamina Saheb, France]	Accept. We refer mainly to technological innovation here, because the other types of innovation are covered by the other enabling conditions.
7690	5	52			For semicolon substitute comma. [Amory Lovins, United States of America]	Accept. Text revised.
31498	5	54	6	7	The phrase "governance compatible with 1.5°C", which is a bit too strong, may mislead readers because it implies that governance can be a necessary and sufficient condition for 1.5°C. In the body text after 4.4.1, there are no evidence for supporting the phrase, so it needs to be modified. [Japan]	Partially accepted. Text modified to "Governance aligned with 1.5C worlds. We reject the point that governance would not be a critical enabling condition. There is evidence in 4.4.1 that indicates that the absence of the right kind of governance - which can take many forms depending on the specific circumstances - leads to losing sight of 1.5C.
36058	5	54	6	7	May consider including mention of governance to accelerate innovation and technology deployment. [India]	Accepted. Text changes made
48650	5	55	5	55	Please clarify to which innovation you ar erefrring to: technology, governance, policy and financial instruments? [Yamina Saheb, France]	See response to comment 48648
55050	6		8		The Executive Summary should include a para on governance. Chapter 4 rightly highlights, the important role of international, national governance, not only to facilitate, accelerate the transition to a low-carbon and climate-resilient economy, but also to: monitor, assess the quality and level of mitigation, adaptation efforts, as well as in scaling up and aligning support to the objectives of the Paris Agreement); facilitate integrated approaches that mutually reinforce the achieveent of climate, sustainable development and security goals, and inform national and international decision making process, based on lessons learnt, and with a view to mitigate potential adverse impacts of unilateral actions or possible (still uncertain) technlocgical options. [Yamide Dagnet, United States of America]	Noted. Para 6 is on governance
22778	6	1			What this 'Political economy means? Fully controlled economy? Planned economy?Economy lead by Politics? [Shuzo Nishioka, Japan]	Taken into account. Political economy is a well-known term in political science but has been added to the Glossary.
31712	6	1	6	7	Point should end with semicolons [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
57322	6	2	6	2	Blurry term “useful” [Hans Poertner, Germany]	Accepted. Text changes made
33086	6	4	6	7	participation, education, access to information are precedural rights that can enhance climate action: Mary Robinson Foundation – Climate Justice (2015a) Right for Action: Putting People at the Centre of Action on Climate Change. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-Rights-for-Action-edition-2.pdf [Tara Shine, Ireland]	Reject for this Executive Summary. We are looking at these issues from the perspective of the global response, chapter 5, more in depth, in the context of sustainable development and equity.
39206	6	4	6	4	It would help if the IPCC could lik readers to the best examples of government produced education on climate change, and actions citizens can take to help in lifestyle change. To date, this expert reviewer has not found government-sponsored literature for the general public which genuinely reflects the seriousness of what is at stake, if we fail to act urgently to hold temperatures to a safer rise. [Lindsey Cook, Germany]	Noted
1854	6	6	6	6	enable unhindered' should be 'enhance'. Unhindered is a ferrytale [Willem Pieter Pauw, Germany]	Accepted. Text changes made
30546	6	6	6	6	The meaning of "unhindered" isn't clear. [France]	Accepted. Text changes made. See Comment 1854
60706	6	6	6	7	Strike ""unhindered access to finance and technology, and address climate-related trade barriers."" ""Unhindered"" is overly broad (e.g., access to finance will always be subject to certain restrictions) and in the case of access to technology, the use of ""unhindered"" in this context does not accurately reflect the balance of the literature. For instance, there is a large body of literature that highlights the importance of intellectual property rights and patents in encouraging and stimulating innovation over the long-term, which is what would be necessary to developing technologies that could facilitate reaching 1.5°C pathways. For example, see: (1) Ang, G., D. Rottgers and P. Burli (2017), ""The empirics of enabling investment and innovation in renewable energy"", OECD Environment Working Papers, No. 123, OECD Publishing, Paris. http://dx.doi.org/10.1787/67d221b8-en. (2) OECD (2008), Environmental Policy, Technological Innovation and Patents, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264046825-en. (3) OECD (2011), Invention and Transfer of Environmental Technologies, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264115620-en. [United States of America]	Partially accepted. Text modified on "unhindered"; see Comment 1854. On the point on IPR, in particular in the context of developing countries (which is the main subject here), there is limited peer-reviewed literature on this issue and diversion of views in the UNFCCC negotiations.
1856	6	9	6	9	I am definitely not an expert here, but isn't 'consumption patterns' more concrete thatn 'behavior and lifestyles'? [Willem Pieter Pauw, Germany]	Noted. Lifestyles is a wider term than consumption patterns and behaviour and supported by the literature. For example, it also includes citizen behaviour and organisational behaviour, as indicated in Table 4.6
10046	6	9	6	15	The first sentence says " change in behavior and life styles are essential for a transition to 1.5c", whereas the second sentence says "behavior and life style related measures led to limited emissions reduction around the world". Does that imply behavior and life styles changes are not effective and that poses a challenge to the feasibility of 1.5c? [Saudi Arabia]	Noted. Text modified to clarify the difference between historical and contemporary lifestyles and those that would be 1.5C compatible ("Behaviour- and lifestyle-related measures and demand-side management have already led to emission reductions around the world and can enable significant future reductions"). See also response to comment 60708
31500	6	9	6	15	It is true that "changes in behavior and lifestyles are essential for a transition to 1.5°C", but behavioral changes have yet to be known to be a sufficient conditions of 1.5°C. For example, body texts of 4.5.1, p.4-82, lines 34-36 point out that knowledge on the feasibility of reaching 1.5°C by behavioral changes are not sufficient. Therefore, we recommend modifying the sentence to "Changing lifestyles and behavior can result in greater participation in governance for the 1.5°C transition through bottom-up initiatives that, in turn, help gather political and public support for further-reaching mitigation and adaptation, creating a virtuous circle. {4.4.1; 4.4.3, Figure 4.4}" by paying attention to the phrase "for the 1.5°C transition". [Japan]	Accepted. Text changes made. See response to comments 10046 & 60708

Comment No	From Page	From Line	To Page	To Line	Comment	Response
33088	6	9	6	15	add a reference to the importance of procedural rights such as the right to particiation & the right to information in the context fo behaviour change. Procedural Rights as a Crucial Tool to Combat Climate Change Georgia Journal of International and Comparative Law, Vol. 38, No. 3, Spring 2010 Svitlana Kravchenko Advancing Climate Justice and the Right to Health Through Procedural Rights Margaux J. Hall Health and Human Rights 2014, 16/1 [Tara Shine, Ireland]	See response to comment 33086.
60708	6	9	6	9	If this is true and people largely reject changing their lifestyles, the logical conclusion is that 1.5°C is unattainable. Qualify finding to state that larger negative emissions (through technology) could potentially occur, or the implementation of SRM, not considered here, could be deployed. Inject some optimism. [United States of America]	Accept. Text modified to give a more optimistic message, which is warranted in the chapter, and also to do justice to chapter 2's findings on this (see comment 24342), which is very much related to this point. This, combined with responses to comments 10046 and 31500, leads to a more balanced statement that acknowledges the potential for emission reduction as a consequence of behavioural change, acknowledges that much more could be done, and names some other side-effects, like the governance aspects.
30548	6	11	6	12	This sentence sounds negative (because of the "limited"), althougth we are not sure it is the intention [France]	Noted. Text modified to clarify historical and contemporary measures. This references that fact that emission levels are much higher than anticipated following on from UNCED and the UNFCCC process. See response to comment 60708.
60710	6	11	6	12	Provide context to statement. Add 'to date': "Behavior- and lifestyle-related measures have led to 12 limited emission reductions around the world to date." [United States of America]	Accepted. Text modified to clarify historical and contemporary measures. See response to comment 60708.
4490	6	13	6	13	Please re-write "result in greater participation in governnance" in more understandable English for non-native speakers. [Mitsutsune Yamaguchi, Japan]	Noted. Concern for clear communication noted but the non-native authors feel this is understandable and don't see a way to improve this without using much more words. We have tried, hope the revisions work.
31502	6	13	6	13	As "Result in greater participation in governance" is difficult to understand, please add more information. [Japan]	Noted. Concern for clear communication noted but the non-native authors feel this is understandable and don't see a way to improve this without using much more words. We have tried, hope the revisions work.
53134	6	17	6	23	Carbon pricing is critical, but so is the reduction and reforming of fossil fuel subsidies, which totaled USD 650 billion in 2015 (Coady et al., 2017). This is mentioned in 4.4.5, but should be highlighted here. [Westphal Michael, United States of America]	Accept, added to the text.
54420	6	17	6	23	Consider mentioning here that public support for climate policy is also shaped by political leadership, as per the findings referred to in section 4.4.3, page 58, lines 8-12. [Conor Little, Ireland]	Accepted. Text changes made
7446	6	20	6	20	Insert behind "non-price": "including international market mechanisms" [Axel Michaelowa, Switzerland]	Accepted. Text modified to reflect this point more succinctly earlier in the sentence.
13142	6	20	6	22	Delete the text "Policy instruments, both price and non-price, are needed to accelerate the deployment of carbon-neutral technologies as long as the market continues to prefer fossil fuel-based technology for a variety of reasons.". [Eleni Kaditi, Austria]	Reject. No reason given why to delete.
28456	6	20	6	23	Pricing CO2 (more) adequately could be a real game-changer in driving mitigation and transition towards 1.5°C. This is not considered sufficiently in these short text. The language is very weak ("suggest", "some form", "necessary but insufficient") and in our view does not represent the scientific evidence and practical lessons on the effectiveness of adequately pricing carbon. Please revise this high level statement, and give more emphasis to the relevance, good practice and barriers of price-systems and instruments in the underlying chapter. [Germany]	Partially accept. While we agree that carbon pricing can play an important role (represented by the "necessary" in the last sentence), we don't feel that the comment does justice to the sentiment in the literature that transitions are not driven by incremental steps, which is what carbon pricing is good at doing. We are taking out the unclear "some form of".
32242	6	20	6	22	The sentence doesn't read clearly. [Jamaica]	Noted. Additional clarifications added
60712	6	20	6	23	Should note that the level of certainty / validity of these statements vary by geography. That is, these conclusions may be more or less valid, or not, depending on country or governance regime. For instance, in regions that have historically offered inefficient fossil-fuels subsidies, simply removing existing market-barriers could be sufficient. [United States of America]	Noted. It is unlikely that removal of fossil fuel subsidies anywhere would be sufficient for the 1.5C transition, but the point is taken that the circumstances greatly affect the most effective and robust policy mix.
11058	6	21	6	22	as long as the market continues to prefer unabated fossil fuel-based technology for a variety of reasons [Wilfried Maas, Netherlands]	Noted. Text modified in line with response to Comment 39208, making this comment obsolete.
14006	6	21	6	21	Policies should also cover non-CO2 warmers - so need to include here too - eg for land use, agriculture [Ralph Sims, New Zealand]	Accept. Modified to "GHG-neutral technologies and practices".
29366	6	21	6	22	Lines 21 and 22 are unsubstantiated (statement that 'the market continues to prefer fossil fuel based technology for a number of reasons' - this is false for two reason as the competitveness of low carbon technologies is rapidly changing and is not consistent across a wide range of technologies - it is also not the case that 'markets prefer' anything - given scale of subsidies particularly in the energy sector. [Shelagh Whitley, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text modified in line with response to Comment 39208. Text now reads: "These instruments would aim to reduce the demand for carbon-intensive services and shift market preferences away from fossil fuel-based technology." Although in specific areas there are changes in market preferences, fossil fuels are still the fuel of choice for many investors.
39208	6	21	6	21	The market cannot 'prefer' because it is not a person. This statement is misguiding as it appears to assume policy/governments do not have the power to influence markets, which is of course untrue. [Lindsey Cook, Germany]	Accept. Text modified to reflect this.
1858	6	22	6	22	leave out 'for a variety of reasons' [Willem Pieter Pauw, Germany]	Accepted. Text changes made
7694	6	22	6	23	I agree that some evidence and most economic theory suggest "that some form of carbon pricing is a necessary but insufficient part of the mix (medium agreement). I strongly agree carbon pricing would be insufficient, but I strongly disagree that carbon pricing—though it is highly desirable and would be very helpful—is necessary for effective global decarbonization. Please see my second general comment (line 4 in spreadsheet) on Chapter 4. [Amory Lovins, United States of America]	Accept. Although even in centrally led economies, governments are turning to carbon pricing of some form, it is not strictly necessary. One could just regulate. Text revised to "can be a helpful but in itself insufficient"
10050	6	22	6	23	Carbon pricing is neither necessary nor sufficient for emissions reductions under the presence of market imperfections and uncertainties in real world compared to the ideal simulated market environments in modeling studies. The evidence from the working of ETS is a good example to cite in that respect. [Saudi Arabia]	Accept. See also response to 7694.
7448	6	23	6	23	Insert behind "medium agreement": "International market mechanisms can reduce mitigation costs and thus induce policymakers to take up more ambitious mitigation targets" [Axel Michaelowa, Switzerland]	Rejected. No evidence for this is given in the chapter nor in the literature as far as we are aware, especially for the latter part.
28458	6	23	6	23	There is a large body of evidence supporting that an international carbon market can reduce significantly mitigation costs and thus enable countries to enhance and strengthen their mitigation target (Cf. e.g. State and trends of Carbon Pricing, 2016 (Ch 4)). Please consider to include a statement along those lines here, and make sure the underlying chapter analysis is revised in order to be consistent (e.g. 4.5.2.2). [Germany]	Reject. There is indeed evidence that international emissions trading may reduce costs significantly, including in the reference provided. However, the same chapter referred to reviews a long list of barriers to international carbon markets that seem to dominate at the moment. Emissions trading has been used less and less since 2012, says the document. We feel that our statements are representing the state of the literature, also in 4.4.5, and that in particular for 1.5C, which requires fast transitions everywhere, the carbon market relevance might actually decrease. The text is revised to be more precise about the point raised in the comment.
56128	6	23	6	23	I would suggest to clarify the text by talking about an insufficient part of the "policy" mix. [Emilie ALBEROLA, France]	Accept. Text modified. See response to comments 10046 & 60708

Comment No	From Page	From Line	To Page	To Line	Comment	Response
58270	6	24	6	32	This paragraph is not clear - what is meant by front-loading investments? And "Reducing risk-weighted capital costs" appears to be a desired outcome, rather than an instrument [Andrew Prag, France]	Accepted. Text modified
30550	6	25	6	27	This subject should be further documented. [France]	Taken into account. Reference to the finance sector is given.
31704	6	25	6	32	The phrase "1.5°C-compatible worlds" can be confusing. How many worlds are there? [Michael SUTHERLAND, Trinidad and Tobago]	Noted. Many possible future worlds as the scenarios and pathways in Chapters 1 and 2 outline. See also cross-chapter box 8 on 1.5ºC warmer worlds in Ch3.
36060	6	25	6	32	Institutional capacity in financial sector, as emphasized in the Report, is needed. All sources of finance are important, given the enormity required. However contrary to what draft Report suggests, the multilateral development banks can come as a supportive channel to leverage climate finance. The front loading has to arrive from the financial pledges the developed country Parties have undertaken under the UNFCCC. Private sector finance also play a supportive and a critical additional role. This needs to be added in the report [India]	Accept, but not intended for the ES. It should be included in 4.4.5.
53136	6	25	6	32	The section gives short shrift to other instruments for low-emission and adaptation investments, such as other derisking instruments, green bonds, and insurance. Also, 4.6 could also mention financial instruments that address co-benefits of climate action, such as social impact bonds that target health improvements from air pollution reductions. [Westphal Michael, United States of America]	Reject. Though the examples mentioned are relevant, there is no literature as to how relevant to 1.5C. Also, because of page limitations, we aim to stick to the core messages. Text slightly revised.
58592	6	25	6	25	Say "impossible to reach" [Elmar KRIEGLER, Germany]	Accepted. Text changes made
60714	6	25	6	27	Report does not provide sufficient evidence to make a claim that active involvement by central banks is "necessary". Moreover, such a statement is not in line the IPCC principles to not be policy prescriptive. [United States of America]	Accept. The chapter does not speak (though it implies) about "active involvement". The chapter does however indicate that without the financial sector, the 1.5C change cannot be met. Text revised to represent the point made here.
1860	6	26	6	26	I would include bilateral banks too. And commercial banks [Willem Pieter Pauw, Germany]	Partially accept. We are very space constrained in this summary and chapter, and cannot represent everything, but the commercial banks, we take on.
7696	6	26	6	27	I doubt that up-to-date models (which no IAMs are) would show "front-loading of investments compared to current actions is unavoidable". IAMs tend to use old and fixed cost data (especially for wind and solar power), and sometimes to assume largely or wholly unnecessary bulk electrical storage (http://dx.doi.org/10.1016/j.tej.2017.11.006), rather than to assume observed experience/scaling curves and least-cost grid integration. Modern renewable electricity sources, in 2017 unsubsidized competitive bids, not only have far lower levelized costs of electricity than new fossil-fueled or nuclear generators, but often have comparable if not lower capital costs (duly adjusted for relative capacity factors), especially when counting their far higher capital velocity from short lead times and fast paybacks, hence their tying up less investment capital for a shorter period. Even if this were not true, modern energy efficiency is even cheaper than modern renewables, displacing more of the costly new thermal generating capacity. Moreover, all efficiency and distributed renewables displace new grid assets, which tend to cost even more than generators. (I do not think IEA's contrary calculation used up-to-date data, let alone plausible forecasts of future asset costs.) The only rational explanation I can see for the front-loading statement is that perhaps major buyouts of stranded assets are being assumed alongside replacement investments, but if so, the buyouts would be transfer payments, not real resource costs. At least I would phrase your frontloading conclusion much more cautiously unless you are highly confident that my skepticism is misplaced. Most analysts were surprised when BNEF's reports of declining renewable investment in some recent years turned out to accompany rising installations—but cost/kW had fallen faster than installations rose. Assuming this will not continue to happen is unwise, both for renewables and for efficiency, whose costs are generally flat or falling too. [Amory Lovins, United States of America]	Reject. We don't claim here that investment costs for RE is higher than those for fossil fuels. We are saying which both IAMs and bottom-up studies are consistently saying: that changing the energy, industrial, infrastructure and land systems requires investments, e.g. in new infrastructure, grids, new industrial clusters etc. etc.
31504	6	26	6	26	We would suggest mentioning not only central and multilateral banks but also financial regulatory authorities because in some countries, functions are distinguished between the central bank and the financial regulatory authority. [Japan]	Accepted. Text changes made. To be read along with the response to Comment 60714
53258	6	26	6	34	relevant to *Scaling BECCS* This section states "The total amount of CDR projected in 1.5°C scenarios is of the order of 380-1130 GtCO2 over the 21st century." Obviously some of this could be afforestation, not BECCS, but it's still shocking in light of this big number to see that in the next paragraph, at line 33, it states, "Such scenarios deploy BECCS at about 0.1 GtCO2 yr-1 in 2030." There is a massive, massive incompatibility between the need to deploy up to over 1100 Gt of CDR, and the ability to execute just 0.1 Gt, if that, by 2030. Is this number right? If it is right, doesn't incompatibility deserve more discussion to the effect that BECCS is totally unscalable in a meaningful timeframe? The report MUST do a better job of synthesizing the modeling and coming to conclusions about what is practical and realistic! [Mary Booth, United States of America]	This comment pertains to chapter 2, not chapter 4.
1862	6	27	6	27	take out 'if this is to happen' and write 'this requires' insteae - it is already happening (but at a small scale only). [Willem Pieter Pauw, Germany]	Accepted. Text changes made
28460	6	31	6	32	A key requirement for the redirection of capital and savings are expectations about policy decisions and instruments. Only with strong, clear and reliable long-term policies that signal the will of policymakers to reach and keep the 1.5°C goal financial actors will change their behaviour and investment decisions. So please add the aspect of credible policy frameworks and goals compatible with the 1.5 temperature goal. If these issues cannot be addressed in the SR1.5 due the lack of the scientific evidence this should please be clearly stated. [Germany]	Accept. "and policy frameworks" added to the text.
60716	6	31	6	32	As currently phrased, presents an incomplete and misleading sense of possible instruments. Should note that not all instruments are financial in nature, and also include local and national-level policy and regulatory reforms. [United States of America]	Accepted. Changes made in text
1864	6	34	6	45	The international transport sector is mentioned in the bold text, but not explained [Willem Pieter Pauw, Germany]	Accept. This was covered in the energy system transition paragraph in the chapter but it's now moved to section 4.3.3 (new) in the Final Draft.
13144	6	34	6	35	Delete the text ", but follows a slower pace in energy-intensive industry and international transport". [Eleni Kaditi, Austria]	Partially accept. "International transport" moved to other paragraph.
14050	6	34	6	39	Agree that solar, wind and storage continue to increase but still are a very small share of primary energy so not sure why this paragraph on energy transition excludes hydro, bioenergy, geothermal etc. "Intermittent" means on/off so the word to use for solar and wind (also wave) power is "variable". [Ralph Sims, New Zealand]	Noted. Sentence was removed so comment not relevant anymore.
28462	6	34	7	28	Results/statements as for the transport sector beyond the generic statement on "international transport" are missing, also concerning the important aspect of logistics and mobility infrastructure. Please add. [Germany]	Taken into account. This is addressed in the urban & infrastructure section in the ES. International transport will also move there.
36710	6	34	6	45	Energy efficiency technologies such as LED lightlng should be added to the list of technologies that are undergoing a rapid transformation. It should also be acknowledged that many "no regrets" energy efficiency technologies can be implemented that reduce emissions and save money rather than saying efficiency is "less economically risky." Offshore wind is also experiencing significant cost reductions in Europe and there are policies in the U.S. to significantly ramp-up deployment that will also result in cost reductions. The characterization of CCS being "less economically risky" and "closer to implementation to for major industrial sectors" is also misleading. The pace of deploying CCS in the electricity sector has been much slower than expected because of high costs. [Steve Clemmer, United States of America]	Taken into account in the paragraph on infrastructure.
37194	6	34	6	45	The comment...."CCS techologies have no role in long run"... negates the fact that the deployment of CCS on an industrial scale, in terms of infrastrucutre, learnings, technology optimisation is a pre-requisite for CDR (BECCS, DACS) which future scenarios highly rely on (as stated in Chapter 2 of this IPCC report). It also ignores the use of natural gas with CCS in some scenarios (Chapter 2 , Page 118, Line 10) . A statement that CCS is needed now for natural gas +CCS and future large-scale CDR should be added. [John Scowcroft, Belgium]	Accept. Text Is clarified to make this point.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
60718	6	34	6	34	What "energy transition"? [United States of America]	Accept. Revised to "The energy system transitions needed for 1.5C".
60720	6	35	6	35	Why does this chapter focus on "international transport" rather than "transport" including domestic. [United States of America]	Noted. Text changes made
6392	6	36	6	36	Suggest deleting here "onshore", as offshore wind energy is also underoing rapid transformation [Cedric Philibert, France]	Accept. Change implemented.
7698	6	36	6	37	Delete “onshore”, as progress with offshore wind has been even more dramatic: see e.g. my FOD comments on 4-19:19–24 cited UNEP data that global offshore wind prices fell 28% in 2016 and REI data that offshore wind EU prices fell 43% in 2016, and noted that EU offshore wind in 2017 was bid into the grid without subsidy. [Amory Lovins, United States of America]	Accept. Change implemented.
38596	6	36	6	36	seems to be is too vague, in my view, and should be reformulated. ("there are indications of.." or something like that.) [Jan Fuglestvedt, Norway]	Accepted. See suggestion in comment 62152.
62152	6	36	6	36	the transformation is taking place, and this report and the chapter show it; the issue is the pace of the change; thus the word "seems to be" should be replaced by "is underway" [Antoine Bonduelle, France]	Accept. Text revised.
6394	6	37	6	37	Suggest deleting "onshore", offshore wind has also improved dramatically [Cedric Philibert, France]	Accept. Change implemented.
6396	6	37	6	37	Suggest replacing "intermittent" with "variable". Intermittent means "stop and go", which is not the case with solar PV nor wind power, but only with concentrating solar PV, which is a very small niche market today. [Cedric Philibert, France]	Accepted. Text changes made
6398	6	37	6	39	Electricity storage technologies in a broad sense, i.e. through energy conversions (otherwise only condensers store electricity) have existed for decades (batteries, pumped-storage hydropower plants in particular), so "getting more feasible" is not appropriate wording. [Cedric Philibert, France]	Accept. Text revised to indicate specifically that certain types of feasibility have improved.
62154	6	37	6	37	the change to sola and wind energy as well as electric vehicle has been demonstrated as feasible (see littérature quoted in the chpater). The wording should not be "feasible" but "more and more industrialized" [Antoine Bonduelle, France]	Noted. Wording revised.
7700	6	38			For “intermittent” read “variable”, because, as my FOD comment at 4-79:42–44 explained, “intermittent” is best reserved for describing unforecastable forced outages, while the “variable” output of windpower and PVs is as accurately forecastable as demand and usually more so. [Amory Lovins, United States of America]	Reject. Intermittency is a very common word for characterising weather- or solar irradiation-dependent renewable energy sources.
8068	6	38	6	38	Intermittent: The literature rather uses the term "variable renewable energies (VRE)". Intermittent is slightly obsolete. [Quentin Perrier, France]	Noted. Text is revised and the word now no longer used.
30552	6	38	6	38	« intermittent renewables » : The literature rather uses the term "variable renewable energies (VRE)". Intermittent is slightly obsolete. [France]	Noted. Text is revised and the word now no longer used.
6400	6	39	6	41	These options should be at least enumerated before being qualified or limited [Cedric Philibert, France]	Accept. Text added.
54086	6	39	6	42	The claim is made that "In industry, the options that lead to deep emissions reductions consistent with 1.5°C are limited by institutional, economic and technical constraints, and pose high financial risks for firms." The list of constraints should be amended by including the word 'political' as many of the decisions that have made, for example, the European Emission Trading Scheme ineffective, are political in nature - such as the setting of too high caps for the total amount of tradeable emissions. [Mikael Hildén, Finland]	Taken into account. The political feasibility is included in institutional (see chapter).
62156	6	39	6	39	The littérature shows clearly that mainly heavy material industries or base chemical production do have a difficulty becoming neutral at the 20(à horizon. This is not the case for most firms. Thus the wording should be. "In some heavy industries, " and not "in industry" which is misleading. [Antoine Bonduelle, France]	Accept. Changed to "energy-intensive".
6402	6	41	6	42	In energy -intensive industries most efficiency improvements have already been done, so the remainder might be risky as well; CCS in most industries remains to be proved and can be very risky. For example, in steel-making, in case of blast furnaces CCS require many different capture systems at the sintering plant, steel plant, reheating furnace, hot stove, lime kiln and coke oven. [Cedric Philibert, France]	Reject. This may be true in developed countries but not in developing countries. Theoretical minimums are nowhere close if looked at the industry sector on a global scale.
7702	6	41			Read “may pose high financial risks for some firms”, because some innovations, such as low-/zero-/negative-carbon substitutes for Portland cement, pose major opportunities for some firms and risks for other firms, and energy efficiency is an opportunity for all firms that adopt it but a competitive risk for those that don’t. It would not be correct to say that deep emissions reductions (consistent with 1.5C?) through new materials and processes pose major risks for all industrial firms; that is why the smartest ones are vigorously pursuing such options, either as hedges or as part of their core strategy. [Amory Lovins, United States of America]	Agreed. Text modified to "many incumbent firms" to accommodate this valuable point.
8070	6	41	6	42	CCS less risky than renewable and closer to implementation? Not so sure… Some renewable are already competiting at market price, not CCS. [Quentin Perrier, France]	Taken into account. RE is perhaps less risky for electricity production, but for industry to both electrify and have that electricity be provided by renewable energy (at huge scales) is not trivial at all. Text modified to clarify
14052	6	41	6	44	Linking CCS with energy efficiency as being "less economically risky" is bizarre given that efficiency is mature whereas CCS has only a very few demonstration plants (other than for enhanced oil recovery). This needs rewriting [Ralph Sims, New Zealand]	Accept. See also response to comment 58276.
17658	6	41	6	43	The assessment on CCS is inconsistent with Section 4.3.2.3. In particular, according to Section 4.3.2.3, "CCS in the power sector is hardly being realised at scale" and "several planned CCS projects in the power sector have been cancelled over the years, mainly because of economic reasons, or have experienced cost overruns". Moreover, the total amount of CO2 stored annually in all CCS projects was just 30 MtCO2 (Section 4.3.2.3) while the global CO2 emissions from fossil fuel combustion, cement prodution and other industrial processes were about 35.8 GtCO2 for 2016 (UN Emission Gap Report 2017, Executive Summary, Section 3: https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf). Emission reduction contributed by CCS does not amount to a "significant" level. [Sai Ming Lee, China]	Taken into account. See response to comment 8070. Note that 4.3.2.3 is about CCS in power, but this statement is about CCS in industry.
18546	6	41		42	the comment that CCS is less risky seems to be in contradiction with statements made in section 4.3.2.3 p18, l1to 3. [Andrea TILCHE, Belgium]	Accept. 4.3.2.3 is about CCS in power. This sentence is about CCS in industry and compares it to more radical changes such as electrification. Text modified to clarify this.
30556	6	41	6	42	« Efficiency and CCS technologies are less economically risky, » Less than what? Renewables? Not so sure for CCS [France]	Taken into account. See response to comment 8070
30558	6	41	6	41	Is it possible to add « Energy [efficiency] » ? [France]	Accept. Text modified.
31506	6	41	6	41	efficiency should be changed to "efficiency improvement". [Japan]	Reject. Not necessary as the text reads "Energy efficiency technologies …".
36062	6	41	6	43	The report states that efficiency and CCS technologies are less economically risky. Citations need to be added to substantiate this statement. [India]	Accept. This comment is on the industry sector. Further relevant citations have been included in Section 4.3.4. A separate paragraph has been included in the ES on industry.
37206	6	41	6	43	The statement CCS "…in the long run are not sufficient to stay below 1.5 degrees C." is misleading. IEA modelling demonstrates that higher levels of ambition such as IEA's Beyond 2 degrees scenario requires CCS to deliver a much larger proportion of abatement. That is, CCS becomes more important at higher levels of emissions abatement as ambition increases beyond 2 degrees. It may be true that all options discussed in the paragraph taken together are insufficient to stay below 2 degrees, however as currently written, the text implies that it is just energy efficiency and CCS that is not sufficient, and as noted, modelling of the beyond 2 degrees scenario by the IEA demonstrates that CCS becomes more important at higher levels of abatement. [John Scowcroft, Belgium]	Accept. Text revised to reflect both the crucial role of these technologies and their limitations.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
51946	6	41	6	45	I find it almost impossible to believe that CCS is not being considered economically risky. While test sites exist, quite a few, scaling up the sequestration efforts to gigatonnes is going to have some very large surprises. This feels very much like wishful thinking. The 'high agreement' should include something on the evidence as well in this case. Also, I am skeptical that the 'high agreement' at the end of this paragraph refers to everything within the paragraph. (Although I'm perfectly willing to believe that it pertains to the final sentence). [Jason Donev, Canada]	Accept, see response to comment 58276.
58276	6	41	6	43	Seems odd to group efficiency and CCS. Sentence seems to apply to efficiency - suggest treating CCS separately (further from commercialisation, but with high potential) [Andrew Prag, France]	Accept, options separated.
60722	6	41	6	43	The sentence suggests that energy efficiency and CCS are not sufficient to stay below 1.5°C. Revised to clarify that they are critical to the mix of mitigation measures to be successful. [United States of America]	Taken into account in the significant revisions of this paragraph (see other comments)
63224	6	41	6	42	....CCS technologies are less economically risky... Than what?? CCS cost $100/tonne CO2 with significant environmental risks? [Greg Rau, United States of America]	Taken into account. See response to comment 8070
39210	6	42	6	42	This statement - 'CCS technologies are less economically risky, closer to implementation for major industrial sectors, and enables significant emission reduction' - is misguiding. Please ensure the statement reflects how 'close', as the current CCS status is not as solid as this statement would reflect, and assumptions are dangerous to less expert policy makers. [Lindsey Cook, Germany]	Accept, see response to comment 58276.
32864	6	47	6	49	• Executive summary, p6, lines 47-49, Figure 5.3, 5.4. and section 5.4.2 and 5.4.3. The propositions and conclusions on trade-offs need to be qualified by providing a more concrete description to which the temporal scales they refers to (e.g. by when?). In particular, different domains/sectors may be impacted differently in different time periods, some impacts may be negative in the short term and positive in the long term while some impacts may be positive and others negative at the same time as they may follow different system dynamics. For instance, as it has already been mentioned in the main text, not carrying a transition may even result in worse impacts in the long term even if some relative negative impacts occur in the short term –although perhaps this temporal dimension need a more concrete description. See comment on the use of the wording on positive /negative trade-offs given on chapter 5. [J. David Tabara, Spain]	Taken into account. Chapter text and subsections substantially revised. Section 5.4.2 deleted. The Executive summary statement mentioned referring to section 5.6.2 is also changed. Sentence deleted.
39212	6	47	7	9	It is not clear to what you are referring. BECCS? If so, please state in relation to land use and biodiversity concerns. If land use change in relation to behavior, for example, plant-based diets, please add recognition of advantages to biodiversity and sustainable agricuture in addition to mitigaiotn advantages. [Lindsey Cook, Germany]	Noted. We are looking here at land and ecosystem transitions. CDR, including BECCS, is discussed elsewhere.
49036	6	47	6	49	This sentence is somewhat unlcear in its intent and seems to imply mostly negative implications from land-use and ecosystem transitions. Many of those transitions to keep temperature change below 1.5C can in fact be quite positive for sustainable development, including agroforestry, forest restoration, and protection of indigenous forest rights. [David Waskow, United States of America]	Accept, text revised to clarify this more.
31706	6	49	6	49	It is unclear as to what "they" refer. [Michael SUTHERLAND, Trinidad and Tobago]	Accept. Text revised to clarify.
54006	6	49	6	49	After "changes in behaviour", add "and support for small scale peasant agriculture, can enhance future mitigation" (Ref: ETC Group, Who will feed us, 2017, http://www.etcgroup.org/whowillfeedus) [Elenita Daño, Philippines]	Reject. We don't have the space to add more detail in the Executive Summary, even when this would have been a valid addition.
910	6	50	6	50	that that' delete 'that' [Robert Shapiro, United States of America]	Accepted. Text changes made
7704	6	50			"that that" [Amory Lovins, United States of America]	Accepted. Text changes made
30560	6	50	6	50	Typo : delete repetition of « that » [France]	Accepted. Text changes made
32244	6	50			that' repeated [Jamaica]	Accepted. Text changes made
51272	6	50	6	50	"that that" needs to be replaced with "that". [Muhammad Latif, Pakistan]	Accepted. Text changes made
55054	6	50	6	50	Delete one of the "that" [Yamide Dagnet, United States of America]	Accepted. Text changes made
14054	6	54	7	8	Nothing on reducing agricultural emissions - essential to reach net zero emissions after mid century. This seems to be a major omission from this Chapter (and Chapter 5). [Ralph Sims, New Zealand]	Accepted. New section added 4.3.2.1
45644	6	54			I suggest including local agriculture to avoid the impact of transport and do more self-providing communities. [Adela M Sánchez-Moreiras, Spain]	Noted
45646	6	54			I suggest replacing conservation agriculture by agroecology and including also agroforestry [Adela M Sánchez-Moreiras, Spain]	Noted
55484	6	54	7	8	The only mitigation options for agricultural emissions given in this para are diet/behaviour change and reduction of food waste. This completely misses the major mitigation options from improving productivity and efficiency of food production systems; e.g. Gerber et al (2013), Tackling climate change through livestock, FAO (Rome), pp139; show that emission reductions of 30% would be possible through productivity routes. The chapter has to at least assess this literature if it wants to be credible with regard to agriculture, even if for some reason the authors then determine that this area is not as relevant or important or feasible as dietary change and food waste. [Andy Reisinger, New Zealand]	Accepted. New section added 4.3.2.1
37556	6	55	7	2	high evidence to support mixed crop/livestock production as a cost-effective strategy is cited here in the Exec Summary; however, there is no supporting evidence in the body of the text for this judgement. On p. 20, "Other analyses show that dietary shift towards low-impact foods, along with increases in agriculture efficiency, offer more environmental benefits than transforming conventional agriculture into organic agriculture or grass-fed beef (Clark and Tilman, 2017)". On p. 22 work by Archibald and Hempson, 2016; Venter et al., 2017 is cited that deals with African savannahs and the competition between fire and herbivory, mostly "natural". Finally, on p. 92, "efficient livestock management and community-based adaptation are mediumly feasible, but have limited scalability and cost effectiveness." [Michiel Schaeffer, Netherlands]	Accepted. New section added 4.3.2.1
16442	7	1	7	2	The statement about mixed crop-livestock systems is not supported by the text in the sections referred to. This must be discussed in 4.3.3 and 4.5. [Australia]	Accepted. Text modified. New section added 4.3.2.1
60724	7	6	7	7	Decreasing food waste is potentially a very cost-effective and scalable mitigation measure with adaptation benefits. It should be highlighted to a greater extent in the chapter summary, and not buried within a discussion of agricultural adaptation. [United States of America]	Noted. New section added 4.3.2.1
54008	7	8			delete "sustainable intensification". This concept stands for an intensification of the use of fertilizers and agrochemicals, which both will worsen cliamte change. Instead, it should be reformulated as: "as well as support for small scale sustainable agriculture" [Elenita Daño, Philippines]	Noted. Text modified
10048	7	10	7	21	The paragraph describes the needed systematic transitions in urban areas consistent with achieving 1.5c but stops short of describing the feasibility (in terms of technology, scalability, and required speed) of such an accelerated transition. There seems to be a "medium evidence and high agreement" on what is needed but not much of evidence or agreement on whether is feasible or how to achieve it. [Saudi Arabia]	Noted. Appropriate text changes have been made in this paragraph. More detail in section 4.3.3.
28464	7	10	7	21	There is no cross-reference given for this statements, please add. [Germany]	Accept. Our apologies for this omission.
30562	7	10	7	11	Transition is necessary in all areas, both urban and rural [France]	Accepted. Text changes made
33090	7	10	7	13	important to emphasise the partciation of communities and local people in these urban transitions. [Tara Shine, Ireland]	Accept. Language added.
45648	7	10			I suggest including urban and perí-urban agriculture that will help to do more self-sustainable cities [Adela M Sánchez-Moreiras, Spain]	Noted

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54010	7	10	7	21	High Tech agriculture, as most of the mentioned options here implies is not an option for developing countries and the vast majority of farmers in the world who are peasants and small-scale producers. Instead of high tech agriculture systems which are proprietary technologies, decentralized, biodiverse and small scale agriculture should be supported and promoted. Ref on impacts of high tech agriculture: ETC Group, "Deere is becoming Monsanto in a box", 2016, http://www.etcgroup.org/content/deere-co-becoming-monsanto-box [Elenita Daño, Philippines]	Noted. New section added 4.3.2.1
60726	7	10	7	21	This finding doesn't seem to be supported by the text in the chapter (and there aren't any references to individual subsections). [United States of America]	Noted. Text 'defining' removed. Relevant section numbers added.
53138	7	11	7	21	One must be a little cautious on electrification. It is important to note that the carbon intensity of the electricity grid determines whether electrification makes climate sense. Above a threshold of about 600 tCO2/GWh, electrification would result in increases in CO2 emissions. See: Kennedy, C., I.D. Stewart, M. I. Westphal, A. Facchini, and R. Mele. 2018. Keeping Global Climate Change within 1.5°C Through Net Negative Electric Cities. Current Opinion in Environmental Sustainability. OR Kennedy, C.A. (2015) Key Threshold for Electricity Emissions, Nature Climate Change, 5, 179-181. Moreover, the social dimensions of electrification need to be investigated. Where electricity access is low, electrification may not help the urban-underserved. People without electricity connections won't be helped by electric stoves, and electric bus fleets may not help the under-served, if their higher costs result in reduced service compared to traditional buses. [Westphal Michael, United States of America]	Partially accept. On the electrification point: in a 1.5C world, there would be no 600 tCO2/GWh power plants anymore. On the second point, good point. Text adjusted to highlight this.
30564	7	13	7	17	This sentence is hard to read. We suggest to rephrase it as "Various mitigation options are expanding rapidly across many geographies, such as..." [France]	Accepted. Text changes made
33946	7	13	7	17	Please consider include in the executive summary information about the three broad mitigation approaches similar to the text in the SPM on page 3 line 40 to 44. However we feel that in the SPM text you should consider to replace "lowering" in line 41 with "limiting" otherwise the SPM sentence can be misunderstood to mean absolute reduction in the demand for energy and agriculture products. See Ch. 2, page 47, line 3-6, which indicates that the absolute final energy demand is expected to increase in 1.5 C scenarios. [Norway]	Noted. This is more of an issue between chapter 2 and the SPM. We are framing our responses around the system transitions that are also mentioned in the SPM.
7706	7	14			comma should probably be a semicolon. [Amory Lovins, United States of America]	Editorial
7708	7	15			Why is there no mention of efficient vehicles in “demotorisation and decarbonisation of transportation systems”? [Amory Lovins, United States of America]	Accept. Electric vehicles added as an example.
60728	7	15	7	15	What is meant by 'demotorisation'? Electric vehicles have motors. [United States of America]	Taken into account. We mean walking and cycling, which are sizeable transportation options in some cities. Electric vehicles are in the "decarbonisation" category.
28466	7	18	7	18	To name "artificial intelligence" (explicitly in addition to ICT) is not adequate in the summary. This seems to overestimate the potential, and is not backed by material in the underlying chapter. Please remove. [Germany]	Accepted. Text changes made
30566	7	19	7	20	Is there a definition for green infrastructure ? Why not low carbon infrastructure ? [France]	Reject. Low-carbon would be only for mitigation infrastructure related to energy. This refers to climate resilience, to sustainability in general (e.g., reduction of water use). The term 'green infrastructure' has been added to the Glossary. See also comment 13146.
36064	7	19	7	21	The Report states that enabling green infrastructure, water and urban eco system services, adapting buildings and land use through regulation and planning are feasible. It also needs to include concrete reference to financial and technological needs [India]	Noted. Enabling conditions are discussed later in the ES.
32108	7	23	7	28	These overarching adaptation options are insufficiently explored in the chapter and present an oversimplification of options given the context specific nature of adaptation. [Jamaica]	Accepted. Table has been modified to better show overarching options by category, and the assessments indicate the context in which they were assessed.
36474	7	23	7	28	These overarching adaptation options are insufficiently explored in the chapter and present an oversimplification of options given the context specific nature of adaptation. [Snaliah Mahal, Saint Lucia]	Accepted. Table has been modified to better show overarching options by category, and the assessments indicate the context in which they were assessed.
33092	7	24	7	24	there is a literature on the role of social protection and adaptation. Social protection can also help to deliver access to sutstainable energy (mitigation). See for example https://www.mrfcj.org/wp-content/uploads/2016/09/The-Role-of-Social-Protection-in-Ending-Energy-Poverty.pdf [Tara Shine, Ireland]	Noted. Unfortunately, no literature provided and we can only include it in the ES if we have literature and an assessment in the underlying chapter.
10054	7	30	7	40	The statement mentioned multiple trade-offs that limit the speed and potential for scale up. Yet, the examples that follow describe only synergy options but not "trade-offs". To give a balanced view the statement should also provide examples of trade-offs. [Saudi Arabia]	Taken into account. We are extremely space-constrained in the ES and refer to the underlying section (4.5.4) for further information and an as comprehensive as possible overview of trade-offs and synergies.
32962	7	30			The assertion that combining adaptation and mitigation in agricultural systems can generate multiple trade-offs that will limit the speed and potential gain of scale is unacceptable. This statement has no scientific basis and should be excluded from the text. Agricultural systems that generate synergistic benefits between adaptation and mitigation have consequences that, on the contrary, enhance the scale gains, reducing trade-offs and increasing the speed of adoption. [Brazil]	Accepted. Text modified
39214	7	30	7	40	Research on benefits of agroecology should be mentioned for policy makers to note. [Lindsey Cook, Germany]	Noted
58594	7	30	7	40	Consider adding examples of trade-offs [Elmar KRIEGLER, Germany]	Accepted. See response to Comment 10054
31708	7	31	7	31	Place a colon after "include" [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
13146	7	36	7	36	Replace "green" with "sustainable". [Eleni Kaditi, Austria]	Reject. Green infrastructure is a technical term, and has been added to the Glossary. See also comment 30566
47124	7	39	7	39	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted. Text changes made
7370	7	42	7	45	I agree with the statement - in light of the full literature on the topic - but I believe the chapter needs more discussion of economic and social feasibility to support this. [Steffen Kallbekken, Norway]	Noted. This will be taken up in section 4.3.6.
405	7	42	7	46	Strongly disagree that these options have "unrivalled cobenefits". Given that some SLCPs have high GWPs, they will be pursued purely for climate reasons. Or to make money; particularly on HFCs, the UNFCCC found that there can be quite perverse incentives - UNFCCC 2009. Issues arising from the implementation of potential project activities under the clean development mechanism: the case of incineration of HFC-23 waste streams from HCFC-22 production. FCCC/TP/2005/1. Bonn, United Nations Framework Convention on Climate Change. http://unfccc.int/resource/docs/2005/tp/eng/01.pdf. A fortiori, you would have to explain why co-benefit for SLCPs are "unrivalled" compared to eneryg efficiency, which saves poor households money. Or co-benefits of reducing NOx SOx PM NMVOCs - these have large health co-benefits. What literature have you assessed on that supports "unrvivalled co-benefits" ? I doubt this is a unanimous finding, reads more like special pleading. [Harald Winkler, South Africa]	Accept. The language "unrivalled" is softened. The co-benefits refer mainly indeed to the options of reducing BC and methane. For HFCs (actually, HFC23 is long-lived so not covered here), this is not the case. Text revised to accommodate this.

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13964	7	42	7	46	Options to reduce short-lived climate pollutants (SLCPs), such as methane, black carbon and short lived HFCs, can provide rapid emission reductions and unrivalled co-benefits such as health due to prevention of air pollution, which enhances political feasibility, but economic and social feasibility are more complex. If the energy, land and urban transitions mentioned above succeed, the emission of SLCPs will be greatly reduced. I think this is a little misleading, as it only mentions the SLCPs that warm the planet, not the ones, that will also be cut at the same time, that cool the planet (organic carbon or sulfate aerosols), so that in the net the cut in the short lived gases and aerosols will end up warming the planet. They will definitely make the air quality better, and will be part of the energy transition, but mentioning only the warming SLCPs seems misleading. [Natalie MAHOWALD, United States of America]	Taken into account. It would go too far to explain this in the ES, but it is explained in the chapter (4.3.6).
18548	7	42	7	43	Does the chapter support this statement, or does it need to be qualified in terms of the magnitude of emissions reductions that can be achieved through reducing SLCPs (and aren't already included in the IAM's/NDCs)? Confer text on page 10, lines 43-46. [Andrea TILCHE, Belgium]	Accept. Statement revised to accommodate this.
24334	7	42	7	46	This statement contrasts strongly in terms of traceability with the other statement. It is also lacking evidence and confidence statements. The chapter highlights that the feasibility of SLCP options is difficult to assess due to a lack of literature and evidence. It is somehow worrying that options for which this is the case are given such strong and unqualified recommendation in the ES. (see also comment on feasibility assessment later.) [Joeri ROGELJ, Austria]	Accept. See response to comment 405 as well. Confidence statement added.
24336	7	42	7	42	My understanding is that it are the actual reductions that bring co-benefits, no matter the technological measures (or options) they are achieved with. The ES message now seems to suggest that these particular SLCP-focussed options are important, although SLCF reductions can also be achieved through other, more holistic and integrated policies that focus on all forcers. [Joeri ROGELJ, Austria]	Accept. Text revised to accommodate this.
33948	7	42	7	45	This section focuses on the primary warming agents black carbon, HFCs and methane. Some types of BC emissions (like BC from biomass burning) are also associated with OC emissions that lead to cooling (long term). This needs to be better reflected in the text. [Norway]	Taken into account. This is reflected in the chapter text, but in the Executive Summary, we are lacking space.
49038	7	42	7	46	This paragraph should be expanded to reflect the emphasis in 4.3.7 on the key role that these pollutants can play in limiting near-term termperature rise needed to keep temperatures below 1.5C. [David Waskow, United States of America]	Noted. We will add a few words but cannot expand too much.
58278	7	42	7	46	Difficult to group all SLCPs in this way. Some methane and HFC reductions have good economic and "social" feasibility. Suggest an extra sentence to make the difference between different sources [Andrew Prag, France]	Noted. This would be good but we have to stay close to our prescribed word count.
24338	7	43	7	43	Unrivalled: This wording implies a value judgement about the relative importance of societal priorities, and has no place in an objective scientific assessment. [Joeri ROGELJ, Austria]	Accepted. Text changes made
60730	7	43	7	43	Not sure that there are health co-benefits associated with HFC emission reductions. [United States of America]	Accept. Text modified to accommodate this.
60732	7	43	7	43	Please replace "unrivalled" with "significant" and insert "for" just before "health", to read as "significant co-benefits such as for health". Rationale: The concept of "unrivalled" is superlative whereas the cited section, 4.3.7, instead uses more relative terms such as "significant", "numerous", and "large" to describe the co-benefits. [United States of America]	Accepted. Text changes made
21710	7	45	7	45	mentioned above appears unclear. What is meant? [Sweden]	Accepted. Text changes made
33950	7	46	7	46	Please consider to insert a sentence that describes trade-offs between SLCF with cooling effects and global warming, such as "However, some short-lived climate forcers related to improving air quality have cooling effects, and thus, reductions come with trade-offs for reducing warming." To make it consitent with text in SPM page 24 line 14-18. [Norway]	Noted. Those cooling effects are discussed in chapters 1 and 2, and chapter 4 only assesses the feasibility of mitigation of warming SLCFs.
17660	7	48	7	48	Suggest adding ", and are far from promising" after "constraints". [Sai Ming Lee, China]	Reject. This would be judgmental language, and thus prescriptive.
19694	7	48	8	3	The removal options through natural ecosystem restoration has not been explored enough, but should be mentioned as socio-ecologically viable option for carbon removal in 1.5° pathway considerations. [Jennifer Morgan, Netherlands]	Accept. We aim to give more attention to this in the FGD (4.3.2) but in the ES we could not free up more space. More on this can be found in the cross-chapter box on land in chapter 3.
24340	7	48	7	50	This seems not to adequately reflect the Chapter 2 assessment. Chapter 2 highlights various configurations, scales and speed of implementation for CO2 removal in 1.5°C pathways. This key message makes a too sweeping and generalising point. It would be better to reflect the characteristics of the entire literature assessed in Chapter 2. [Joeri ROGELJ, Austria]	Accept. We will bring this fully in line with chapter 2. In our defence, we did not have access to chapter 2 when we had to hand in this Executive Summary.
33532	7	48	7	55	CDR has not been defined yet. Why is direct air capture not capitalised while others (Enhanced Weathering, Soil Carbon Sequestration) are? Make consistent. [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Accept.
49040	7	48	8	3	This paragraph should also address the potential represented by approaches such as agroforestry, reduction in forest degradation, and landscape restoration that are not incorporated in integrated models, per Table 2.8 in Chapter 2, and therefore are not adequately part of the 1.5C pathways assessed. [David Waskow, United States of America]	Taken into account. These options are incorporated in the paragraph on land and ecosystem transitions (4.3.2 in the FGD). Unfortunately, our space constraints in the ES mean that we cannot add more words about this.
51050	7	48	7	53	Be transparent. BECCS and afforestation are the prominent CDR options in pathways because they are the ONLY options that are used in the majority of the IAM models. Reword the beginning sentences accordingly and qualify the sentence that starts on line 50. [Doreen Stabinsky, United States of America]	Accept, although it should be noted that chapter 2 also has scenarios that use no CDR or only AR.
51190	7	48	8	3	The scale and speed of CDR implementation assumed in some, in fact: most 1.5 pathways is beyond reasonable, and the infeasibility of assuming such large amounts of CDR should be unequivocally communicated as such, as well as pathways relying on large-scale CDR be excluded from the analysis. [Linda Schneider, Germany]	Taken into account. Chapter 2 indicates the speed and scale of implementation. In Chapter 4 we discuss the literature on what affects the feasibility of those options. Observant of IPCC procedures, we refrain from passing judgment.
54440	7	48	7	55	Suggest adding something on permanence issues and MRV issues to the list of feasibility constraints for most CDR options. Also suggest explicitly calling out the land intensity of BECCS and AF/RF (quantitatively) [Christopher Weber, United States of America]	Accept. More information, differentiated per CDR option, is included on land. However, we did not have room for quantitative information (and the ranges are huge anyhow; it depends enormously on assumptions).
53872	7	48	49	3	Negative emissions technologies are still speculative, and would imply severe impacts on ecological and social systems. I suggest stronger language. See: https://www.nature.com/articles/d41586-018-02184-x?utm_source=twt_nnc&utm_medium=social&utm_campaign=naturenews&sf182855449=1 and Heck, V., Gerten, D., Lucht, W., & Popp, A. (2018). Biomass-based negative emissions difficult to reconcile with planetary boundaries. Nature Publishing Group, 1–7. http://doi.org/10.1038/s41558-017-0064-y and Anderson, K., & Peters, G. P. (2016). The trouble with negative emissions. Science, 354(6309), 182–183. http://doi.org/10.1126/science.aah4567 [Grandin Jakob, Norway]	Taken into account. These references are all used in the chapter text. In addition to these, there is a literature that emphasises the possibilities of BECCS and other CDR options. We are trying to represent the balance of evidence, including weighing the critical voices.
55670	7	48	7	55	Add, after first sentence of non-bold text (ie after "feasibility constraints (medium agreement, medium evidence): "Additional ecosystem based measures such as ecosystem restoration (medium agreement, medium evidence) and soil carbon sequestration (high agreemeent, high evidence) offer adiditonal options." [David Cooper, Canada]	Taken into account. Ecosystem restoration in is addressed earlier in the ES (based on 4.3.3). SCS comes later in the para.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
56362	7	48	8	3	This bullet hints at, but I don't think fully captures, the 3-way tension that, arguably, frames the entire 1.5C mitigation challenge: the tension between (1) near-term demand reduction, (2) investing for longer-term CO2 removal and (3) achieving sustainable development on both near and longer terms. The degree to which CDR options are limited must surely depend on the level of investment in CDR technologies over the coming decades. Current "limits" reflect limited technology options (e.g. only BECCS available in IAMs), not physical constraints. It might be helpful to consider this 3-way tension as a framing device in Chapter 4 (and possibly 1). [Myles ALLEN, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This valuable point will be taken up in the SPM discussions. As for framing chapter 4: it is a good thought to look at the technological mitigation challenge, but in chapter 4 our scope is wider: we look at other responses than mitigation options too, including policy and innovation, and at adaptation too.
60734	7	48	7	53	The chapter summary discussion of carbon dioxide removal should address the availability of pore space, discussed on page 4-18, line 45. The summary focuses on constraints but not opportunity. In general, given the importance of CDR for achieving 1.5°C (as reflected in Chapter 2), CDR should be given more prominence in the chapter summary. [United States of America]	Reject. Line 4-5 on page 18 are about pore space availability indeed, but for CCS in power, and for 2C-pathways. Not sufficient evidence of this point to reflect it in the ES, specifically for CDR. Chapter 2 has a lot of emphasis on CDR, so it's covered extensively in the report.
17662	7	50	7	50	Suggest adding "very" before "challenging". [Sai Ming Lee, China]	Reject. This would be considered prescriptive.
28468	7	50	7	50	The high amount of uncertainty and open questions as for CDR makes the implementation more than "challenging". This term rather understates the unsolved problems concerning CDR at scale. Please find more adequate wording (also compare Statements in Ch2 on this matter). [Germany]	Reject. In English, challenging is a pretty strong characterisation of the state of things for CDR. It means that a lot of barriers need to be overcome - which is a fair qualification for CDR and its scale-up.
33952	7	50	7	53	Please consider to include in this sentence issues concering land transition at necessary scale and food production systems. [Norway]	Taken into account - The structure of this statement has changed in the meantime, but we took care to mention the issues coming forth from the implied land transitions.
53264	7	50	7	52	relevant to *Plausibility of BECCS vs. afforestation* The report frequently mentions BECCS and afforestation in the same context as if they were similarly feasible. For instance, here it states, "Among the carbon dioxide removal options, bioenergy with carbon capture and storage and afforestation and reforestation – the prominent CDR options in 1.5°C pathways - are technically feasible but face environmental, economic, institutional and social feasibility constraints (medium agreement, medium evidence)." This is misleading, because afforestation is something we know how to do, it's happening already, and it has lots of adaptation benefits alongside its mitigation benefits, whereas BECCS is practically a fantasy – yes it exists in theory and has been deployed in tiny amounts, but basically, it is just a modeling concept. Thus these options are *not* equivalent and the report should be scrubbed of any statement that makes them seem like they are. In fact, when the report cites certain studies as evidence that bioenergy and BECCS provide realistic climate mitigation options, sometimes when one looks at the actual papers, the real take-home message of these studies is these options are *not* feasible. For instance, Chapter 2 discusses "mitigation measures representation in the integrated pathway literature" in a table at page 2-41. For "bio-electricity, including biomass co-firing," under "studies presenting/assessing measures" it cites Bruckner et al 2014 and Hetland et al 2016, and under "integrated studies explicitly exploring specific measures" it cites Klein et al 2014 and Rose et al 2014. We examined these studies. By and large, they do NOT provide support for the idea that bioenergy and co-firing provide mitigation. [Mary Booth, United States of America]	Partially accept. It is not the intention to equal AR and BECCS in terms of feasibility, and the reviewer is right that the ES text tended to do this. Multiple revisions are made to avoid this, and this is something that will also be implemented in the rest of the chapter. The comment on chapter 2 will be transferred to the chapter 2 authors. However, we also flag that AR has feasibility and permanence constraints that are different from those of BECCS but could be just as important.
56052	7	50	7	52	Assignment of agreement on and evidenence for this statement about BECCS and afforestation should be split into two separate statements (one for BECCS, one for afforestation, especially since BECCS as a technology is very new and largely doesn't exist while afforestation is an old strategy. [Kelly Stone, United States of America]	Accept. Implemented.
2180	7	51			technical feasibility is misleadingly-used. It must refer to the SYSTEM - and at scale. The feasability of a single industrial energy plant does not make the system feasible for exercising a meaningful impact on climate change. real limits exist http://www.avoid.uk.net/2015/07/planetary-limits-to-beccs-negative-emissions-d2a/ [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Reject. The reference does not give rise to a change in this assessment, and the underlying chapter makes statements on technical feasibility that indicate that it's feasible. It is geophysical and economic feasibility where the problems are.
33954	7	51	7	55	Soil Carbon Sequestration bears important co-benefits (high agreement, high evidence). Why is this option not dealt with in the same manner as bioenergy with carbon capture and storage, regarding both cost-effectiveness, e.g. effects of possible delay in mitigation action (discounted climate action) and their potential? Please discuss this with the Ch. 2 authors. [Norway]	Accept. This is discussed with chapter 2 and it is not incorporated in the IAMs in a way close to BECCS and AR, which is why it is given less prominence here. The text has been revised to avoid the advocative language that this comment implicitly makes us aware of.
28470	7	52	7	52	The "technical feasibility" is not proven on a large scale. Please specify. [Germany]	Accept. Upscaling added to the feasibility constraints.
28472	7	52	7	52	There are not only environmental, economic etc. "constraints". As for these aspects there are still a lot of open questions and challenges if BECCS really ever can be applied on a large scale. Please rephrase to read "severe constraints", or rephrase entirely. [Germany]	Reject. Qualifying the constraints would be perceived as policy prescriptive and judgmental, and is not supported by the width of the literature.
7710	7	54	7	55	Italicize contents of both sets of parentheses [Amory Lovins, United States of America]	Editorial
60736	7	54	7	55	If soil carbon sequestration has co-benefits (and no listed tradeoffs/issues), why doesn't it feature more prominantly? [United States of America]	Accept. See response to comment number 33954.
10562	7	55	7	55	… important co-benefits'. Need to specify what they are. [Hong Yang, Switzerland]	Accept. See response to comment number 33954. Text revised.
57324	7	55	7	55	Confidence/uncertainty language in italics [Hans Poertner, Germany]	Editorial
33094	8	1	8	3	need to also look at the impacts of mitigation on human rights, ethics and justice. This paper address the human rights implications of 1.5 pathways: Robinson, M. & Shine, T. (submitted) Achieving a climate justice pathway to 1.5oC. Nature Climate Change. [Tara Shine, Ireland]	Taken into account. This is part of chapter 5.
51454	8	1	8	2	there is a "de facto moratorium" on commercial ocean fertlization within the Convention on Biological Diversity - see comment above. [Astrid Schulz, Germany]	Noted. Comment has become obsolete as sentence removed.
62916	8	1	8	1	delete severe. Now too strong for proposed text modification that recognises more recent papers [ian Jones, Australia]	Noted. Comment has become obsolete as sentence removed.
4276	8	2	8	3	I find this sentence has no logic. In line witht the previous statements, there is no need to "significately upgrade other options" unless they proof to have effective mitigation potential. I suggest this alternative sentence here: "Other options that are in early stages of developement may need rigurous life cycle studies to assess their effective mitigation potential {4.3.8} before they are considered for scale up" [Abanades Carlos, Spain]	Accept, but a slightly different sentence, avoiding some of the prescriptiveness, is included now.
44072	8	2	8	2	needs spaceat at beginning of sentence "Other optiond " [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Sentence removed so comment has become obsolete.
47126	8	2	8	2	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted. Text changes made. See response to comment 4276
1030	8	5	8	8	The uncertainties and the constraint exist in the present, but might or might not persist. Thus, "the existing uncertainties… presently constrain…" [Jesse Reynolds, Netherlands]	Reject. There is no reason to believe that such constraints will not persist in the future.
1032	8	5	8	11	I believe that the fact that modeling evidence consistently indicates that RMMs could reduce climate change anomalies (both temperature and precipitation) at the regional scale should be stated in the executive summary, with the appropriate qualifications regarding uncertainty, etc. [Jesse Reynolds, Netherlands]	Accept. Text adapted to reflect this point.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
5002	8	5	8	11	In that the likelihood of the world's nations doing enough to actually limit the warming to 1.5 C (a rather large overshoot is looking to be inevitable given international actions to date), that man impacts will be dependent on peak warming and will not be able to be reversed by coming back from an overshoot in the warming, and that even the impacts of limiting the warming to 1.5 C (as very optimistically explained is possible in this chapter and assessment) will be leading to very disruptive consequences, it would seem that the only possible approach for limiting warming to below 1.5 C (or higher levels) is so cursorily covered in this summary and in the chapter. The SRM framing here is presented as if SRM is being evaluated on its own rather than as a potential peak-shaving option to do what the other approaches simply cannot do, which is to limit global warming to no warmer than its present value. Yes, there are uncertainties and technological issues to work on, but in that the leading techniques (namely stratospheric aerosol injection and cloud brightening) both are phenomena occurring now as a result of volcanic eruptions and air pollution, resepctively, and that we have a fair handle on the mechanisms and effects from those analogous situations, it seems to me that the uncertainties in modeling are actually less than for our projections of what a 1.5 to 2 C world will be like (after all, we are modeling climatic conditions we are familiar with instead of conditions for which the only precedents are more than many millions of years ago) and the technological and implementation details can be worked out in an iterative way, learning as the effort seeks to keep the global average temperature near to where it is or pushed down slightly to a value typical of the second half of the 20th century (Nature does more than this with large volcanic eruptions and initial efforts to do this would be considerably less). And with regard to ethical concerns, it seems to me the question much more applies to the situation of not helping to reduce impacts for the global population when a potential technology is available than to undertaking the effort itself, especially in that any climate intervention effort could be quickly ended or adjusted because it is not tied to supplying 80% of the energy for the planet, as is the problem with an immediate cessation of use of fossil fuels. It seems to me that at the very least there needs to be a strong research program aimed at early implmentation of approaches that could offset the global warming sufficiently to keep the global average temperature increase to no more than 1 C and, in addition or separately, to limit the warming of other effects of climate change in regions where the effects are particularly severe, such as the Arctic, the Great Barrier Reef, and areas where tropical cyclones are intensifying to unprecedented levels. Everything that we do related to dealing with global climate change has uncertaintes, poses implementation challenges, and involves ethical and governance issues--singling out SRM (or RMM as defined in the text) when this is the only possible approach for really offsetting/avoiding the unprecedented warming that is virtually inevitable over the next few decades does not seem to me at ll justified based on the reasoning that has been provided. Virtually all of the modeling studies bring the climate conditions back toward the unperturbed state, or at least within the natural variability around the baseline state---not actively pursuing research aimed at early, very modest deployment just seems to me closing off an option that would seem likely to be beneficial to the billions that will be facing serious impacts from the climate change path that we are on, even if it can be limited to 1.5 C (which, given interntaional practicalities and actions to date, unfortunately seems very unlikely to be achievable). [Michael MacCracken, United States of America]	Noted. There are many points in this extensive comment that we have covered, in the chapter, or in the x-chapter box on SRM. This includes considering SRM as a potential remedial measure in peak-shaving contexts and alongside mitigation, as well as the moral hazard of research.
5004	8	5	8	11	Given the quite negative review of such climate intervention approaches, that such approaches are not included in the analyses done for and presented in this report needs to be clearly stated--basically indicating that, although there are conceptual approaches for offsetting warming that are analogous to conditions existing in the observed world, understanding about their possible application is deemed not sufficiently robust for consideration as an option for dealing with the issue. If this is not done, then a number of the findings in this report will be subject to questions and challenge as not considering all possible options. [Michael MacCracken, United States of America]	Noted. We will look into the consistency of the treatment of SRM with mitigation measures. We would like to point out though that SRM's effectiveness depends on model calculations while the other options at least have a demonstration plant in place that demonstrably reduces GHG emissions.
9488	8	5	8	11	add word "currently" (that is, currently constrains responsible implementation to make it clear that this refers to the situation today, not all possible future situations) [Douglas MacMartin, United States of America]	Reject. See response to comment 1030.
19136	8	5	8	11	I have a twofold problem with this bullet. First it is not a fair summary of the chapter content on RRM (eg on the efficiency of SAI to limit global warming). Second very similar statements on technological maturity, ability to scale, public resistance, side effects of negative CO2 emissions through BECCS could be made (but are not made) in the context of strong and rapid mitigation. [Olivier Boucher, France]	Accept. See response to comment 1032.
7264	8	5	8	11	It's true that there are uncertainties, but I think this is a decidedly unbalanced statement. You've just spent several points discussing transitions that are ridiculously hard, if not impossible, and then you're saying that RMMs are too uncertain to implement. They _might_ be infeasible. They might also be the only option that can be rapidly employed to alleviate hardships and loss of life, so that "public resistance" you quote could be the exact opposite – massive public support and resistance to anyone who says that it's off the table. The point being, we don't know, so a science document presenting such a one-sided argument reads as an attempt to prescribe policy. [Ben Kravitz, United States of America]	Taken into account. See also responses to comments 5004 and 1032.
33534	8	5	8	8	defining RMM in the middle of this statement really detracts from the message. Suggest redrafting [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Redrafting done.
37276	8	5	8	11	This executive summary does not include an explanation of RMMs' potential efficacy about which there is plenty of robust modeling results. This exec summary should at minimum mention: 1) RMMs offer a unique means of reducing global temperature; 2) RMMs do not perfectly offset the effects of climate change though robust model evidence suggests that they could reduce the overall magnitude of climate change. These points have been made consistently in IPCC AR5, the NAS report and elsewhere and are of obvious relevance. [exec summary of Chapter 7 of WG1 IPCC AR5, Keith and Irvine (2016) in Earth's Future, Irvine et al. (2016) in Wiley Interdisciplinary reviews] [Joshua Horton, United States of America]	Accept. See response to comment 1032.
37458	8	5	8	8	The uncertainties and the constraint exist in the present, but might or might not persist. Thus, "the existing uncertainties… presently constrain…" [Matthias Honegger, Germany]	Reject. There is no reason to believe that such constraints will not persist in the future.
38598	8	5	8	11	It is not clear to me what these statements builds on in the underlying chapter text. Section 4.3.9 is quite descriptive in my view with more review than assessment, and does not fully support the ES text, as far as I can see. [Jan Fuglestvedt, Norway]	Taken into account. Consistency with both 4.3.8 (in FGD) and the cross-chapter box on SRM is ensured.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
37460	8	5	8	11	I believe that the fact that modeling evidence consistently indicates that RMMs could reduce climate change anomalies (both temperature and precipitation) at the regional scale should be stated in the executive summary, with the appropriate qualifications regarding uncertainty, etc. Some relevant publications are: MacMartin, D. G., Ricke, K. L. & D. W. Keith (2018). Solar Geoengineering as part of an overall strategy for meeting the 1.5°C Paris target. Forthcoming in Phil. Trans. Royal Soc. A. doi:10.1098/rsta.2016.0454 Jones, A., Hawcroft, M., Haywood, J., Jones, A., Guo, X., & Moore, J. (2018). Regional climate impacts of stabilizing global warming at 1.5 K using solar geoengineering. Earth's Future. Irvine, P. J., Ridgwell A., & Lunt D. J. (2010). Assessing the regional disparities in geoengineering impacts. Geophysical Research Letters, 37(18). Ricke, K. L., M. G. Morgan, & M. R. Allen (2010). Regional climate response to solar-radiation management, Nat. Geosci., 3(8), 537–541. [Matthias Honegger, Germany]	Accept. See response to comment 1032.
51188	8	5	8	11	The is no apparent or stated reason for introducing new terminology here. Solar Radiation Management (SRM) is a well-established term in the literature and in international climate policy discourse, and this term is used consistently throughout the rest of the report, to avoid confusion and ambiguity, Chapter 4 should stick with the established terminology. [Linda Schneider, Germany]	Accept. We changed it back, though we are using "solar radiation modification" to be more factual about what SRM does.
54442	8	5	8	6	Strongly suggest not adding a new confusing term into the 'geoengienering' discussion. SRM is now finally widely accepted as the term of art, there is no reasing to add a new term (RMM) [Christopher Weber, United States of America]	Accept. Term will be "Solar Radiation Modification (SRM)".
60738	8	5	8	11	To what does "low agreement" refer? The whole finding, including the bolded statement? [United States of America]	Noted. It refers to the whole paragraph.
54014	8	6	8	11	Replace RMM with what it really is: SRM. The change of name from SRM to RMM is meant to distract attention from the many potential impacts associated with Solar Radiation Management and geoengineering. It would be not responsible for IPCC to play this game of geoengineers. [Elenita Daño, Philippines]	Accept. We changed it back, though we are using "solar radiation modification" to be more factual about what SRM does.
63226	8	6	8	6	I would council against renaming SRM RMM [Greg Rau, United States of America]	Accept. We changed it back.
1034	8	7	8	7	I believe that "effectiveness" is better than "efficiency," which requires a denominator [Jesse Reynolds, Netherlands]	Accept, word changed
2182	8	7			SAI does not face scale constraints. This is spurious. SRM Governance/ethical issues are comparable to those relating to emissions - which continue regardless of such concerns. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, sentence was modified. SAI indeed does not have scale issues so much, but MCB, for instance, would have them. So the word is still there but not in the same way.
37462	8	7	8	7	I believe you mean "effectiveness" rather than "efficiency"; if denominator of efficiency of RMM was financial resources the literature would suggest RMM's to be overwhelmingly efficient (but that's not the message here)... [Matthias Honegger, Germany]	Accept, word changed
60740	8	7	8	8	The phrase "constrain their responsible implementation" is a convenient shorthand, but may contain more of a value judgment than would be desirable. [United States of America]	Accept. "responsible" removed.
37278	8	8	8	9	This statement implies that the evidence suggests that the adverse effects of RMMs outweigh the potential benefits. We did not see evidence to suggest this was the case. [Joshua Horton, United States of America]	Noted. The statement merely indicates that SRM may have adverse side-effects, which is widely supported in the literature.
54016	8	8			Eliminate "responsible". There is no evidence nor indication that "responsible implementation of geoengineering" is at all possible. [Elenita Daño, Philippines]	Accept. "responsible" removed.
56978	8	8	8	11	See comment on SPM p18 line 20 -- which I believe derives from this sentence: The use of "uncertain" is unnecessary, and gives the impression of "unlikely", when the likelihoods have not in fact been judged. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We mean uncertain, not unlikely. Sentenced unchanged.
63228	8	8	8	11	Rewrite: "Even in the case where methods of RMM deployment can reduce or eliminate potential adverse side effects, governance issues, ethical implications, public resistance and impacts on sustainable development could render RMMs undesirable. Still the climate benefits of RRM must be weighed against any adverse impacts to the environment and society." [Greg Rau, United States of America]	Reject. We appreciate the constructive suggestion, but find the added sentence, using "must", quite prescriptive. We do replace "infeasible" with the weaker "undesirable".
37280	8	9	8	11	The framing "these problems could render it infeasible" seems too strongly negative and too confident. A more neutral framing would be "solar geoengineering deployment could face substantial X, Y and Z issues. Understanding of the science, technology, governance, etc. of solar geo is at too early a stage to evaluate its feasibility with any confidence." [Joshua Horton, United States of America]	Taken into account. With help of this suggestion, we worked on the text to introduce the "too early to tell" phrasing.
1036	8	10	8	10	There is no evidence to suggest that RMM would be economically infeasible. See section 4.3.9.2 [Jesse Reynolds, Netherlands]	Reject. Economic feasibility is more than costs. According to table 4.2, it also includes distributional impacts. This is where, potentially, problems for SRM may emerge.
37464	8	10	8	10	There is no evidence to suggest that RMM would be economically infeasible. See section 4.3.9.2 [Matthias Honegger, Germany]	Reject. Economic feasibility is more than costs. According to table 4.2, it also includes distributional impacts. This is where, potentially, problems for SRM may emerge.
54018	8	10			Eliminate the word "could", as all those factors render the development of SRM infeasible. [Elenita Daño, Philippines]	Reject. It is really not clear from the literature what would determine the eventual feasibility, except that such barriers would impact it. It would be judgmental and prescriptive to remove "could".
62158	8	10	8	10	replace "could" by "is likely" ? [Antoine Bonduelle, France]	Reject. A likelihood statement has a very specific meaning in IPCC.
44696	8	13	8	21	This is an extremely important summary of critical gaps, which could be very useful to have in the SPM. [Penny Urquhart, South Africa]	Noted
55052	8	13	8	21	This para on knowledge gap is important, but like the rest of the chapter, fails to also address the critical need to address capacity building/mobilization/development and access to knowledge and support. These enabling considerations are critical to take into account for effective implementation [Yamide Dagnet, United States of America]	Accept. Add "capacity development" to the list in line 15.
28474	8	15	8	16	As mitigation will be the main challenge with regard to 1.5°C it should be named first here ("…in reducing emissions and improving resilience"). [Germany]	Accept. Replace wording by "in reducing emissions and improving resilience"
7712	8	16			I see no need for "technical breakthroughs in fuels for industry and international transport." Though further innovation is always welcome, simply combining proven, available, and nearly or already cost-effective electrification, solar process heat, and hydrogen (including, as mentioned in Table 4.4 on p 4-30, for process heat and direction reduction, as well as liquid hydrogen for cryoplanes—see my FOD comments at 4-20:37 and :39) should suffice for these two sectors. Of course, a new fleet of transcontinental airplanes would be needed, but it will be anyway on this timescale; what's missing is the authors' understanding of the state of the art and the adoption of business and policy strategies to implement established LH2 technologies. [Amory Lovins, United States of America]	Noted. We would qualify airplanes on hydrogen as a technological breakthrough, not necessarily because of the hydrogen generation, but because of the novelty of the airplane.
19698	8	17	8	18	It should rather be "realistic and under the SDGs socially and environmentally justifiable assessment of available land-use". [Jennifer Morgan, Netherlands]	Accepted. Text changes made

Comment No	From Page	From Line	To Page	To Line	Comment	Response
32248	8	18	8	21	revise sentence [Jamaica]	Noted. No suggestions made. Hence no action taken on this comment
51052	8	18	8	21	important statement. [Doreen Stabinsky, United States of America]	Noted
60742	8	18	8	22	CBDR is not framed as a justice or ethical principle, and the report should not make a leap to suggest that it is. Different parties have different views about what it means and what underpins it. [United States of America]	Noted. Appropriate changes have been made in the text. Term also expanded to CBDR-RC.
60744	8	19	8	20	global governance could be interpreted to imply that national sovereignty must be relinquished. Later in the chapter it is made clear that this is not the case, but the summary should clearly state such to avoid misinterpretation. [United States of America]	Accept. Text changed to "governance".
63230	8	19	8	20	A challenge remains how the convergence of climate and sustainable development policies can be organised within a global governance frame... A more fundamental question is why is it necessary to merge climate and SDGs, as long as each can be pursued without impacting each other? [Greg Rau, United States of America]	Noted. The mandate of this chapter is to examine the strengthening of Climate responses in the context of Sustainable Development. Underlying literature and Chapters 1 and 5 indicate that there are interaction between the two
7714	8	20			"justice and ethical" or "justice and ethics" [Amory Lovins, United States of America]	Editorial
32246	8	20			what does CBDR stand for? [Jamaica]	Taken into account: Common but Differentiated Responsibilities. 'Common but Differentiated Responsibilities and Respective Capabilities' has been added to the Glossary.
33096	8	20	8	21	the global governace frame based on justic e and ethics needs to be supported by the international human rights framework : see for example Mary Robinson Foundation – Climate Justice (2015a) Right for Action: Putting People at the Centre of Action on Climate Change. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-Rights-for-Action-edition-2.pdf Mary Robinson Foundation – Climate Justice (2015b). Zero Carbon Zero Poverty the Climate Justice Way: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Available online at https://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Rejected. Limited peer reviewed literature available on this, and therefore no basis in the underlying chapter.
33536	8	20			typo "ethic" --> "ethical". Also "CBDR" should be "CBDR-RC" and moved. So suggest sentence is "…justice and ethical principles (CBDR-RC), reciprocity…". Also CBDR has not yet been defined in this chapter. [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Common but Differentiated Responsibilities and Respective Capabilities has been added to the Glossary.
58316	8	20	8	20	Here I think we can use "ethical" rather than "ethic" [Peter Marcotullio, United States of America]	Accepted. Text changes made
53908	9				I like the way this chapter starts, it has less waffle than other chapters [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - Thanks
7218	9	1	10	26	This is a great opening section for Ch4 - well done!! [Petra Tschakert, Australia]	Accepted - Thanks
39218	9	2	9	8	Could 1.5C warming save human lives compared to 2C? If so, please say so when noting 'challenges'. It is our responsibility to act if our inaction would leave to loss of life. [Lindsey Cook, Germany]	Rejected - Not because your point is uninteresting but because this is an introductory section and because of space constraints is not the place to go beyond the current statement in this sentence. The response to your question will be in the entire chapter or even in the entire report, including Chapter 2.
5006	9	5	9	5	I don't think it is adequate to just say that the impacts at 1.5 C "are still significant" given what is expected. First, the equilibrium sea level sensitivity derived from paleoclimate data would suggest that a 1.5 C long-term warming would be associated with of order a 30 m rise in sea level--this would require the relocation of virtually evey coastal city and community in the world, and mny very large urban areas would be included--that is hardly s situation for which levees would be adequate adaptation--full retreat would be requried and many nations would be wiped from the Earth. Then there is the expansion of the subtropics, the intensification of tropical cyclones and other storms, and lots more. While the impacts of being on a 1.5 C path during the 21st century might be within the bounds of what can be adapted to (and low confidence on this), it is not at all clear that thiswould be the case for long thereafter. So, somehow, this is a place to make clear that the longer term warming really needs to be less than 1 C or 0.5 C, at most. [Michael MacCracken, United States of America]	Rejected - Not because your point is uninteresting but because this is an introductory section and because of space constraints is not the place to go beyond the current statement in this sentence. The response to your question will be in the entire chapter
31508	9	5	9	5	Specific sectors whose climate impacts are "still significant" even under 1.5°C world need to be mentioned because this is an important scientific knowledge. [Japan]	Rejected - Not because your point is not interesting but because this is an introductory section and because of space constraints is not the place to go beyond the current statement in this sentence. The response to your question will be in the entire chapter
5008	9	6	9	9	There has been virtually no mention in the report that the baseline climate sensivity for most of the discussion seems to be for a value near 2.5 C per doubling of CO2, which we can hope for, but is a value that does not really recognize the likelihood that the climate senstivity could be higher. Indeed, in due-diligence analyses that businesses and banks are supposed to do that consider risks, the appropriate approach is to use plausible worst case values and not the mean or most likely value. It seems to me that the text here needs to have some discussion here of what the implications would be were values of climate sensitivity ranging from perhaps 2 to 4 C were to be used (or even a broader span). Indeed, I would suggest that a proper "risk assessment" would be consideirng the implications of the uncertainty about the climate sensitivity and it needs to be pointed out here that this is not fully done in this report and that, instead, the report does porovide some probability estimates of a target being met by a set of actions that is intended to, at least in part, account for this. [Michael MacCracken, United States of America]	Rejected - Not because your point is not interesting but because this is an introductory section and because of space constraints is not the place to tackle the question of the baseline climate sensitivity here.
47128	9	7	9	7	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorial
33098	9	8	9	9	the justice and equity aspects of stengthening climate polciies mentioned in this sentence need to be further elaborate on in this chapter (relfecting the literature etc. used in chapters 1 and 5) [Tara Shine, Ireland]	Taken into account - In the final version of other sections and in chapter 5.
60746	9	8	9	9	This statement begs the question of whether you have neglected some climate policies that might not be synergistic with goals of sustainable development, equity, and justice. Is it more accurate to says something like "This chapter is about how to strengthen climate policies consistent with a 1.5°C world. It is frequently found that such policies can be implemented in a synergetic manner with the goals ..." [United States of America]	Taken into account - By explaining later that climate policies can generate other economic and social impacts that can block the transition from the outset
5010	9	11	9	21	This paragraph gives no indication of how rapidly all of this must occur to really limit peak warming to no more than 1.5 C. In that achieving this will require getting global CO2 emissions to zero by roughly mid-century (assuming a linear path, so starting essentialy now). I think it essential for this paragraph to indicate the urgency that is needed. [Not to mention that a higher climate sensitivity would force that all of this be accomplished even more rapidly.] I do note that the time scale comes up in the next paragraph--I think, however, that the issue really needs to be very explicitly raised in this paragraph as it is this paragraph that might be extracted as a summary. [Michael MacCracken, United States of America]	Rejected - Not because your point is uninteresting but because this is an introductory section and because of space constraints is not the place to go beyond the current statement in this sentence. The response to your question is in chapter 2
40424	9	11	9	21	As it is recognized in the literature and acknowledged in several sections of this report, the integration and protection of indigenous and local knowledge is crucial for coping with climate change in a just and sustainable manner, it should be mentioned in the paragraph among the critical issue. (see Smith (2012) Indigenous climate knowledges, WIREs Clim Change, 3:467–476. doi: 10.1002/wcc.185 and references therein.) [Pedro Alfredo Borges Landaez, Venezuela]	Rejected - Not because your point is uninteresting but because this is an introductory section and because of space constraints is not the place to go beyond the current statement in this sentence. We tried nevertheless to refer to the endogenous and local knowledge in many places in the chapter.
60748	9	11	9	21	When referring to AR5 conclusions, it would be helpful to indicate the specific working group contribution and section. [United States of America]	Rejected - Because the measures evoked here are very generic and are treated in many places of AR5.
7716	9	13	9	14	Close up "short –" in line 13 and delete comma in line 14 [Amory Lovins, United States of America]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
47130	9	13	9	13	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested alternative '...Party submits information…' [Sarah Connors, France]	Editorial
60750	9	13	9	21	The statement should be clarified: The social costs and benefits ... depend critically on whether these actions occur or the degree to which they occur. Note that there are distinct embedded issues of technical feasibility and the relative social benefits and costs. These should be distinguished here. [United States of America]	Taken into account - we have clarified of the distinction of technical feasibility and determinants of social benefits and costs, including by an emphasis on the short term impact of the transition
7718	9	14			Read “mobilizing energy-efficiency and low-emission technologies”. As I’ll comment more generally elsewhere, this draft scarcely improves on the previous draft in dramatically underanalyzing and understating the scope for profitable energy efficiency—the most important mitigation opportunity, as described in AR5 WG3 Chs 8–10. Surely this report should show greater not lesser understanding of and emphasis on efficiency than IPPC AR5 did four years ago. [Amory Lovins, United States of America]	Rejected - Not because your point is uninteresting but because this is an introductory section and because of space constraints is not the place to go beyond the current statement in this sentence. The response to your question will be in the entire chapter or even in the entire report, including Chapter 2.
34730	9	14	9	15	Suggest adding: "innovation" knowledge and R&D DD to include all the tec cycle. Also, on the same line, land"-use" … and "sustainable" transition. Land transition doesn´t read well, and a sustainability qualifier seems necessary, since a transition by itself is happening in the trend, but towards non sustainable patterns. [Mexico]	Noted. In our rewrite of section 4.1, this sentence and the listing was dropped.
60752	9	14	9	15	This sentence could potentially be a mischaracterization of AR5 conclusions, as it would be too difficult quantitatively to relate "knowledge and R&D" developments to a reduction in GHG emissions via low-carbon technology deployment. The assumption or conclusion here that R&D improvements are necessary to reach 1.5°C is not an area of consensus given that low-carbon technologies exist, are being deployed, and can be accelerated with supportive policies and enabling environments. [United States of America]	Rejected - in almost all IPCC scenarios the only deployment of existing technologies, although highly recommended over the short and medium-term, is not enough to meet 2° target. New technological options are needed and this is obviously the key for 1,5° target;
57326	9	15	9	15	Spell out “R&D” [Hans Poertner, Germany]	Editorial
7720	9	17			clarify punctuation, perhaps by deleting comma after “local” [Amory Lovins, United States of America]	Editorial
60754	9	17	9	17	creating global governance should be clarified since it could be interpreted as an implied loss of national sovereignty. Just clarifying what is meant by global governance can alleviate the concern. [United States of America]	Taken into account - In the final version, the term governance is used twice in a context with no ambiguity about the fact that governance doesn't mean loss of national sovereignty
57328	9	21	9	21	Unclear definition of country-classification. And do you only relate to “economies” here? Suggest to avoid this unclear distinction between developed, emerging and developing countries/economies. [Hans Poertner, Germany]	Accepted - This distinction is no longer used in this section
10052	9	23	9	34	In addition to (1) through (5), the transition to 1.5c would also require management of the adverse socioeconomic and distributional implications during the transition. [Saudi Arabia]	Taken into account - Through the more in depth treatment of this socioeconomic and distributional implications of mitigation action
33100	9	23	9	25	this statemnet is supported by the findings of this research. Mary Robinson Foundation – Climate Justice (2015b). Zero Carbon Zero Poverty the Climate Justice Way: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Available online at https://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Rejected - not because the remark is irrelevant but this is an introductory section in which, given space constraints, this is not the place to quote literature
34732	9	23	9	23	The major differnece between the 1.5 and 2 world is not the non-temporal flexibility aspect, but the actual risk of disruptive changes above 1.5, which could hamper important ecosysts and social vulnerabilities in many regions of the world. I suggest to rewrite this. I suspect the idea is to emphasize that with a 1.5 target, policy requires speed action both in implementation and in the innovation of "removal technologies", but a caveat on selling the 1.5 as a no-flexibility scenario as if there were no other issues that are calling for more speed action precisely given uncertainties on tipping points [Mexico]	Rejected - there might be a misunderstanding here. The acceleration concerns all mitigation actions and not removal technologies which are not even evoked in this section
50074	9	23	9	34	What is missing in this paragraph is mentioning the importance of stronger incentives and more stringent mandatory requirements to realise the drastic transition in time. [Bert Metz, Netherlands]	Taken into account - The new version refers to a more comprehensive set of incentives
51948	9	23	9	25	The opening sentence seems quite unlikely and I think the likelihood of finding environmentally sound carbon dioxide removal technologies that are cheap and rapidly deployable is practically non-existant, and that should be stated more clearly. CCS technology cannot is appealing for a number of reasons, but we must be clear that the scope of CCS that is being discussed here is beyond just wishful thinking, it's well into the realm of science fiction. [Jason Donev, Canada]	Taken into account - however one can always imagine that huge CDR penetration will give some flexibility to the page at which policy variables will be acted. The final version doesn't say that CDR will allow for postponing immediate action
58598	9	23	9	25	It is not true that massive CDR penetration allows to delay mitigation in 1.5°C pathways, if overshoot is to be avoided. It is also not true that 2°C would not require immediate action. Both are implied by the current sentence, which I therefore think is a bit misleading on these two levels. [Elmar KRIEGLER, Germany]	Taken into account - however one can always imagine that huge CDR penetration will give some flexibility to the page at which policy variables will be acted. The final version doesn't say that CDR will allow for postponing immediate action
19700	9	24	9	25	A stronger and more critical definition of "environmentally sound CDR" would be helpful and would support the urgency due to the underlying uncertancy. [Jennifer Morgan, Netherlands]	Rejected - Not because your point is uninteresting but because this is an introductory section and because of space constraints is not the place to go beyond the current statement in this sentence. The response to your question will be in a specific section of this chapter
50072	9	24	9	24	add "and geographical" after "temporal" [Bert Metz, Netherlands]	Taken into account - The sentence has been totally changed
60756	9	25	9	25	Another possibility is if RMM becomes much better understood and is found to be effective. [United States of America]	Rejected - Not because your point is uninteresting but because this is an introductory section and because of space constraints is not the place to go beyond the current statement in this sentence. The response to your question will be in a specific section of this chapter
60758	9	25	9	25	It would be helpful to add some specificity to the phrase "in time" – e.g., by what year or which decade? [United States of America]	Rejected - Because in this introductory section 'in time' has a very generic meaning
34734	9	27	9	28	I suggest to add: accelerate the realization of short-term development co-benefitsof mitigation and adaptation, "for instance policies targeting short-lived climate forcers" that while contributing to climate change mitigation provide health benefits and reduce the vulnerability of cities' environments [Mexico]	Taken into account - even though this is made in a different manner that suggested here. We indeed introduce a better focus on the short-term implications of policies
50080	9	27	9	27	insert a paragraph that explains the organisation of the chapter. [Bert Metz, Netherlands]	Accepted - this has been done
54088	9	27	9	34	The list provides necessary conditions. However, it should also note that 'diverting investments' actually requires a 'creative destruction' that removes support from incumbent actors that maintain the paths. These challenges have been addressed e.g. by Kivimaa, P., Kern, F., 2016. Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. Research Policy. 45 (1): Tammikuu-18https://doi.org/10.1016/j.respol.2015.09.008 [Mikael Hildén, Finland]	Taken into account - Although in an indirect way throw the introduction of a discussion about stranded assets
58322	9	32	9	32	deeper reductions compared to…? [Peter Marcotullio, United States of America]	Accepted - this has been clarified
40426	9	34	9	34	Market barriers are among many specific types of barriers that need to be addressed, I suggest a more general and comprehensive approach: replace “that address institutional, market and behavioural barriers to transformative changes” for “… that address institutional, economic, social, technological and behavioural barriers to transformative changes.” [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account - we have removed reference to market barriers in 4.1
912	9	36	9	36	reduce of the' delete 'of' [Robert Shapiro, United States of America]	Editorial
5012	9	36	9	36	Need to delete "of" on line 36 [Michael MacCracken, United States of America]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
8072	9	36	9	49	you mention three different levels here, but only one gap... I think that, conceptually, there are two gaps: 1/ between what is announced in article 2 of the Paris agreement and the sum of NDC 2/ between NDC and what is effectively implemented [Quentin Perrier, France]	Accepted
30568	9	36	9	39	You mention three different levels here, but only one gap. Another gap could be the sum of NDCs and the long-term objective of holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, [France]	Taken into account - although in an indirect way
32110	9	36	9	39	The gap between policy aspirations and achieving global temperature limit of 1.5C also needs to be reduced and should be acknowledged here [Jamaica]	Rejected - there might be a misunderstanding here because all the section and the entire chapter are about to how to reduce this gap.
32250	9	36			delete the word 'of' [Jamaica]	Editorial
36476	9	36	9	39	The gap between policy aspirations and achieving global temperature limit of 1.5C also needs to be reduced and should be acknowledged here [Snaliah Mahal, Saint Lucia]	Rejected - there might be a misunderstanding here because all the section and the entire chapter are about to how to reduce this gap.
50076	9	36	9	44	In my opinion it is misleading to make the "implementation gap" one of the central concepts of the chapter. As has been well established through the UN's Emissions Gap Reports, limiting warming to "well below 2 C and pursuing efforts to stay below 1.5C" does require a significant strenthening of NDCs. Just implementing the NDC's by 2030 will definitely mean we will not longer be able to meet the Paris objectives. So the emphasis should shift to "strengthening the NDCs by 2020". [Bert Metz, Netherlands]	Accepted - the term implementation gap is no longer used in this section
55846	9	36	9	36	Remove 'of' [Debora Ley, Guatemala]	Editorial
60760	9	36	9	38	The text as written does not adequately describe how "R&D" as a climate policy would lead to a reduction in the implementation gap. R&D policy and investment sets R&D programs and collaborations that may lead to further advances in technologies over time, but benefits may not be immediate. Deployment policies and enabling environments, and carbon pricing (as IAM results find in Chapter 3), may be more critical. Suggest deleting R&D reference here. [United States of America]	Taken into account - Although in an indirect way with a clear distinction about the time lag between investments (including beyond R&D) and their impact of the carbon content of development
40428	9	37	9	37	Carbon pricing is a very contentious issue that can or cannot be part of financial instruments or regulatory measurements; it shouldn't be mention as an example of "aspirations of climate policies", it would depend of countries and social groups, and on development pathways and particular circumstances. [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account - although in an indirect way because all the policy tools are controversial. For all of them there is a gap between the level it should be calibrated and the real level. In this introductory section the discussion is very generic and the problem you refer to is treated later
60762	9	37	9	40	The reference to "stated aspirations of climate policies" is unclear. What does this mean in relation to "their actual level" and to the NDCs themselves? [United States of America]	Taken into account - in a clearer sentence
5014	9	41	9	41	The word "may" needs to be replaced by a term from the IPCC likeihood/confidence lexicon. I'd suggest saying here "will" or perhaps "will very likely" [Michael MacCracken, United States of America]	Accepted
19648	9	41	9	44	Whatever its potential long-term benefits, a transition to a 1.5°C world may suffer from a lack of broad political and public support, if it exacerbates existing short-term economic and social tensions, including unemployment, poverty, inequality, financial tensions, competitiveness issues and the loss of economic value of carbon-intensive assets. This sentence has been improved significantly from the FOD which were even more explicetly arguing for minimising the "loss of economic value of carbon-intensive assets". Given the huge difficulties to reach 1.5C, the need to be also in line with the SDGs and the massive benefits the fossil-intensive industry enjoyed the last 150 years while causing the problem in the first place; we believe the potential loss of economic value of fossil-intensive assets should only be a concern from the angle of just transition. [Jennifer Morgan, Netherlands]	Taken into account - in the final version of this introductory chapter, although the response to your comment is made in other sections
33102	9	41	9	44	Because of these risks it is important to mitigate them by maksing sure that all climate action respects human rights (as per the paris agreement) [Tara Shine, Ireland]	Rejected - Given very hard space constraints, terms as equity and justice refer to human rights
32112	9	41	9	44	This sentence needs to be deleted or substantially reworded based on appropriate evidence. The benefits of achieving the 1.5dC temperature goal are not only "potential long-term benefits". There is no evidence provided to support the claim that achieving the temperature goal would "exacerbate existing short-term economic and social tensions, including unemployment, poverty, inequality, financial tensions, competitiveness issues and the loos of economic value of carbon-intensive assets". This statement is unsubstantiated and lacks consideration of the implications of not achieving the goal or of only staying below a higher temperature threshold of 2C. [Jamaica]	Rejected - the quasi totality of economic discussion about any transition towards low carbon societies, including for 2°, are focused in the potential negative impact of energy prices on industrial cost, the purchasing power of households, employment, poverty...all this is treated in the section 445
34736	9	41	9	44	Stating "whatever the long-term benefits" is a bit too broad, particularly that some long-term benefits could include protecting human communities and ecosystems that could suffer irreperable damage in a 2C world. Thus, I sugges rethinking how to present this idea. It is undertood that the message is that short-term economic consequences might stop higher ambition given future benefits, but that is not a very useful mindset. While understanding the need to address short-term policy concerns, the idea of long-term thinking is to take into account potential impacts to prevent actions that could hamper both development and life in the long-term. [Mexico]	Rejected - Not because your point is not interesting but because this is an introductory section for a chapter that is devoted to short-term action. Then , the long-term benefits threatened in other places of the report and non discussed assumption
36478	9	41	9	44	This sentence needs to be deleted or substantially reworded based on appropriate evidence. The benefits of achieving the 1.5dC temperature goal are not only "potential long-term benefits". There is no evidence provided to support the claim that achieving the temperature goal would "exacerbate existing short-term economic and social tensions, including unemployment, poverty, inequality, financial tensions, competitiveness issues and the loos of economic value of carbon-intensive assets". This statement is unsubstantiated and lacks consideration of the implications of not achieving the goal or of only staying below a higher temperature threshold of 2C. [Snaliah Mahal, Saint Lucia]	Rejected - the quasi totality of economic discussion about any transition towards low carbon societies, including for 2°, are focused in the potential negative impact of energy prices on industrial cost, the purchasing power of households, employment, poverty...all this is treated in the section 445
50078	9	43	9	44	The inclusion of "loss of economic value of carbon-intensive assets" as something to be avoided in 1.5 degree strategies is very problematic. We know from the extensive literature that current investments in and assets of fossil fuel resources will not be recoverable in 1.5 degree strategies. So it is inconsistent to mention it here. Delete the wording. [Bert Metz, Netherlands]	Taken into account - Is never said that the loss of economic values of carbon-intensive assets have to be avoided, it is said that this is a problem to be responded. The final version hopefully clarifies this potential misunderstanding
39220	9	46	9	47	Excellent, please highlight this clear point in bold. [Lindsey Cook, Germany]	Editorial
47132	9	46	9	46	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorial
60764	9	46	9	47	The first sentence in this paragraph is unclear, overly broad, and policy prescriptive. It is not clear what it means that it needs to be consistent with "universal implementation" of the SDGs, particularly given that the draft report otherwise discusses possible tradeoffs. Moreover, it is not clear how this sentence follows from the previous paragraph, which concludes with a statement that transition to a 1.5°C pathway may suffer from a lack of broad political and public support. It is not clear what is the basis for concluding that focusing on the SDGs would address this issue, and in any case the assertion is policy prescriptive. [United States of America]	Taken into account - in the new phrasing of this entire paragraph

Comment No	From Page	From Line	To Page	To Line	Comment	Response
60766	9	46	9	46	The assertion that a 1.5°C transition "needs to be immediately consistent with the universal implementation of the SDGs" is inappropriately normative in the context of an IPCC report. [United States of America]	Taken into account - in the new phrasing of this entire paragraph
63232	9	46	9	47	Rewrite "Therefore, a 1.5°C transition must not impede universal implementation of the Sustainable Development Goals." [Greg Rau, United States of America]	Taken into account - the term has been deleted in the final version
5016	9	47	9	47	What does "production possibility frontier" mean? This seems like jargon that needs to be explained more clearly. [Michael MacCracken, United States of America]	Taken into account - the term has been deleted in the final version
34738	9	47	9	54	The paragraph is still not rounded. What is the intended message of presenting popoulation and economic output growth? Why are IT, nano and bio-technologies singled out? Why does this speak to the 1.5C question? While this could be connected, as written is impossible to say what the IPCC intends with this paragraph. [Mexico]	Accepted - we revised the entire paragraph
57330	9	47	9	47	Explain term “production possibility frontier” [Hans Poertner, Germany]	Taken into account - the term has been deleted in the final version
60768	9	47	9	48	It would be helpful to explain further why a shift in the production possibility frontier is implied. Alternatively, suggest deleting this statement. [United States of America]	Taken into account - the term has been deleted in the final version
48094	9	48	9	50	Population projections are repeated on page 94, line 27 [Sarah Connors, France]	Editorial
57332	9	48	9	48	Unclear statement. In which respect did “interconnectedness” increase? Only economically, i.e. trade and production networks? [Hans Poertner, Germany]	Taken into account - the term has been deleted in the final version
5018	9	49	9	49	Need to change "growing" to "projected to grow", perhaps adding 'based on evoloving demographics' [Michael MacCracken, United States of America]	Accepted
51950	9	49	9	49	I may have miscounted, but it seems like we're at 7.6 B people now. :) [Jason Donev, Canada]	Accepted
5020	9	50	9	51	Given the 2008 recession, etc., is it really proper to say just "consistent growth"--perhaps it needs to be said to be "decade-to-decade growth" [Michael MacCracken, United States of America]	Accepted -We clarify the language about goals
51506	9	50	9	51	and rising inequality [Souparna Lahiri, India]	Accepted - hopefully the link is clearer in the final version
5022	9	51	9	51	I think this phrase needs to be justified, perhaps by saying "Given the development imperatives in many underdeveloped nations, …" [Michael MacCracken, United States of America]	Taken into account - we totally revised the wording about the tension between the development goals and climate policies
21548	10	1	10	6	Is it related to climate change? [Nathalie HILMI, France]	Rejected- because the dynamics behind the 2008 financial crisis were treated in the economic literature well before 2008
47396	10	1	10	3	This sentence discussion the impacts of the 2008 financial crisis on economists and institutions however the rference used (Stiglitz) is from 2002. This inconsistency should be removed. [Sarah Connors, France]	Rejected- This sentence is critical to understand the difficulty of triggering climate action in an adverse context
50082	10	1	10	17	remove the financial jargon [Bert Metz, Netherlands]	Rejected - there is no financial jargon here. Only the language used by many first class authors to clarify the pre-existing difficulties of the word economy independently from climate change
1866	10	4	10	5	Income equality within countries is increasing, but as Milanovic (book: global inequality) explains, the global inequality is reducing (mainly because of the rise middle classes in emerging economies like China and India) [Willem Pieter Pauw, Germany]	Rejected - this is an introductory chapter and we cannot enter in a detailed discussion of each topic here.
47398	10	4	10	4	This reference is a magazine article. No news items or blog posts can be used as references in an IPCC report. Please check with and follow the IPCC guidelines for grey literature: https://wg1.ipcc.ch/guidancepaper/AR5GuidanceNotes_Literature.pdf [Sarah Connors, France]	Taken into account - In the final version we payed attention to the type of literature that we quoted
7894	10	8	10	10	Confusing. Suggest replacing "instead of exacerbating," with"while avoiding exacaerbating" [Christopher Bataille, Canada]	Accepted
60770	10	8	10	8	What does "fault lines" mean? [United States of America]	Taken into account - In this introductory section we use expressions of famous books or articles, suggesting some problem in the way the world economics functions. Fault lines is simply used in the language of the man in the street.
60772	10	8	10	15	This paragraph contains an intriguing argument about regional mismatch between savings and investment that is not addressed further in the remainder of the chapter. It should be elucidated, or deleted if it cannot be explained more clearly. (The statement "They can also do so" is confusing; who is the antecedent "they"?) [United States of America]	Taken into account - by addressing that clearly in the reminder of the chapter
51952	10	9	10	10	The ideas of propensity to save and propensity to invest need to be clearly defined. Since the liquidity of assets has a large continuum, the specific meaning of this propensity is ambiguous and must be defined. [Jason Donev, Canada]	Taken into account - In this introductory section we use expressions of famous books or articles, suggesting some problem in the way the world economics functions. Fault lines is simply used in the language of the man in the street.
34740	10	11	10	12	The statement is unsustained. How are future savings going to stimulate growth and employment over the short-term and what is the connection of this with the 1.5C world? Why would we leave sustainable investment and infrastructure only for the medium term (this seems rather odd)? [Mexico]	Taken into account - Hopefully the new phrasing of the section will make clearer that the focus of the problem to be treated is whether climate action will deliver short term benefits in terms of development. Investment in sustainable infrastructure delivers long term benefits but what is at stake take here is their short term positive spill over impact
914	10	12	10	12	termenhance productive,' should be 'term enhance productive,' [Robert Shapiro, United States of America]	Editorial
5024	10	12	10	12	Change to "term enhance" [Michael MacCracken, United States of America]	Editorial
7896	10	12	10	12	Separate "term" and "enhance", reaplce "enahnce" with "enhancing" [Christopher Bataille, Canada]	Editorial
32252	10	12			termenhamce should be medium-term enhance [Jamaica]	Editorial
37576	10	12			space between "term" and "enhance" [Michiel Schaeffer, Netherlands]	Editorial
44074	10	12	10	12	reads "termenhance productive, climate-resilient investments" pernaps should read "term enhance productive climate-resilient investments" [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
7898	10	13	10	13	Replace "resources" with "reseource" [Christopher Bataille, Canada]	Editorial
58284	10	13	10	15	Suggest citing OECD-IEA-ITF-NEA (2015), Aligning Policies for the Low-carbon Economy [Andrew Prag, France]	Editorial
7900	10	16	10	16	Remove "and dualistic" - unclear. [Christopher Bataille, Canada]	Editorial
1868	10	19	10	20	replace 'enables access' with 'increases access'. [Willem Pieter Pauw, Germany]	Editorial
60774	10	19	10	20	What is meant by "an enabling international governance"? [United States of America]	Taken into account - in the phrasing of the final report possible misunderstandings about international governance have been hopefully clarified
1870	10	20	10	21	address trade barriers? There are many scholars who believe that a neoliberal world order with limited trade barriers is one of the reasons for sustainaed poverty in developing countries as well as for strong emission increases. 'trade barriers' could stay, but it would be important to add something like 'for goods that increase and speed up mglobal mitigation and adaptation efforts' [Willem Pieter Pauw, Germany]	Taken into account - there is no longer a reference to that in the final version
40430	10	21	10	21	Change “address trade barriers” for “address barriers for technological innovation and trade”. [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account - there is no longer a reference to that in the final version
51954	10	22	10	22	I do know what free-riding is in general, but I think that this paragraph would be included in a specific definition of how its being used in this context. Beware of jargon, this document must be readable by a wide range of disciplines. [Jason Donev, Canada]	Taken into account - there is no longer a reference to that in the final version

Comment No	From Page	From Line	To Page	To Line	Comment	Response
60776	10	22	10	22	It is not clear what is meant by "free-riding". [United States of America]	Taken into account - there is no longer a reference to that in the final version
6120	10	29			This sub-section features many findings/statements that are only supported by one reference. [Anne Olhoff, Denmark]	Accepted. We have improved this point and firmed up the robustness of section 4.2.
18550	10	29			This sub-section features many findings/statements that are only supported by one reference. [Andrea TILCHE, Belgium]	Accepted. We have improved this point and firmed up the robustness of section 4.2.
50084	10	29	12	51	This section should summarise the relevant material from chapter 2, not do its own assessment of the literature on pathways that is already done in chapter 2. So replace the current text with a good summary of chapter 2 material. [Bert Metz, Netherlands]	Accepted. Revised section synchronizes better with chapter 2 and the stock take objective of the section
60778	10	29	14	43	Section 4.2 should be examined in comparison to Chapter 2 to ensure that it is not redundant. The first paragraph may fit better in Chapter 2. [United States of America]	Accepted. Revised section synchronizes better with chapter 2 and the stock take objective of the section
5506	10	31	11	20	In looking at the trends consistent with 1.5, this section seems to focus on energy intensity rather than overall carbon or ghg intensity. As the section notes, 1.5 pathways approach net zero emissions mid-century and so the overall ghg intensity would be 0 mid-century. This is more out of line with past trends than energy intensity which is sumarized for 1.5 pathways in table 4.1. Suggest that the challenge of ghg intensity be given more attention in this section [Haroon KHESHGI, United States of America]	Noted. Section revised to better synchronized with chapter 2. In doing so a lot of the discussion of emissions profiles is removed to be discussed by chapter 2.
24344	10	33	10	37	Ensure this statement captures the full IAM literature assessed in Chapter 2, not only the SSP-based 1.9 W/m2 scenarios by Rogelj et al. Several studies are now exploring and presenting very strong reductions in energy demand (e.g. the IIASA LED scenario by Grübler et al, and others). This has to be adequately represented. [Joeri ROGELJ, Austria]	Accepted. Section revised to be more synchronized with chapter 2
5026	10	35	10	35	Is not Chapter 2 most focused on the impacts of a 1.5 versus 2 C world? I also think that saying "1.5 C pathways" is not really adequate in that many of the pathways do not keep global average warming below 1.5 C, and indeed allow an overshoot. And, of course, the real world situation is that the overshoot could be quite substantial, even a degree or two. [Throughout this paragraph I keep finding that points I want to hear about in one paragraph get put off to the next paragraph, which is going to require that a lot of paragraphs to be read. I wonder if making a more complete statement early on would help and then elaborate on the various subpoints after that in some better connected way.] [Michael MacCracken, United States of America]	Taken into account. The revised version addresses the later part of the comment. The earlier part regarding the distinction of 1.5c pathways is actually addressed in 2.2
10056	10	35	10	37	Are the faster and more radical change of innovations and financial systems and life styles are feasible and if so why not being incorporated in the IAM literature to simulate their implications. [Saudi Arabia]	Taken into account. Feasibility is key to the chapter and is discussed in details in section 4.3
31714	10	35	10	35	IAM should be defined when first used [Michael SUTHERLAND, Trinidad and Tobago]	Editorials done
55056	10	35	10	35	Change "will rely on" into "will build upon", or "will be guided/driven by" [Yamide Dagnet, United States of America]	Editorials done
58600	10	35	10	37	I would avoid the the term IAM literature. Chapter 2 assesses the quantitative global 1.5°C mitigation pathway literature. Would also avoid citing the literature (which has much more than two references) rather say "reviewed in Chapter 2." [Elmar KRIEGLER, Germany]	Taken into account. The revised section is more synchronized with chapter 2 and refrains from citing references that are already referenced there.
7722	10	36	10	37	I'm glad that advances on the IAM literature's deficient treatment of energy efficiency are mentioned, and wish its weaknesses were tersely described here. In the 1.5C? context, it's important for non-IAM-expert readers to understand the major gaps between the efficiency potential revealed by AR5 WG3 Chs 8–10 (let alone other literature more advanced than Chs 8 and 10) and IAMs' methods and assumptions, which ignore most of the efficiency potential and overemphasize the supply side (Lovins 2018: "How Big Is the Energy Efficiency Resource?", in review, Envtl. Res. Letters, and 2018a, "Fully Counting Energy Efficiency Potential in Climate Models" [retitled], Clim. Change, invited and in submission). [Amory Lovins, United States of America]	Taken into account. Point well noted. Discussion of modelling of energy efficiency in IAMs and related gaps are within the domain of chapter 2. Some discussion of energy efficiency potentials in relation to characterization of feasibility is included in section 4.3.
55550	10	36	10	36	The following reference would also apply. This reference presents the use of MARKAL/TIMES to define well below 2D portfolios at global (5 case studies), national (15 case studies on 15 different countries) and local levels (3 case studies on regions and cities). Giannakidis G., K. Karlsson, M. Labriet, B. Ó Gallachóir (eds.), 2018. Limiting Global Warming to Well Below 2°C: Energy System Modelling and Policy Development. Springer, Lecture Notes in Energy, in press (I can send the manuscript if needed). This book shows that a well below 2°C world is feasible but extremely challenging. [Maryse Labriet, Spain]	Noted. Thanks for providing this reference. Reference passed to chapter 2 authors. Our focus in the revised version of the section is limiting assessment of mitigation to the literature cited in chapter 2
1554	10	39	10	43	Chapter 2 assesses the pathways. All the pathways have overshoots at the end of the century. This points out the Herculean task of this transformation. As the draft sentences here state: "… achieved by meeting 2050 policy targets … as well as BECCS, management of land-use transitions, and emergent technologies." All of these conditions will have to happen to get to 1.5 C. My only obvious comment here is that this will require not only technology improvements, technology breakthroughs, but all done at world-scale, and all done with coordination of policy and governance from major governments around the world. All this will need to be planned in the next decade and need to be executed at multiple levels of society. This is truly Herculean. [Arthur Lee, United States of America]	Noted. Section revised to be more synchronized with chapter 2
12184	10	39	10	41	They don't all feature overshoot - important to be consistent with chapter 2. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Section greatly revised to synchronize with chapter 2 and took on board your comment
19704	10	39	10	40	The 1.5°C pathways reviewed in Chapter 2 are at or below the emissions pathways of RCP2.6 in AR5, and all feature temperature overshoot. This is not correct. Not all the pathways reviewed in Chapter 2 feature overshoot. [Jennifer Morgan, Netherlands]	Accepted. Section greatly revised to synchronize with chapter 2 and took on board your comment
24346	10	39	10	40	all feature temperature overshoot: This is incorrect. Chapter 2 now also includes a category of pathways that limit peak median warming to 1.5°C. This can be dealt with by writing that all pathways result in "some probability of overshooting the 1.5°C level". [Joeri ROGELJ, Austria]	Accepted. Section greatly revised to synchronize with chapter 2 and took on board your comment
28476	10	39	10	40	This seems inconsistent with Ch 2 where some pathways were described that do not include temperature overshoot (the "Threshold Peak Budget" scenarios). [Germany]	Accepted. Section greatly revised to synchronize with chapter 2 and took on board your comment
42808	10	39	10	46	Should add something to the last sentence something along the lines of not diminishing the benefits for reducing SLCPs or making the distinction that they are significantly reduced under 2C as the lead into the sentence about how there is less added benefit because as written the sentence makes it seem like SLCPs are not important. [Kristin Campbell, United States of America]	Editorials done. Section greatly revised and in so doing has left discussion of issues related to the role of non-CO2 gases including SLCPs to chapter 2, sections 2.3 and 2.4.
43054	10	39	10	46	This statement is misleading, and needs to be recast to note the critical role SLCP mitigation plays in 1.5 and 2C scenarios. If SLCPs are critical for 2C, then are critical for 1.5C, which of course comes before 2C in reality. [Durwood Zaelke, United States of America]	Editorials done. Section greatly revised and in so doing has left discussion of issues related to the role of non-CO2 gases including SLCPs to chapter 2, sections 2.3 and 2.4.
55058	10	39	10	46	This para seems to minimize the potential of SLCP and contradict to some extent what was said into the Executive Summary in page 7 line 42 till 46 [Yamide Dagnet, United States of America]	Accepted. Section greatly revised and in so doing has left discussion of issues related to the role of non-CO2 gases including SLCPs to chapter 2, sections 2.3 and 2.4.
60780	10	39	10	43	Chapter 2 assesses the pathways. All the pathways have overshoots at the end of the century. This points out the Herculean task of this transformation. As the draft states: "... achieved by meeting 2050 policy targets ... as well as BECCS, management of land-use transitions, and emergent technologies." All of these conditions will have to happen to get to 1.5°C. This will require not only technology improvements/breakthroughs, but all must be done at world-scale, and all done with coordination of policy and governance from major governments around the world. All this will need to be planned in the next decade and executed at multiple levels of society. Daunting. [United States of America]	Noted. Section revised to be more synchronized with chapter 2

Comment No	From Page	From Line	To Page	To Line	Comment	Response
60782	10	39	10	46	This paragraph's conclusion that global emissions will need to move from ~50 GtCO2e/yr to net zero by mid-century is very important and should be included in the chapter summary. (Note, however, that the sentence should be revised to make clear that emissions need to be reduced "in order to achieve the 1.5°C pathway.") The points in this paragraph should also be included in the SPM, including possibly the high-level statements in SPM1.2. [United States of America]	Taken into account. Section greatly revised with characterization details including required emissions reductions profiles left to be discussed by chapter 2, sections 2.3 and 2.4.
7410	10	40	10	40	Reference is needed here, but I would also present an uncertainty range here. There also large uncertainties, and it also depends on the land use emissions estimates, which differ between 0 and 5 GtCO2. See: Grassi, G., House, J., Dentener, F., Federici, S., Den Elzen, M. & Penman, J. (2017) The key role of forests in meeting climate targets requires science for credible mitigation. Nature Clim. Change, 7, 220-226. [Michel den Elzen, Netherlands]	Noted. Section revised to be more synchronized with chapter 2, and as a result detailed discussion of emissions profiles for 1.5C warming is left to chapter 2. Thanks for the reference and will be passed to authors of chapter 2
17664	10	40	10	40	all feature temperature overshoot: This is not consistent with Table 2.1 of Ch.2. [Sai Ming Lee, China]	Accepted. Section revised to better synchronized with chapter 2. and accordingly discussion of temperature overshoot is left to chapter 2.
47134	10	40	10	40	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorials completed. Sentence removed in the revised version
58602	10	40	10	40	Distinguish between target overshoot and peak and decline in temperature without target overshoot. A few pathways have been identified that do not overshoot the 1.5°C limit with median likelihood. [Elmar KRIEGLER, Germany]	Accepted. Section revised to better synchronized with chapter 2. and accordingly discussion of temperature overshoot is left to chapter 2.
19708	10	43	10	43	...as well as BECCS, management of land-use transitions and emergent technologies. Not all 1.5°C pathways assessed in Chapter 2 include BECCS. This needs to be reflected in this sentence too, for example, by replacing it with the following text: "...as well as CO2 removal measures such as reforestation, afforestation and/or bioenergy with carbon capture and storage (BECCS). [Jennifer Morgan, Netherlands]	Accepted. Section greatly revised with discussion of BECCS and land-use change patterns consistent with 1.5C is left to chapter 2.
58604	10	43	10	46	This appears to be incorrect. SLCPs play an important role to reach 1.5°C as discussed in Section 4.3.7. The fact that their incremental contribution to 1.5°C compared to 2°C is small in the pathway literature points to an important question for Chapter 4: Can deeper emissions abatement potentials, in particular for CH4 in agriculture, be conceived than assumed by the IAMs? More may be possible, and it could change 1.5°C pathways quite a bit. [Elmar KRIEGLER, Germany]	Taken into account. Text revised and corresponding discussion removed. Assessing in more depth the potentials of non-co2 in the transition between 2.0c to 1.5c is within the domain of chapter 2, yet chapter 4 touches briefly on the issue in section 4.3 on discussion of feasibility
5028	10	44	10	46	Suggesting that non-CO2 GHGs will "play a minor role in the additional transition" seems to be a bit strange given that the world is nowhere near being on a pathway to no more than 2 C warming and so can be less discussed here seems very strange. I'm sort of assuming that this report is covering what needs to be done to get from the 3+ C pathway we are on based on Paris plus INDCs to the 1.5 C pathway and not just what needs to be done to go from 2 to 1.5 C. Perhaps what needs to be done is to mention in the sentence on line 40-41 that this step will also require that non-CO2 GHGs go to near zero as well as CO2 emissions going to zero. [Michael MacCracken, United States of America]	Taken into account. Text revised to clarify the role of non-CO2 gases more broadly. The reference to 2C in relation to 1.5C is only meant to synchronize with the frame of reference in chapter 2 for the characteristics referred to in this section
24348	10	44	10	44	in Chapter 2, we use the term SLCF (Short-Lived Climate Forcers) instead of SLCPs. SLCF is a more scientific and policy neutral term. SLCPs only point towards warming species. I would recommend to harmonize the use of this term to the scientifically most robust one. [Joeri ROGELJ, Austria]	Accepted. Reference to SLCPs and role of non-Co2 removed from the revised section to be addressed exclusively by chapter 2
3248	10	48	10	48	It should be clear what type of energy this refers to (primary/secondary/final). [Vassilis Daioglou, Netherlands]	Taken into account. Section revised and now specifies clearly the type of energy meant
10058	10	48	10	52	The reported numbers reveal how large of a challenge would the transition to 1.5c be for energy access and SDGs. How then the assessment would fit with the terms of reference for this report relating to the context of sustainable development. A message explaining this challenge would need to be reflected in both executive summary of the chapter and as well in the SPM. [Saudi Arabia]	Taken into account. Implication of 1.5C for energy access and sustainable development is made more clear. For further in-depth assessment see sections 2.4.3, 2.5.3, and 5.4. The implications to energy access and other SDGs are now reflected in the SPM (sections C and D).
12186	10	48	10	49	No 1.5C scenarios feature energy demand over 450EJ - is this true? Doesn't appear to be from figure 2.11 (chapter 2, page 46) and the accompanying text (chapter 2, page 47, lines 1-10). Additionally the same part of chapter two has a different value for current energy demand. Please can someone cross check chapter 4 with chapter 2 for consistency - the latter should be forming the basis for the former and the two should be consistent. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Section revised to be more synchronized with chapter 2. Now the discussion of energy demand is directly linked to section 2.3
37578	10	48			final energy demand [Michiel Schaeffer, Netherlands]	Taken into account. Phrase corrected in the revised version
51956	10	48	10	52	This paragraph is unclear and should be re-written. [Jason Donev, Canada]	Editorials done. Paragraph as well as the whole section now revised for clarity and better consistency with chapter 2
51958	10	48	10	52	We must be very careful with the choice of words here. We are not talking about transitioning between a 2C warming world and a 1.5 warming world. We are talking about transitioning from our current path which has us on track to warm considerably more than 2C to paths that are consistent with 2C and paths that are consistent with 1.5C. That's a choice, but not a transition. [Jason Donev, Canada]	Noted. 2c is set by both chapters 1 and 2 to be part of framing the assessment of 1.5c for this special report. The 2c reference is used here to be consistent with chapter 2 since the section is a stock take of chapter 2
60784	10	48	10	50	This sentence needs more specificity. Do the authors mean final energy demand or primary energy demand on line 48? Are reductions in demand due to service reductions or efficiency gains? References to "energy demand" should clarify that they refer to "global energy demand." [United States of America]	Taken into account. The distinction is made clear in the revised section
62722	10	48	10	49	Comparing 1.5°C and 2°C median values from the scenario database can be problematic, if there is a strong sampling bias. A way to address this would be to focus strictly on 1.5°C/2°C pairs from the same model and study. This gives a more robust estimate of differences between 1.5°C/2°C. I suggest to discuss this with Chapter 2. [Elmar KRIEGLER, Germany]	Taken into account. The section revised to be more synchronized with chapter 2. Comparisons of 1.5C to 2C are now made on ranges and probability as in section 2.3
12188	10	50	10	52	It would be more consistent with the mitigation scenarios to talk in terms of the population values in the SSPs. See here for a summary https://www.sciencedirect.com/science/article/pii/S0959378014001095 [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Discussion of population and its projection is removed from the section and left to be addressed by chapter 2
31644	10	50	10	52	There is a range of UN population projections, including some well below 11 million, as mentioned earlier in the report. The sentence should rephrased if kept, but it is in any case strange to imply in this paragraph that energy demand is directly linked to population only, without mentioning GDP or other factors. [Lorcan Lyons, France]	Taken into account. Discussion of population and its projection is removed from the section and left to be addressed by chapter 2
55672	10	50	10	52	human populations are expected to grow … This is referring to UN statisically-based projections. The SSPs give a far wider range of projections taking into account things like female education (as noted elsewhere in the SR). In this case, and sicne most 1.5C secanrios are much more feasible with lower population growth scenarios (SSP1 vs SSP2 vs SSP3/4), better to avoid language like are expected to. [David Cooper, Canada]	Taken into account. Discussion of population and its projection is removed from the section and left to be addressed by chapter 2
60786	10	50	10	52	This sentence is difficult to understand. Is the 11 billion people in 2100 at all consistent with the pathways in Chapter 2? Also, are there going to be changes in the amount of people without electricity or cooking over time? [United States of America]	Accepted. Section and sentence are revised to be more synchronized with chapter 2. Discussion of population and its projection is removed from the section and left to be addressed by chapter 2
60788	10	50	10	52	It is not clear from the text if this line implies that a larger poputlation would require electricity and clean cooking facilities. Clearly specify the implication of this growing population. [United States of America]	Accepted. Section and sentence are revised to be more synchronized with chapter 2. Now discussion of population and its projection is removed from the section and left to be addressed by chapter 2

Comment No	From Page	From Line	To Page	To Line	Comment	Response
53576	10	54	11	1	In terms of policy targets and technologies, the scearios assessed feature energy demand reduction, greater penetration of low emission and carbon free technologies as well as electrification of transport and industry, and importantly reduction of landuse change. The query here is that in the face of ongoing, large scale urbanisation, landuse change cannot be avoided and is a big driver of lock-ins of future emissions, also through embodied energy of urban infrastructure. Table 4.1 does not include landuse change as a separate sector, but absorbs it within agriculture, which is problematic, from an urban perspective. While urban solutions emerge from different sectors such as industry, construction, transportation; land appropriation and modification of urban landscapes needs to be dealt with as a separate category, suggesting low-material construction and decoupling of urbanisation from material intensity. [Sumetee Pahwa Gajjar, India]	Noted. Agree that land use change is an important option but could not include in table 4.1 for lack of consistent statistics from the reviewed literature in chapter 2. Nonetheless some of the discussion related to land use change is reflected in section 4.3 on feasibility assessment.
10060	11				Table 4.1: The table clearly indicates the magnitude of the challenge to achieve the transition to 1.5c, including the reduction of global energy use required for end use sectors compared to 2c warming. Informing the decision makers of these challenges is a critical input of this report and should find its wary to the executive summary and the SPM. [Saudi Arabia]	Taken into account. Table 4.1 is revised to synchronize better with chapter 2. Messages related to emissions reductions, mitigation costs, energy access, and implications to sustainable development are left to chapters 2 and 5 while ES messages for chapter 4 are focused on enabling the transition to 1.5C.
10344	11	1	11	1	The term "reduction of land-use change" should be clarified as it is slightly ambiguous in the current context. The purpose is not to reduce land-use change itself (as afforestation is also a type of land-use change), but to mitigate emissions and increase sinks from the sector. Probably this formulation has occured during editing. [Hungary]	Not applicable. Paragraph removed and the table changed to achieve better synchronization with chapter 2.
48654	11	1	11	1	Based on table 4,1, buildings will also be highly electrified but only transport and industry are mentioned in the text. [Yamina Saheb, France]	Not applicable. Paragraph removed and the table changed to achieve better synchronization with chapter 2.
47102	11	2	11	2	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Not applicable. Paragraph removed for better synchronization with chapter 2
3250	11	5	11	10	It is unclear what "policy target" refers to in this table. Which policy? Is this based on the mitigation scenarios of Chapter 2 (median values?). This should be explained better [Vassilis Daioglou, Netherlands]	Taken into account. Old table 4.1 replaced by a new one which does not include the subject of the comment
7724	11	5	11	10	Table 1 illustrates this draft's continued serious deficiency in assessing energy efficiency potential (please see my comments on p 4-2). Buildings rightly show 39% lower final energy use by 2050 vs REF and 20% absolute, but transport is 22% higher absolute and industry 16% because neither properly considers modern efficiency opportunities, instead following IAMs' general practice of focusing far more on fuel-switching than on efficient end-use. Below the table is a welcome citation to Kuramochi et al 2017, but it's unclear that those authors' benchmarks are properly reflected in Table 4.1. The major studies this report continues to overlook (see my comments on 4-6:22–23) show considerably larger profitable potential. One example to illustrate the importance of what's omitted here is low-friction fluid-handling systems in buildings and industry, which are in no official forecast, model, or study but if fully implemented worldwide could save roughly half the world's coal-fired electricity with very high financial returns (see my FOD comments on 4-29:36–42). A study of climate mitigation options that omits today's energy efficiency revolution—including integrative design—from "Energy system transitions" (4.3.2) exhibits impressive resistance to new information and ill-serves our readers. [Amory Lovins, United States of America]	Not applicable. Old table 4.1 replaced by a new one which does not include the subject of the comment
12190	11	5	11	5	Can you clarify why we are comparing against 2010 here? Are the scenarios all run from 2010? That has not really been discussed or justified (or the implications outlined) either here or in chapter 2. [United Kingdom (of Great Britain and Northern Ireland)]	Not applicable. Old table 4.1 replaced by a new one which does not include the subject of the comment
18552	11	5	11	10	Table 4.1 is useful but needs better design and explanation. The column 'policy target' appears to contain a mixture of % changes wrt 2010 and % shares of a total (though this is not entirely clear). Also, it is not appropriate to describe the increases in energy use as "policy targets". Suggest: i) adding a column increase/decrease energy use compared to 2010 and remove the corresponding data from the 'policy target' column; ii) use + or - for any change wrt 2010, REF or 2°C. [Andrea TILCHE, Belgium]	Not applicable. Old table 4.1 replaced by a new one which does not include the subject of the comment
24350	11	5	11	10	Table 4.1: This table should be updated to better reflect the diversity in scenario outcomes from Chapter 2. [Joeri ROGELJ, Austria]	Accepted. Table 4.1 is revised and updated in coordination with chapter 2
58338	11	5			Table 4.1: suggest to add numbers for total change in electricity demand also, as a means to highlight the importance of electrification for deep decarbonisation. Lower down in the chpater, electrification is currently considered as an urban issue, with a focus on EVs. Suggest introducing it as a section of its own right, somewhere in 4.3 [Andrew Prag, France]	Taken into account. Table 4.1 now is expanded including adding more sectoral details and coverage of literature. Unfortunately the space allowed to the section is too limited to accommodate adding the new subsection suggested in the comment.
60790	11	5	11	10	Are the median values consistent in Table 4.1? That is, will you actually get to 1.5°C if you do the median reduction in each area? Or do the pathways include extremes in some dimension (i.e., the median is a mix of models/scenarios)? Also, "policy target" is probably not an appropriate column heading. [United States of America]	Not applicable. Old table 4.1 replaced by a new one which does not include the subject of the comment
60792	11	5	11	20	Table 4.1 offers a potentially useful summary of sectoral policy targets consistent with 1.5°C, but it should be more clearly cross-walked to Chapter 2 and it should be more clearly explain how the numbers were derived. It is not straightforward to understand how these points were derived from section 2.4. The results in the table should be referenced as a benchmark throughout Chapter 4. For example, the points in lines 12-19 (which seem to refer to "opportunities for direct emissions reductions" rather than observed emissions reductions) are not necessarily well integrated into section 4.3. It would also be helpful to have a summary row that totals cross-sectoral changes in energy or land-use supply and demand. In addition, the reference scenario ("REF") should be spelled out. [United States of America]	Taken into account. Table 4.1 is revised and updated in coordination with chapter 2. subject of the comment no longer there
61964	11	5	11	11	Table 4.1 is reporting median targets, could it be possible to also report a range ? [Valérie Masson-Delmotte, France]	Not applicable. Old table 4.1 replaced by a new one which does not include the subject of the comment
5030	11	9	11	10	I don't think the column heads are very clear at all. I'm not clear on what the Reference scenario is and what is being compared to what. Which is the 1.5 C and which is the 2 C scenario, and if one takes the "Transport" row it talks about a 22% increase in final energy use but then columns 3 and 4 suggest there are energy decreases. I just think clearer column titles are needed. [Michael MacCracken, United States of America]	Taken into account. Table 4.1 is revised and updated in coordination with chapter 2. subject of the comment no longer there
7902	11	9	11	10	More sourcing for Table 4.1, only reference is to Chapter 2 and vague, at least add pages numbers to make it easy to trace back [Christopher Bataille, Canada]	Accepted. Table 4.1 is revised and updated in coordination with chapter 2 adding more sources.
18554	11	9			Why are synfuels - power to liquid - not mentioned here [Andrea TILCHE, Belgium]	Rejected. Breakdown to enable inclusion is not available from chapter 2
19712	11	9	11	10	Table 4.1 Agriculture should also include emission reduction potential through ecological/ conservation agricultural practices and less meat production. [Jennifer Morgan, Netherlands]	Not applicable. Table 4.1 is revised and updated in coordination with chapter 2. subject of the comment no longer there
60794	11	9	11	10	Rephrase heading to Impact of achieving policy target (since increasing transport energy by 22% seems like it is not the goal). [United States of America]	Not applicable. Table 4.1 is revised and updated in coordination with chapter 2. subject of the comment no longer there
62724	11	9	11	9	Table 4.1: I suggest to provide uncertainty ranges together with medians. Make sure that pairs of 1.5°C/2°C and 1.5°C/Ref scenarios are used to calculate percentage changes. An important - and probablymore informative - point of comparison is also percentage changes from current trends / levels. [Elmar KRIEGLER, Germany]	Taken into account. Table 4.1 is revised and updated in coordination with chapter 2. subject of the comment no longer there
37586	11	11	11	12	correct quote from Kuramochi et al 2017: phasing out fossil-fuel passenger car sale by 2035–2050. [Michiel Schaeffer, Netherlands]	Editorial is done. Paragraph removed and subject of the comment no longer there

Comment No	From Page	From Line	To Page	To Line	Comment	Response
39222	11	11	11	19	If humans went to a plant diet and reduced food waste, what mitigation contribution would that make? These figures are not clear to the reader, while other mitigation approaches have figures.. [Lindsey Cook, Germany]	Not applicable. Old table 4.1 replaced by a new one and paragraph removed. The subject of the comment no longer there.
42810	11	11	11	19	For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. Shah N., et al. (2015) BENEFITS OF LEAPFROGGING TO SUPEREFFICIENCY AND LOW GLOBAL WARMING POTENTIAL REFRIGERANTS IN AIR CONDITIONING, Ernest Orlando Lawrence Berkeley National Laboratory. [Kristin Campbell, United States of America]	Not applicable. Old table 4.1 replaced by a new one and paragraph removed. The subject of the comment no longer there.
43056	11	11	11	19	For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. Shah N., et al. (2015) BENEFITS OF LEAPFROGGING TO SUPEREFFICIENCY AND LOW GLOBAL WARMING POTENTIAL REFRIGERANTS IN AIR CONDITIONING, Ernest Orlando Lawrence Berkeley National Laboratory. [Durwood Zaelke, United States of America]	Not applicable. Old table 4.1 replaced by a new one and paragraph removed. The subject of the comment no longer there.
45964	11	11	11	11	Similar information with a high level of technology breakdown is also provided in the OECD/IEA and IRENA, 2017 study that has been cited in chapter 2 of the report. [Deger Saygin, Turkey]	Noted. Table 4.1 is revised and the relevant paragraph is removed for better synchronization with chapter 2
49752	11	11	11	16	It is not clear what these lines are useful for - If the authors want to open a critical discussion on the numbers in Table 4.1, citing only two studies is not the right way. Moreover, the two studies are completely different from each other and refer to topics already addressed in Chap 4: the section 4.4.4.2 already discusses in a deeper way the technological aspects climate actions while short-term policy targets are already cited in Cross-Chapter Box 4.1 [Fabio Monforti-Ferrario, Italy]	Accepted. Table 4.1 is revised and paragraph removed for better synchronization with chapter 2
58286	11	11	11	15	Specify that IEA ETP is a well-below 2C pathway (distinct from 1.5C). Could also add that in IEA WEO 2017 the Faster Transition Scenario (equivalent to a well-below 2C pathway) points to the end-use sectors requiring most increased efforts relative to a 2C pathway (e.g. 25% of trucks would need to be electric; industry would need widespread CCS). [Andrew Prag, France]	Not applicable. Paragraph removed for better synchronization with chapter 2
60796	11	11	11	14	Do these studies account for the supply sector emissions implications of demand side changes? [United States of America]	Not applicable. Paragraph removed for better synchronization with chapter 2
60798	11	11	11	19	Relevant addition here would be recognition that existing building stock, including all historic buildings, are an important reservoir of embodied energy. The more effectively this building stock, including historic buildings, is used, it may be possible to reduce energy inputs for new construction. "The Greenest Building: Quantifying the Environmental Value of Building Reuse" (http://forum.savingplaces.org/connect/community-home/librarydocuments/vi...) is a report on this topic from the US National Trust for Historic Preservation, and is a relevant reference and a starting point for the peer-reviewed literature on this topic. [United States of America]	Not applicable. Old table 4.1 replaced by a new one and paragraph removed. The subject of the comment no longer there.
18556	11	12		13	the comment that CCS is is amongst the options for the greatest emission reductions is in contradiction with statements made in section 4.3.2.3 p18l1to 3 [Andrea TILCHE, Belgium]	Accepted. Section revised and the subject paragraph removed to better synchronize with chapter 2.
58324	11	12	11	12	Change "(IEA, 2017c) to "IEA (2917c)" [Peter Marcotullio, United States of America]	Not applicable. Paragraph removed for better synchronization with chapter 2
35518	11	13	11	14	It is not clear whether the energy efficiency improvement in buildings includes improvements in building envelope and other approaches or it only includes appliance efficiency. [Ashok Sreenivas, India]	Not applicable. Paragraph removed for better synchronization with chapter 2
10062	11	15	11	16	Need to scrutinize the feasibility of a target like phasing out fossil-fuel passenger car sale by 2035 globally -- Are there any other studies looking into this? [Saudi Arabia]	Not applicable. Paragraph removed for better synchronization with chapter 2
19716	11	15	11	15	An unquestioned increase use of biofules is not socially and environmentally justifiable from our view. [Jennifer Morgan, Netherlands]	Not applicable. Paragraph removed for better synchronization with chapter 2
60800	11	15	11	15	The use of "emphasise" is vague: Are these options or are they necessary to achieve the emissions targets consistent with a 1.5°C pathway? [United States of America]	Not applicable. Paragraph removed for better synchronization with chapter 2
62726	11	15	11	16	Those policy packages have been investigated in one IAM study currently in review at ERL (Kriegler et al., Short term policies to keep the door open for Paris climate goals). It is uncertain whether this study will meet the acceptance deadline, but if it does it would be relevant for this discussion and also Section 4.4. [Elmar KRIEGLER, Germany]	Not applicable. Paragraph removed for better synchronization with chapter 2
3894	11	16	11	16	Two years are given by which phase out of fossil fuel passenger car sales must happen, rendering the sentence unclear. [Emily Tyler, South Africa]	Editorial is done. Paragraph removed and subject of the comment no longer there
7904	11	16	11	16	sale to "sales", and change semi-colon to comma [Christopher Bataille, Canada]	Editorial is done. Paragraph removed and subject of the comment no longer there
19720	11	16	11	16	Halting net deforestation 2025 is not ambitious enough and not aligned with the SDGs (SDG 15.2 states: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally). The shift in agricultural production could be highlighted next with the other options in this paragraph. [Jennifer Morgan, Netherlands]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there
60802	11	16	11	16	Suggest replacing "and" with "or" in the line "phasing out of fossil-fuel passenger car sale by 2035 and 2050". Why would they be phased out twice? Or is it supposed to refer to sales and use? [United States of America]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there
24352	11	17	11	18	This is not correct. Creutzig et al use an IAM (the REMIND model, from the Potsdam Institute for Climate Impact Research). [Joeri ROGELJ, Austria]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there
41646	11	17			Add explanation of "IAMs" [Czech Republic]	Editorial completed. Whole paragraph removed to better synchronize with chapter 2
49754	11	17	11	19	Same as previous comment, but even worse: these two lines cite a highly debated topic (the feasibility of scenarios with very high penetration of PV and other renewables) in a way too simplistic manner. Moreover, the same topic is more appropriately discussed in 4.3.2.1 [Fabio Monforti-Ferrario, Italy]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there
51960	11	17	11	19	I believe Jacobson et all 2017 also talks about biofuels which are not mentioned here. [Jason Donev, Canada]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there
51962	11	17	11	19	Jacobson's paper is sloppy, contested and an unwise paper to site. I implore you to read Jacobson's paper properly and evaluate whether his paper proposes a feasible future. Please also read Clack et al in detail and evaluate the criticisms of Jacobson's paper. There are other papers that are critical of Jacobson's paper and need to be reviewed. The inclusion of Jacobson's paper will erode the scientific credibility of this document. [Jason Donev, Canada]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there
57212	11	17	11	19	the two following literature pieces should be added documenting that a 100% renewables scenario till 2050 is possible as part of a least cost scenario: DOI: 10.1002/pip.2950 and Ram et al. (2017) (ISBN: 978-952-335-171-4) link: https://www.researchgate.net/publication/320934766_Global_Energy_System_based_on_100_Renewable_Energy_-_Power_Sector - in Ram et al. zero GHG emissions in 2050 is shown and very deep decarbonisation by 2040 [Christian Breyer, Finland]	Not applicable. Paragraph removed for better synchronization with chapter 2. Table 4.1 is now based on literature assessed by chapter 2 only. References provided are referred to chapter 2 authors.
60804	11	17	11	19	This sentence seems incomplete. Do the non-IAM studies suggest these cuts are "possible", "likely", "economic"? [United States of America]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there
60806	11	17	11	17	The phrase "suggest deep cuts of GHGs" is not clear; does this mean that the referenced studies suggested that deep reductions in emissions would be achievable in certain ways? [United States of America]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there

Comment No	From Page	From Line	To Page	To Line	Comment	Response
62728	11	17	11	17	The scenario presented by Creutzig et al. is calculated with the IAM REMIND for a 2°C target. It is therefore not a scenario study outside IAMs (referring to its part concerned with scenarios). Moreover, the deep emissions cuts are triggered by 2°C carbon pricing, leading to large scale PV deployment. The implication here that adopting lower PV cost projections leads to deep emission cuts by its own is incorrect. [Elmar KRIEGLER, Germany]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there
1594	11	18	11	19	…although some of this work is contested. The reference provided does not address any of the results in Jacobson et al. (2017) - instead it address an earlier paper from 2015. In addition, the following new paper supercedes the 2015 paper and comes to the same conclusion as the 2015 paper but with multiple scenarios instead of 1 and in 20 world regions instead of in 1 region: Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, and B.V, Mathiesen, Matching demand with supply at low cost among 139 countries within 20 world regions with 100% intermittent wind, water, and sunlight (WWS) for all purposes, Renewable Energy, 2018, https://doi.org/10.1016/j.renene.2018.02.009 [Mark Jacobson, United States of America]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there, while Table 4.1 is now solely built on assessed literature of chapter 2.
1596	11	18	11	19	Some scenario studies outside IAMS… Please add the following worldwide studies on 100% clean renewable energy for all energy sectors: (1) Jacobson, M.Z., and M.A. Delucchi, A path to sustainable energy by 2030, Scientific American, November 2009; (2) Jacobson, M.Z., and M.A. Delucchi, Providing all Global Energy with Wind, Water, and Solar Power, Part I: Technologies, Energy Resources, Quantities and Areas of Infrastructure, and Materials, Energy Policy, 39, 1154-1169, doi:10.1016/j.enpol.2010.11.040, 2011; (3) Delucchi, M.Z., and M.Z. Jacobson, Providing all global energy with wind, water, and solar power, Part II: Reliability, System and Transmission Costs, and Policies, Energy Policy, 39, 1170-1190, doi:10.1016/j.enpol.2010.11.045, 2011; (4) Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, and B.V, Mathiesen, Matching demand with supply at low cost among 139 countries within 20 world regions with 100% intermittent wind, water, and sunlight (WWS) for all purposes, Renewable Energy, 2018, https://doi.org/10.1016/j.renene.2018.02.009 [Mark Jacobson, United States of America]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there, while Table 4.1 is now solely built on assessed literature of chapter 2.
4278	11	18	11	19	The reference to (Jacobson 2017) should be completed with another reference to a similar study for the European Energy System (D. Connolly, H. Lund, B. V. Mathiesen, Smart Energy Europe: The technical and economic impact of one potential 100% renewable energy scenario for the European Union Renew. Sustain. Energy Rev. 2016, 60, 1634-1653.). On the other hand, I find the debate Jacobson-Clack noted in this paragraph is extremely policy relevant and should deserve a more detailed assessment in this report. Shifting towards scenarios based on 100% wind-water-solar, aided by synthetic fuels (H2 as in Jacobson et al and/or carbonaceous as in Connolly et al above), are gaining interest because of their inherent political and public attraction (i.e. no fossil, no nuclear, no CCS). However, IAMs literature is still ignoring these options. Why?, may be because of their poor set of assumptions and hidden contradictions (see Clack et al, 2017). If yes, this should be highlighted (in particular regarding the availability in IAMs of extremely large surpluses of low cost electricity and the availability of electrolyzer equipment expected to operate at very low capacity factors...). [Abanades Carlos, Spain]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there, while Table 4.1 is now solely built on assessed literature of chapter 2.
36568	11	18	11	19	The line that states that a study has been contested. In other parts of the report this is not mentioned. Both sides are presented and the reader is left to make their decision. The open contesting does not need to be stated in such a manner. [Snaliah Mahal, Saint Lucia]	Not applicable. Paragraph removed for better synchronization with chapter 2. The subject of the comment is no longer there, while Table 4.1 is now solely built on assessed literature of chapter 2.
37588	11	19			Also cite Heard et al. http://dx.doi.org/10.1016/j.rser.2017.03.114 and Loftus et al. doi:10.1002/wcc.324 [Michiel Schaeffer, Netherlands]	Rejected. Whole paragraph is removed to better synchronize with chapter 2 and the section stock take objective
5508	11	22	11	38	there is a much more detailed assessment of investment in 1.5 pathways in chapter 2; suggest that this be refered to here rather than re-assessing in chapter 4. [Haroon KHESHGI, United States of America]	Taken into account. The section tries to summarize what chapter 2 has assessed on investment rather than to duplicate the assessment of chapter 2, i.e. it is a stock take. Paragraph is revised to better synchronized with chapter 2 and stock take objective.
10064	11	23	11	37	Why not these substantiative evidence of the challenge in terms of speed and scale of investment needed not stated clearly in the executive summary of the chapter? [Saudi Arabia]	Taken into account. Messages on investment costs are within the domain of chapter 2, chapter 4 focus in the executive summary is more on enabling conditions
30570	11	23			Section « Scale, speed and type of investment » An assessment of investment needs in energy efficiency would be welcomed. [France]	Noted. Unfortunately chapter 2 assessment does not provide cost number for energy efficiency separately to include here.
55060	11	23	11	37	These 2 paragraphs could refer to the New Climate Economy paper "Infrastructure Investment Needs of a Low-Carbon Scenario" There are large infrastructure investment needs over the next 15 years, totalling approximately US$90 trillion between 2015 and 2030. Developed countries have ageing infrastructure that needs to be replaced and developing countries will continue to invest in rapidly expanding their infrastructure, all in the context of a growing global population and increasing urbanisation. Citation:Global Commission on the Economy and Climate. New Climate Economy Technical Note: Infrastructure investment needs of a low-carbon scenario. November 2014. [Yamide Dagnet, United States of America]	Noted. Thanks for the reference. The section is revised with focus on better synchronizing with literature assessed in chapter 2. the reference is passed to chapter 2 authors.
12192	11	24	11	29	Are these costs the same as those quoted in Chapter 5 (page 36, line 4)? The range looks lower than the values quoted there (and the source differs too). Again, need to be consistent. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Numbers are updated and better referenced to the sources in chapter 2. Note is taken that chapter 2 and not chapter 5 is the source of assessment of energy system investments.
24354	11	24	11	26	Having one reference to indicate that there is "high agreement in the literature" is not convincing at all. [Joeri ROGELJ, Austria]	Accepted. Sentence revised to remove "high agreement" and broad citation of sections in chapters 2 and 4 discussing the issue are added replacing the single reference.
37590	11	24	11	37	Although the point in these paragraphs is that to meet 1.5C a large upscaling of investment will be needed beyond what is necessary for 2C, the ranges of investment numbers given here very strongly overlap . One could just as easily say that the same level of investment will be needed, within current levels of uncertainty [Michiel Schaeffer, Netherlands]	Accepted. Investment costs are updated and averages are used in addition to break the possible ranges overlap
58292	11	24	11	37	Could add: "The IEA estimates energy sector investment needs towards the top of this range, and highlights that more ambitious mitigation scenarios require considerably more investment in the demand-side of the energy sector. For example, IEA (2017f, WEO) estimates that moving to a scneario with a higher chance of staying well-below 2C, without requiring negative emissions, woudl require increased investment needs of around USD 260bn per year in the demand-side only". [Andrew Prag, France]	Rejected. For better consistency with chapter 2 on energy system investments and their costs , only those assessment reported in section 2.5 are used in the revised version of this section.
3896	11	26	11	26	Mcollum et al has no date. [Emily Tyler, South Africa]	Taken into account. Referencing "McCollum et al" study is replaced with broader referencing of section 2.5 that assesses the relevant literature on energy investment costs
6118	11	26	11	29	The lower end mean is actually lower in the 1.5 context than in the 2 degree context, contradicting the statement made. [Anne Olhoff, Denmark]	Accepted. Investment numbers are updated based on chapter 2 (section 2.5) and averages/medians are used in addition to ranges to break possible range overlaps

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7906	11	26	11	27	You cite a global cost for the 2C pathways (Riahi et al 2012) from 2012; the DDPP found a minimum of 1.9 billion/yr $2015 by 2050 from the 16 DDPP countries, which covered 76% of energy related emssions. This source provides an updated "bottom-up" (as opposed to top-down IAM) estimate of the cost of the 2C pathways, which may be useful. Source: Bataille, C., H. Waisman, M. Colombier, L. Segafredo, J. Williams & F. Jotzo (2016) The need for national deep decarbonization pathways for effective climate policy, Climate Policy, 16:sup1, S7-S26, DOI: 10.1080/14693062.2016.1173005 Please note this is a seperate source from the already listed article with similer authors from the same special issue. [Christopher Bataille, Canada]	Rejected. Referencing of given studies is dropped and replaced with referencing of the chapter2 section assessing the relevant literature to ensure consistency.
18558	11	26	11	29	The lower end mean of the investment projection is lower for 1.5 than for 2 degree context. This needs to be explained. Is it because low-investment 1.5°C scenarios concentrate more on energy efficiency and demand reduction? [Andrea TILCHE, Belgium]	Accepted. Investment numbers are updated based on chapter 2 (section 2.5) and averages/medians are used in addition to ranges to break possible range overlaps
47136	11	26	11	26	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorials applied in the revised version.
60808	11	26	11	29	It is confusing to see that the emissions reductions for 1.5°C could be lower than for 2°C. Suggest explaining this when it appears. [United States of America]	Accepted. Investment numbers are updated based on chapter 2 (section 2.5) and averages/medians are used in addition to ranges to break possible range overlaps
62730	11	26	11	29	Investment numbers should be based on latest references. McCollum et al., 2013, Climate Change Economics; AR5 Chap. 16; and the new McCollum et al. paper in review. [Elmar KRIEGLER, Germany]	Accepted. Investment numbers are updated based on chapter 2 (section 2.5) and averages/medians are used in addition to ranges to break possible range overlaps
3898	11	27	11	27	Grammar error: Investment 'is', not investment 'are'. [Emily Tyler, South Africa]	Editorials applied in the revised version. Sentence deleted in the revised version
24356	11	27	11	29	Chapter 2 has a section on investments which discusses this in more detail. Please ensure consistency. [Joeri ROGELJ, Austria]	Taken into account. Revised version is better synchronized with chapter 2
51964	11	27	11	29	The range of costs for 1.5C includes numbers that are *lower* than 2C, that seems unlikely. [Jason Donev, Canada]	Accepted. Investment numbers are updated based on chapter 2 (section 2.5) and averages/medians are used in addition to ranges to break possible range overlaps
58328	11	27	11	27	Remember to put the date on "(MoCollum et al)" perhaps 2018? Twice in this paragraphy, lines 26 and 29 [Peter Marcotullio, United States of America]	Editorials applied in the revised version. Reference to specific studies is replaced with referencing of the relevant section of chapter 2 for consistency in the revised version
14056	11	31	11	37	This concentration on wind and solar ignores the much larger shares of hydro and bioenergy as well as geothermal and potentially ocean energy (all covered in detail in the IPCC SRREN, 2011). Needs a better balance - and if not adequately included in the LAMs, then discussion needed as to why not. Renewables are for more than wind and solar. [Ralph Sims, New Zealand]	Rejected. The revised version of the section closely follows chapter 2 footsteps as the objective is to take stock of what assessed by chapter 2. The cited numbers for solar and wind are not used in this version, instead an updated assessment in section 2.5 is used. Unfortunately, hydro is not broken out in section 2.5 assessment, mostly likely because the focus is on incremental investment and that may be little for hydro in a 1.5C or 2C pathway
37592	11	31	11	37	a table with these results on investment needs for 1.5 and 2 dC pathways would be useful. [Michiel Schaeffer, Netherlands]	Rejected. To avoid duplication the revised version limit assessment of investment to stock take based on chapter 2. section 2.5.2 provides detailed assessment of investment needs comparing 1.5C with 2C including graphical representation. Hence, no need to duplicate that effort here
48656	11	31	11	38	Suggest adding a paragraph on investment in energy efficiency technologies. See for reference the IEA EE market report and the IEA world investement report [Yamina Saheb, France]	Rejected. Need to be consistent with what assessed by chapter 2 and there is a limited space that may not accommodate additional paragraph
51966	11	31	11	37	Wind and solar require substantial grid upgrades. Jurisdictions that are now relying on these sources of electricity are finding that the grid has to be updated to a distributed energy regime. Do these cost estimates include the need for tremendously expensive storage? The electronics necessary to put solar power on the grid itself? If these estimates do, (and I am concerned that these costs have not been appropriately figured in), then this paragraph should reflect that. Cost estimates on solar power specifically often focuses almost entirely on the panels themselves, which *have* gotten much cheaper, the the rest of the electronics remain a cost barrier for large scale solar implimentation. [Jason Donev, Canada]	Taken into account. The revised version now provides statistics on investment costs in electricity transmission, distribution, and storage
60810	11	31	11	37	This paragraph could be expressed as a table. It should be carefully cross-checked against Chapter 2 to ensure consistency. A key issue is that it is missing discussion of many key elements, including: carbon capture and storage, AFOLU, nuclear energy, and energy demand. [United States of America]	Taken into account. Consistency is ensured in the revised version. Also now both nuclear and investment in transmission, distribution, and storage are cited.. Unfortunately, providing a table similar to table 4.1 on breakdown of investment by generation that includes in addition land use change and CCS is not possible because of lack of consistent cost data based on chapter 2 assessment. Nevertheless, you may refer to section 2.5.2 and 2.5.3 for graphical representation of the breakdown of invest in electricity generation.
3900	11	32	11	37	The comparison here is between low carbon investment for 1.5 degrees and 2 degrees, but some reference to how this compares to total investment, and how much could represent a diversion from high carbon investment would be very valuable in situating the discussion. The OECD 2017 report 'Better climate, Better investment' has some figures. [Emily Tyler, South Africa]	Rejected. The revised version of the section closely follow chapter 2 footsteps as the objective is to take stock of what assessed by chapter 2. Accordingly only literature that assessed in chapter 2 is included in this version.
47138	11	33	11	33	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorials applied in the revised version
51968	11	38	11	39	There is no mention of Small Nuclear Reactors (SMRs) as a disruptive technology that can provide reliable electricity with no need to rely on non-existent grid storage technology. With dozens of companies in several different countries having submitted reviews for the safety the safety cases of nuclear reactors that can be deployed in unprecedented locations (e.g. the arctic, island nations) which get large amounts of energy from diesel fuels, SMRs are a potential game-changer that are irresponsible to ignore in this section. SMRs could prove to be substantially cheaper than the wind and solar that is being proposed here. [Jason Donev, Canada]	Taken into account. Revised version provides investment cost numbers for nuclear generation
62732	12	1	12	7	Consider adding the following key decision making implications from the 1.5°C pathway literature: Carbon pricing is critical to achieve phase-out of coal use during 2020-2050 (earlier in industrialized countries). Sustainable CDR options to be deployed earlier to compensate residual emissions and reach the point of carbon neutrality as early as possible. Global cooperations and participation critical, climate policy leadership needed (no time left to point fingers and wait for others to act). [Elmar KRIEGLER, Germany]	Rejected. The section is investigating policy designs and not policy instruments. The policy instruments are considered in section 4.4.5.
60812	12	2	12	7	The blending of the discussion of mitigation and adaptation is confusing and results in a loss of clarity and precision. Holding warming to 1.5°C does not "raise the bar" on adaptation, as compared to 2°C pathways. [United States of America]	Accepted. The paragraph is revised to remove the confusion
8074	12	3	12	3	1.5°C does not raise the bar on adaptation! (ambiguous sentence). On the contrary, less adaptation will be needed [Quentin Perrier, France]	Accepted. The paragraph is revised to remove the confusion
29648	12	3	12	3	Please insert after "impacts": (see Michaelowa et al. 2018 for a discussion about appropriateness of policies for a 1.5°C scenario)." Reference: Michaelowa, Axel; Allen, Myles; Fu Sha (2018): Policy instruments for limiting global temperature rise to 1.5°C – can humanity rise to the challenge?, in: Climate Policy, 18, p. 275-286 [Mareike Blum, Germany]	Rejected. This section is about policy design not policy instruments. Policy instruments are addressed in sections 4.4.5. The reference will be suggested to authors of those sections
30572	12	3	12	3	« as well as adaptation to climate impacts. » 1.5°C does not raise the bar on adaptation (ambiguous sentence) [France]	Accepted. The paragraph is revised to remove the confusion

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30574	12	4	12	7	This literature review is pretty short and might be expanded. A few references: - "Tracking sectoral progress" (doi:10.1016/j.enpol.2017.08.053), - "dynamic adjustment"(doi: 10.1080/14693062.2016.1179618) [France]	Accepted. Reference on dynamic adjustment added
7908	12	5	12	5	Add "and" before "feedback" [Christopher Bataille, Canada]	Editorial is done. Sentence revised to fix the problem flagged
1556	12	9	12	16	These lines also point out the Herculean, almost impossible, nature of the task to go from 2 degree to 1.5 degree. The price of carbon, as a proxy, will need to triple in 2050, based on the integrated assessment models of chapter 2. Costs will also double in the period 2030-2080 compared to the 2 degree scenario. Even with good policy design, the costs will be so large that distributional effects across sectors, across nations, will likely be impossible to bear by any single or even number of groups of people or sectors. [Arthur Lee, United States of America]	Noted.
10066	12	9	12	10	The statement "even with good policy design and effective coordination, the transition to 1.5c may be associated with considerable costs" would signify the contribution of the this chapter in terms of strengthening the response if included in the executive summary and the SPM. [Saudi Arabia]	Taken into account. The implications of the transition to 1.5C on cost are now reflected in SPM sections C and D.
60814	12	9	12	16	These lines also point out the Herculean, almost impossible, nature of the task to go from 2 to 1.5°C. The price of carbon, as a proxy, will need to triple in 2050, based on the integrated assessment models of Chapter 2. Costs will also double in the period 2030-2080 compared to the 2°C scenario. Even with good policy design, the costs will be so large that distributional effects across sectors, and across nations, will likely be impossible to bear by any single or even number of groups of people or sectors. [United States of America]	Noted.
45370	12	9	9		suggestion: Unless the word 'coordination' is specifically meant in this paragraph, it could be changed to 'implementation' more widely. Climate change policy is an intractable issue, and implementation is wider than coordination.This paragraphs starts with 'Even with good policy design and effective coordination…' This indicates that 'policy design' is equivalent to 'policy development' and that 'effective coordination' is good 'policy implementation.' In terms of the policy scholarship - policy implementation is the outcome of policy design (for correctness here), and that policy implementation is much wider than 'coordination' which is only one aspect of implementation. Policy implementation includes an understanding of how the policy ideals can unfold in the real world; policy implementaion is concerned with how policy is actions and manifests; and the processes and conditions under which this occurs. Given this, and given that great policy ideas can fail if implementation strategy isn't well understood, it might be clearer changing that opening sentence to increase clarity. that is: "Even with good policy design and implementation.... considerable costs." [Veryan Hann, Australia]	Accepted. Coordination changed to implementation
60816	12	9	12	16	This paragraph makes an important point, though it is somewhat misstated. The claim that abatement costs "would increase by about three times under 1.5°C compared to 2°C in 2050" is not strictly correct even with the reference to carbon price, as the carbon price represents "marginal" abatement cost (under certain assumptions that may not be fully realized), rather than total abatement cost. Suggest changing the statement to refer to "marginal abatement costs." [United States of America]	Accepted. Phrase "abatement cost" is changed to "marginal abatement cost"
62736	12	10	12	13	Carbon prices are marginal abatement costs, not aggregate abatement costs. See Box 2.1 and Box 2.2 for a discussion of cost metrics etc. [Elmar KRIEGLER, Germany]	Accepted. Phrase "abatement cost" is changed to "marginal abatement cost"
62734	12	11	12	11	Avoid saying "Chapter 2 reported … in their models". These are not models operated by Chapter 2. Say IAMs or "integrated pathway models" (a broader category than IAMs summarizing all models that produced 1.5°C pathways; this terminology is introduced in Chapter 2). [Elmar KRIEGLER, Germany]	Accepted. "their models" changed to "Integrated Assessment Models, IAMs"
40432	12	12	12	13	Su et al. (2017) showed that achieving 1.5°C will require tripling of carbon prices is not an accurate statement. This is a projection of their model (which includes carbon pricing in specific ways) not a fact; not to mention the uncertainties that the authors themselves mention as a limitation. Other scenarios and models have been proposed. This cannot be presented as a factual statement, but, in any case, as a possible, and disputable, scenario among other. Uncertainty levels should be stated. [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account. Sentence is dropped out in the revised version
60818	12	12	12	13	Why isn't the Su et al. study incuded in the Chapter 2 synthesis sentence? It is odd to single out an individual study here. [United States of America]	Taken into account. Sentence is dropped out in the revised version
30576	12	14	12	14	Benefits [of avoided impacts] and not "cost" [France]	editorial is done. Sentence is dropped out in the revised version
37598	12	14	12	14	replace 'cost' with 'benefit': This does not account for the benefits of avoided impacts with lower warming. [Michiel Schaeffer, Netherlands]	editorial is done. Sentence is dropped out in the revised version
32254	12	18			year missing from in text citation: Roelfsema et al. [Jamaica]	Rejected. Roelfsema et al is not mentioned in the section
39224	12	18	12	52	Is this consistent with Chapter 3 findings? And what of the Arctic studies with significant differences between 1.5C and 2C warming, why is this not mentioned in adaptation, since the consequences would be profound? https://www.pik-potsdam.de/news/press-releases/archive/2012/gronlands-eismassen-konnten-komplett-schmelzen-bei-1-6-grad-globaler-erwarmung [Lindsey Cook, Germany]	Noted. Yes, the assessment in this section is consistent with chapter 3. The revised version referenced the relevant sections in chapter 3. Due to limit on space, only some examples are provided in the section. Refer to 3.4 for more complete assessment of adaptation.
24358	12	19	12	19	SSPs are not "the foundation of the IAM scenarios". They are definitely underlying quite a few of them, but this cannot be generalized, even not for 1.5°C pathways. [Joeri ROGELJ, Austria]	Accepted. The phrase "the foundation of the IAM scenarios" is deleted in the revised version
45368	12	19	13	32	p.12 line 19 is the abbreviation IAM; on p.13 line32 it is written "Integrated Assessment Models (IAMs)." Normally it is the first mention that the abbreviation is used. There are so many abbreviation,s and I did not see a list of abbreviations for chapter 4 or in chapter 1. I suggest a List of Abbreviations after the end of the table of contents. A number of government advisors read this material and won't remember what each term is. [Veryan Hann, Australia]	Taken into account. IAMs is fully spelled when first used in the revised version. The abbreviations are explained in the glossary section of the report.
60820	12	19	12	19	SSPs should be introduced before their first use in this chapter. [United States of America]	Editorial is done. SSPs are defined in the revised version
62738	12	19	12	20	The SSPs are not the foundation of all IAM scenarios assessed by Chapter 2, only of a few. There are many scenarios with other assumptions concerning energy and land demand. There is also an increasingly rich literature on SDG implications of mitigation pathways, including studies on 1.5C and SDGs. See Chapter 5 assessment. [Elmar KRIEGLER, Germany]	Accepted. The phrase "the foundation of the IAM scenarios" is deleted in the revised version
36570	12	20	12	20	Remove the word a before literature' [Snaliah Mahal, Saint Lucia]	Editorial is done.
32256	12	22			revise sentence. Grammar seems off. [Jamaica]	Editorials applied in the revised version. Sentence revised
24360	12	23	12	23	Maybe also reference Chapter 2, section 2.5.3, which also provides an overview of sustainable development features of 1.5°C pathways in coordination with Chapter 5. [Joeri ROGELJ, Austria]	Taken into account. Reference to section 2.5.3 is added
58294	12	23	12	23	Suggest adding: "The IEA has a new scenario highlighting how climate goals can be simultaneously achieved with SDG 7 on energy access and SDG 3.9 on air pollution (IEA, 2017f). [Andrew Prag, France]	Rejected. Though the reference is relevant, referencing specific studies as examples is removed in the revised version for better alignment with chapters 2 and 5 and replaced with broad referencing to the relevant sections in chapters 2 and 5. Accordingly the suggested IEA study is passed over to the authors of chapters 2 and 5.
12194	12	27	12	27	In the interests of brevity, is the discussion in this section necessary? Covers adaptation and impacts, both of which are summarised in other chapters [United Kingdom (of Great Britain and Northern Ireland)]	Noted. The objective of this section is taking stock of the detailed assessments of mitigation in chapter 2 and the detailed assessment of adaptation in chapter 3. the revised version made large cut in text to better synchronize with chapters 2 and 3 along with the stock take objective

Comment No	From Page	From Line	To Page	To Line	Comment	Response
32114	12	27	12	51	This section needs a concluding statement to summarize what the evidence highlights: There is a difference in adaptation needs between 1.5C and 2C pathways [Jamaica]	Accepted. Section is revised and a concluding paragraph is added.
36480	12	27	12	51	This section needs a concluding statement to summarize what the evidence highlights: There is a difference in adaptation needs between 1.5C and 2C pathways [Snaliah Mahal, Saint Lucia]	Accepted. Section is revised and a concluding paragraph is added.
10068	12	28	12	31	This paragraph is also critical and worthy of highlighting in the executive summary along with the indicating the limited evidence on these impacts. [Saudi Arabia]	Noted. Chapter 4 executive summary is focused on messages related to challenges and enablers. Other messages on adaptation would be the focus of chapter 3
230	12	33	12	37	More and more literature data support the notion that adaptation of coral reefs may be an important issue. Suggest to revise the text in a way that reflects the whole spectrum of ideas/scenarios. Some supporting citations: Baker, A. C., Starger, C. J., McClanahan, T. R., Glynn, P. W. (2004). Coral reefs: corals' adaptive response to climate change. Nature, 430(7001), 741-741; Rowan, R. (2004). Coral bleaching: thermal adaptation in reef coral symbionts. Nature, 430(7001), 742-742; Coles, S. L., Brown, B. E. (2003). Coral bleaching—capacity for acclimatization and adaptation. Advances in marine biology, 46, 183-223; Palumbi, S. R., Barshis, D. J., Traylor-Knowles, N., Bay, R. A. (2014). Mechanisms of reef coral resistance to future climate change. Science, 344(6186), 895-898; Hume, B. C., Voolstra, C. R., Arif, C., D'Angelo, C., Burt, J. A., Eyal, G., ... & Wiedenmann, J. (2016). Ancestral genetic diversity associated with the rapid spread of stress-tolerant coral symbionts in response to Holocene climate change. Proceedings of the National Academy of Sciences, 113(16), 4416-4421; Howells, E. J., Abrego, D., Meyer, E., Kirk, N. L., Burt, J. A. (2016). Host adaptation and unexpected symbiont partners enable reef?building corals to tolerate extreme temperatures. Global change biology, 22(8), 2702-2714; Matillano BJE (2017) Resilient seagrass in the Realm of Climate Change. J Mar Biol Oceanogr 6:3. doi: 10.4172/2324-8661.1000181. [Baruch RINKEVICH, Israel]	Taken into account. Section is revised and better streamlined to improve the stock take focus of the section while leaving the details to chapter 3. The contributed references are passed to chapter 3 authors.
42812	12	33	12	37	Another example of irreversible (within human timescales) impacts from warming includes sea level rise. Solomon S., et al. (2009) Irreversible climate change due to carbon dioxide emissions, PROC. NATL. ACAD. SCI. USA 106(6):1704-1709, 1707, 1708 ("Anthropogenic carbon dioxide will cause irrevocable sea level rise…. An assessed range of models suggests that the eventual contribution to sea level rise from thermal expansion of the ocean is expected to be 0.2–0.6 m per degree of global warming (5). Fig. 4 uses this range together with a best estimate for climate sensitivity of 3 °C (5) to estimate lower limits to eventual sea level rise due to thermal expansion alone. Fig. 4 shows that even with zero emissions after reaching a peak concentration, irreversible global average sea level rise of at least 0.4–1.0 m is expected if 21st century CO2 concentrations exceed 600 ppmv and as much as 1.9 m for a peak CO2 concentration exceeding 1,000 ppmv."). [Kristin Campbell, United States of America]	Taken into account. Section is revised and better streamlined to improve the stock take focus of the section while leaving the details to chapter 3. The contributed references are passed to chapter 3 authors.
43058	12	33	12	37	Another example of irreversible (within human timescales) impacts from warming includes sea level rise. Solomon S., et al. (2009) Irreversible climate change due to carbon dioxide emissions, PROC. NATL. ACAD. SCI. USA 106(6):1704-1709, 1707, 1708 ("Anthropogenic carbon dioxide will cause irrevocable sea level rise…. An assessed range of models suggests that the eventual contribution to sea level rise from thermal expansion of the ocean is expected to be 0.2–0.6 m per degree of global warming (5). Fig. 4 uses this range together with a best estimate for climate sensitivity of 3 °C (5) to estimate lower limits to eventual sea level rise due to thermal expansion alone. Fig. 4 shows that even with zero emissions after reaching a peak concentration, irreversible global average sea level rise of at least 0.4–1.0 m is expected if 21st century CO2 concentrations exceed 600 ppmv and as much as 1.9 m for a peak CO2 concentration exceeding 1,000 ppmv.") [Durwood Zaelke, United States of America]	Taken into account. Section is revised and better streamlined to improve the stock take focus of the section while leaving the details to chapter 3. The contributed references are passed to chapter 3 authors.
45650	12	33			I suggest including animal and plant species extinctions (not just coral reefs) as an irreversible impact of global warming, which is specially important in one of the greatest biodiversity areas, the tropics. [Adela M Sánchez-Moreiras, Spain]	Rejected. No numbers available from reviewed literature to cite on these species
60822	12	34	12	37	This sentence is unclear with regard to what is projected to decrease by 90% in 2050. Is it a 90% reduction in all tropical reefs? Please reword. [United States of America]	Accepted. Sentence is removed and the whole section is revised
16444	12	39	12	44	Dry spells will have impacts on carbon sequestration as well as crop yields [Australia]	Rejected - while this can be true, the cited study does not estimate impacts of dry spells on carbon sequestration. As the section is revised , more detailed assessment of incremental impacts are left to chapter 3.
60824	12	39	12	51	This discussion is important and compelling, but perhaps it belongs in Chapter 3. It is not linked here to adaptation as the subsection title would suggest. [United States of America]	Taken into account. Section is revised and better streamlined to improve the stock take focus of the section while leaving the details to chapter 3.
48096	12	40	12	43	Does the entire para refer to Schleussner et al? Please check [Sarah Connors, France]	Not applicable. Paragraph is rewritten to remove confusion. Reference to Schleussner et al study is now removed and replaced with referencing the relevant sections of chapter 3.
60826	12	42	12	43	If the study is about the Mediterranean, how do "world regions" factor in? [United States of America]	Not applicable. Yes, the word 'world" is a typo. Section revised and whole sentence and referenced study are no longer there.
5032	12	43	12	44	Need to change "predicts" to "projects"--and the sentence needs to indicate assuming that the ice sheets do not have a transition to much more rapid loss of ice as a result of extensive collapse and calving of major ice sheets. [Michael MacCracken, United States of America]	Not applicable. Word 'predict' changed to "project", yet the whole sentence is now removed from the revised version
38600	12	48	12	49	Some references are needed re GHGs/aerosols. One of these could be a recent paper by Samset et al: Climate impacts from a removal of anthropogenic aerosol emissions. Geophysical Research Letters, January 2018. DOI 10.1002/2017gl076079 [Jan Fuglestvedt, Norway]	Taken into account. Specific references are avoided in the revised section. Instead, reference is made to the relevant section in chapter 3.
14058	12	49	12	49	Why only maize yields quoted? Isn't "decreased run-off" a benefit assuming water and nutrients then infiltrate into the soil. [Ralph Sims, New Zealand]	Accepted. The specific sentence and reference are removed from the revised version. Instead now broader statement is made with respect to crops and yields while reference is made to relevant sections of chapter 3 for details
50086	13	1	14	43	What this section should do is answer the question if the rates of change used in the IAMs (in ch 2) are realistic or not. The current text does not do that. I only see a general discussion of rates of change and innovation, which is not addressing the key issue. It also contains conflicting messages: in lines 19-20 on page 13 it says that historical patterns of change will make limiting warming to 1.5C impossible, while in lines 54-55 on page 13 it says that required rates of change for 1.5C are not necessarily faster than historic rates. [Bert Metz, Netherlands]	Accept. Text will be revised to make it more conclusive and detailed on what the models and historical data actually say. Inconsistencies will be repaired.
60828	13	1	14	43	Section 4.2.2 should be substantially condensed. The last two paragraphs on page 4-13 are probably unnecessary. [United States of America]	Accept. This will be done, at least the last paragraph.
62740	13	1			Chapter 4.2.2 in its current form does not take the opportunity to meaningfully evaluate the change rates in 1.5°C pathways. It would benefit from a more quantitative comparison of current trends, with change rates in 1.5°C pathways with bottom-up estimates of change rates where available. [Elmar KRIEGLER, Germany]	Noted. The text has been substantially revised and made more quantitative in places, in particular in Table 4.1. Also, literature was largely missing for a quantitative comparison.
62742	13	1			Chapter 4.2.2. is in strong need of improvement. It seems to claim that models (which ones?) use a first approach of extrapolating trends into the future (citing Chap. 6, AR5), but this would be misperception at least concerning mitigation pathway models assessed in Chap. 6 AR5 and Chap. 2 of this report. The changes in 1.5°C and 2°C pathways constitute trend breaks compared to the past. The same holds for the second approach, which is described as fitting the future to the past (what then is the difference between the two approaches?). This is certainly not the case for mitigation pathways models. In addition, it seems that cited papers - to the extent I know them - often do not corroborate the content attributed to them in this section. [Elmar KRIEGLER, Germany]	Taken into account. We looked again at the two approaches and revised and simplified the text. The extrapolation point, however, still applies, though not of course for temperatures or emissions, but for parameters like economic and population growth, and transport demand.

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60830	13	3	13	55	Section 4.2.2.1 is really abstract with little support for many of the statements (including those in the Executive Summary). [United States of America]	Noted. The text has been substantially revised and made more quantitative in places though this is mostly done in other sections and this is largely introductory concepts.
46006	13	5	13	8	Literature actually covers also a third basic approach, which is to look at empirical studies and dataseries to highlight when, where and how many times a given percentage of fall in emissions has occurred. Please review the literature on national and sectoral cases, for instance for a fall of 9% or more. While integrating existing literature, please note that a fall of 9% - which, if replicated to total emissions each year from 2016 on, would forever keep the cumulated emissions under the TRB for 1.5°C - occurred 1132 times at national level in the years 1959 to 2016 in the 220 countries considered by the (Le Queré et al.) Global Carbon Budget 2017. This corresponds to 9% of cases. It's true that in the large majority of these cases, the fall was connected to a GDP reduction. So what is really difficult is decoupling emission from GDP. But also for this there are good examples you should highlight. [Valentino Piana, Italy]	Noted. The text has been substantially revised and made more quantitative in places though this is mostly done in other sections and this is largely introductory concepts. Decoupling is highlighted elsewhere, e.g. in a paper by Newman (2017).
62800	13	10	13	36	Both approaches do not take into considerations dramatic changes which may occur during a short period of time, for instance sharp decrease of PV prices from 2012 onwards or ongoing and strong progress in storage [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, see further down in the text (lines 38-45 in SOD). We intend to bring this out more in the text.
60832	13	13	13	13	exptrapolation is an overly simplistic description of these models. [United States of America]	Accept. Term will be removed.
51970	13	17	13	20	I want to be clear, I *agree* with this statement and, wish it weren't true. That being said, the nuance of this statement must be brought out more. This statement is very important and is part of the need to restate the same statement consistently throughout the document. Can something be said more clearly about 'it still may be possible but difficult...' or whatever the central conclusion winds up stating. The world can't afford for this document to be even slightly vague on this point. [Jason Donev, Canada]	Noted. We will remove this here because this paragraph is not the place for it. It is stated clearly in the x-chapter box on NDCs, in the SPM and in the ES of this chapter. The document is absolutely not vague about this!
58344	13	18	13	18	What does "and reference therein" mean in this context? [Peter Marcotullio, United States of America]	Accept. Text removed.
60834	13	20	13	20	Which "patterns"? [United States of America]	Accept, meaning unclear. Text revised and moved.
5034	13	22	13	25	With the world now on a 3+ C pathway, adatpation planning would seem to need to be focusing on this higher number (and recognizing that if on this pathway, the situation may even worsen) and sea level rise will go on and on. Given that situation doing adaptation planning for only 1.5 C would seem irresponsibly optimistic and so it would seem there is bound to be maladaptative investments--the uncertainty of what nations will be able to do is thus a critical factor likely to increase waste of resources by doing too little or too much. The challenge is finding adaptive measures that can deal be adjusted over time, etc. [Michael MacCracken, United States of America]	Accept. This has been taken up in the part of transformative adaptation.
60836	13	22	13	22	What does "avoiding pitfalls" mean? [United States of America]	Accept, meaning unclear. Text revised and moved.
55902	13	23	13	24	Adaptation pathways are just defined in 5.3, which then makes a reference to Ch. 1, so Ch. 4 might want to put the diagram in here. [Debora Ley, Guatemala]	Accept. We are adding text on adaptation pathways
1558	13	29	13	36	The second approach utilizing integrated assessment models to llok at whether past trends can inform the validity of the assumptions in the models is fine. However, IAMs are well recognized to reflect technology substitutions based on costs, and the costs of technologies need to be raised significantly if the rate of transiton is to be able to achieve the 1.5 C. It is clear that past historical trends were not impacted by any global policy that would drive such high costs, and the comparison with historical trends may be fraught with difficulties. [Arthur Lee, United States of America]	Accept. This is represented by the speed and scale question - the scale can limit economic impact (because of economies of scale) but speed can negatively impact, because learning cannot keep up with installation.
12196	13	29	13	36	This discussion suggests that the IAMs are performing well. However this paper (which is not acknowledged by van Sluisveld) suggests that models have been overoptimistic on emissions https://www.nature.com/articles/452531a. It's a fairly old paper but think a more criticial and expanded discussion of these issues is needed here. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This is revised in the text that discusses weaknesses of IAMs.
45550	13	29	13	36	The first cited source has bioenergy at 250-300EJ gobally whch exceeds what is said to be sustainable supply (below). Therefore rates of change depend indirecty on unsustainable bio supply. The paper also conclude sthat while investment in electricity generation is within historic range, other ndictaors are not. The sources cited also refer to 2 degrees not 1.5. Finalyl the Wilson paper is basded on the "policy-free" SRES scenarios. The fairly optimistic "broadly consistent" tone appears not to be truly supported by the cited sources. Also see the Loftus et al reference in the feasibility box in Chapter 1 which takes on feasibiity head-on and has a different message. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Loftus reference added and the other messages nuanced further. Some stay valid but others not.
60838	13	29	13	36	The second approach utilizing integrated assessment models to look at whether past trends can inform the validity of the assumptions in the models is fine. However, IAMs are well recognized to reflect technology substitutions based on costs, and the costs of technologies need to be raised significantly if the rate of transiton is to be able to achieve 1.5°C. It is clear that past historical trends were not impacted by any global policy that would drive such high costs, and the comparison with historical trends may be fraught with difficulties. [United States of America]	Accept. See response to comment 1558.
5036	13	30	13	30	Again, important to use IPCC lexicon rather than "may" even if have to add a qualifying phrase. [Michael MacCracken, United States of America]	Accept. Text revised.
8076	13	32	13	32	what metrics? This sentence is mysterious without reading the paper. It should be clarified here or removed. [Quentin Perrier, France]	Accept. Will be further explained - they are metrics like electricity generation by RE and the like.
30578	13	32	13	32	« when metrics are normalised to GDP » What metrics? This sentence is mysterious without reading the paper. It should be clarified here or removed. [France]	Accept. See response to 8076.
31716	13	32	13	32	IAM is only now being defined after being used previously in the chapter [Michael SUTHERLAND, Trinidad and Tobago]	Accept. Will be revised.
60840	13	33	13	35	This sentence needs more detail. Are "modelled rates of change" consistent with the past for the 2°C scenario? For the 1.5°C scenario? In all scenarios? All emissions? [United States of America]	Accept. More detail will be added. To our knowledge, no papers on this specifically are published on 1.5C.
8078	13	35	13	35	Models can also be much more optimistic. Cf CCS in the past ten years… and maybe negative emissions today? [Quentin Perrier, France]	Accept. It's a mixed bag. Will reflect that.
10070	13	38	13	45	The effects of shocks and discontinuous changes in speed of change could be temporary rather than permanent. Models usually try to capture long term trends of speed of change and thus may miss short term spikes but account for that on the long run trend. So the question is really whether the documented departures in speed of change are temporary or permanent. [Saudi Arabia]	Taken into account. This may be, but shocks can also be permanent, because of inertia of energy systems, for instance. Nuclear only needs to be unpopular for ten years to inhibit its implementation for fifty years, for instance.
45372	13	38		45	The first sentence could be reworded, to be made clear, even if only removing "abstracting from the specific speed of change" - as that phrase does not add muc, the entire section is about accelerating change, so that is a given. [Veryan Hann, Australia]	Accept. Text is revised.
58336	13	38	13	45	Is this entire paragraph related to the "second appraoch" to an analysis of mitigation technologies? If so, can we specify how? [Peter Marcotullio, United States of America]	Accept. Text revised to clarify the flow.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
45374	13	38		45	suggestion: This is an important paragraph, given the wider context it embraces for change. It could also be mentioned here that there can be a kind of positive feedback or cumulative effect of acceleration as different sectors are aligned and implement istrategies for change. The sentence starting on line 40 could be expanded on. Specifically the Geels Multiple-level Perspective (MLP) is a qualitative starting starting point as a framework that quantitative models could be worked into. The MLP elements that could be modeled in terms of alignment are policy/market preferences (consumer demand)/ economics (cost)/ political will etc... a measure of alignment between these could be arrived at and expressed in the usual IPCC way eg (low/med/high agreement or alignment; and low/med/high evidence). [Veryan Hann, Australia]	Noted. The text has been substantially revised and made more quantitative in places though this is mostly done in other sections and this is largely introductory concepts.
13148	13	40	13	45	Delete the text " Further, energy transitions are associated with wider socio-economic transformations that are generally not represented in models (Geels et al., 2016a), which gives reason to believe that energy transitions could proceed much faster (Sovacool, 2016). An 'autonomous' rate of change, determined by political will and the willingness to see energy transitions as a 'political, social and cultural project' rather than just a techno economic one (Kern and Rogge, 2016), gives reason for optimism. Most recently, Creutzig et al. (2017) confirmed this for solar energy.". [Eleni Kaditi, Austria]	Reject. This is a well-referenced and scientifically rather uncontroversial set of sentences that have recent literature and are relevant to 1.5C. So no reason to delete it.
58332	13	42	13	42	proceed much faster than what? There are a lot of comparison constructions in this chapter, but without specifiying what is being compared! [Peter Marcotullio, United States of America]	Taken into account. The phrase is removed in the new version.
60842	13	44	13	45	Normative construct. [United States of America]	Accept. Text revised.
60844	13	44	13	45	What did Creutzig "confirm" for solar energy? Optimism? [United States of America]	Accept. Text revised to clarify this. They confirm the potential for rapid change caused by systemic drivers.
6122	13	47	13	55	The paragraph is difficult to understand [Anne Olhoff, Denmark]	Accept. This paragraph is also a bit too academic. It will be removed while the policy-relevant messages will be incorporated elsewhere in this section.
12198	13	47	13	55	This discussion is lacking sufficient criticial depth and fails to address the full breadth of the literature. At the very least you need to be addressing papers that also demonstrate the scale of the challenge and reach opposite conclusions about feasibility. For example, http://wires.wiley.com/WileyCDA/WiresArticle/wisId-WCC324.html https://www.sciencedirect.com/science/article/pii/S0360544217311155 http://www.mdpi.com/1996-1073/10/1/116 http://www.mdpi.com/1996-1073/10/1/89. It's obviously important to point to optimistic studies, but the absence of a balanced discussion could undermine the credibility of the report. [United Kingdom (of Great Britain and Northern Ireland)]	Accept. Those paper are very good, and will be incorporated in the discussion.
18560	13	47	13	55	Consider stating the message of this paragraph more directly. For example, this sentence is rather meandering. "both approaches indicate that the speed of changes in the past have not necessarily been slower than the ones that 1.5°C pathways, including those assessed in Chapter 2, indicate" [Andrea TILCHE, Belgium]	Taken into account. This paragraph will be removed because it's too complicated and academic.
31718	13	47	13	54	Is it possible to write more objective sentences than using "we"? [Michael SUTHERLAND, Trinidad and Tobago]	Accept, rephrased as 'it is assumed that the future direction of technological change can be better understood by looking at the past'
53574	13	47	13	48	The authors provide an interesting explanation for the two different but complementary views on how the past leads into the present and the future, and what can be learnt from history. The extension of the past into the future (first approach) and seeing how the present fits into models of the future (second approach) are actually quite divergent views on historicity and time. While the first approach imagines a continuous time with predictable bleeps, the second approach attempts to tame the uncertainties from disruptive innovations towards desired futures. At a philosophical level, the two approaches differ in their view on agency and power to bring about societal change, at the scale of global economic patterns. The conclusion that the one approach leads to slow change and the other to fast change (speed) may not be accurate. Incremental versus transformational change appears to fit better. The message from this text appears to be that 1.5 degree limit can be achieved whether change is achieved through increments or disruptions. Is this inference accurate? Because later in the text, authors tend to favour transformational over incremental change. [Sumetee Pahwa Gajjar, India]	Accept. This is a nice comment that has a lot of thought going into it. If it is so that that inference (that incremental change can get us to 1.5C) is coming from the two approaches, something is wrong. We will look at the two approaches again. This reviewer is the only one who seemed to understand the distinction, so perhaps we should remove it as it may only be of interest to educated historians!
60846	13	47	13	51	Are the authors really "fitting historical growth patterns" or just comparing model outputs to historical trends? Treatment of learning from the past is treated too casually here. The field of anthropological archaeology and cultural evolution has done a great deal of research and analysis into how to look at patterns in the past and consider connections between the past and present. The first two sentences should be rephrased so that it is very clear throughout that a particular approach to technological change is being discussed. If possible, discussion of the broader issues of understanding complexity of patterns in the past could be added. This particular section does not have any references. Relevant starting scholars for this topic include: Margaret Nelson, Michelle Hegmon, and Charles Redman. [United States of America]	Accept. The reviewer is right about this - we don't have the space to go into this literature in this short section. The more academically oriented parts will be simplified, and the distinction between the two approaches will be removed. See also response to comment 53574.
48310	13	49	13	51	The sentence: "When fitting historical growth patterns into models (the second approach), we assume that time has a cyclic character, that history can repeat itself, and that patterns of change in the past can predict, to some extent, patterns of change in the future." is vague and imprecise. To say that they "can predict patterns of change in the future" is a bold and inaccurate comment. The existence of long waves of about 50 years average-length in economic life was first presented by Nikolai Kondratieff (1935). (Simon Kuznets identified economic waves of about 15 to 25 years of duration). It is recommended to formulate the former sentence as: "When fitting historical evolution patterns into models (the second approach), we assume the cyclic character of both economic growth and technological change due to processes of innovation and structural adjustment, as stated by long wave and business cycle theorists (Schumpeter, 1939; Freeman y Pérez, 1988). Patterns of regularity and change in historic periods of major socio-technological transformations (Freeman and Pérez, 1988) reveal shared conditions and arrangements which may contribute to assess patterns of change in the future." Related references: Kondratieff, N. D. (1935) 'The Long Waves in Economic Life', Review of Economic Statistics, 17, 105-115 Schumpeter, J. A. (1939:1982), Business Cycles, 2 vols., Philadelphia: Porcupine Press. Freeman, C., and Perez, C., (1988). Structural crisis of adjustment, business cycles and investment behaviour. In Technical Change and Economic Theory, eds. G. Dosi,, C. Freeman, R. Nelson, G. Silverberg and L. Soete (London: Pinter), 38–66. [Miriam Solera Ureña, Germany]	Accept. Sentences are strongly revised. The references, however, are not considered 1.5C-relevant or recent enough.
7910	13	50	13	50	Remove "we assume that time has a cyclic character, that history can repeat itself, that " - highly speculative and unnecessary [Christopher Bataille, Canada]	Accept. This paragraph will be removed.
30580	13	50	13	50	« we assume that time has a cyclic character, that history can repeat itself » Dubious, unnecessary philosophy [France]	Accept. This paragraph will be removed.
10072	13	54	13	55	To conclude that both approaches suggest that speed of changes in the past is not necessarily slower than what simulated by models for 1.5c pathways is simply not right because that would mean there is no need for strengthening responses to effect fact transition to enable 1.5c. [Saudi Arabia]	Accept. Text revised to reflect this.
45484	13	54	13	55	not necessarily been slower is vague an dpotentially misleading. One trend (elec gen) not slower, others have been. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Text carefully revised.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
58340	13	54	13	54	The line that staes "Both approaches" is confusing. I had thought, and it seems to be stated in the text, that the "Fouguet (2016) article presents transitions as very long term processes, but this statement seems otherwise. This summary statements seems otherwise, but without clarification, as far as I can tell. . [Peter Marcotullio, United States of America]	Accept. Text is revised and the conclusions based on historical approaches will be reconsidered.
62744	13	54	13	55	This statement is incorrect, at least in its general form. It is not true for emissions, electrification rates and the phase-in of many low-carbon technologies. Energy efficiency improvements in pathways are also higher than in the past, although some countries might have seen similar improvement levels after the oil crisis (to be checked). The statement may hold for some quantities (e.g. RE power technologies), but those would need to be singled out then. [Elmar KRIEGLER, Germany]	Accept. Text will be revised to make it more conclusive and detailed on what the models and historical data actually say.
10588	14	1	43	1	The whole section addresses the adaptation and mitigation options. Although in many cases, they can not be clearly separated, in some other cases, they are clearly different. In this section, the differences in adaptation and mitigation options should be distinguished. [Hong Yang, Switzerland]	Noted.
12200	14	1	14	43	This section is generally cluttered and unclear and in need of a proof read. I will try to highlight the obvious as individual points. But generally speaking lines 2-11 are very unclear, and I'm not convinced that lines 13-20 mean anything - very vague and hard to understand what points it is actually trying to convey. Additionally, there's a concern that the title here is a bit of a misnomer as the section does not appear to deal with behaviour change, but rather it deals only with socio-technical systems change and the concept of growth decoupling from GHG emissions. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text modified to explain better, including behaviour.
51972	14	1	14	11	I'm not quite sure what's being said here. If we *do* have disruptive changes, there will be stranded assets? That's a conditional statement. It seems like this paragraph is arguing that there will be, or even must be disruptive changes to grid level storage, which frankly, I find highly unlikely. The economic demand for grid-level storage didn't start with the movement to have large amounts of wind and solar on the grid, utilities have long needed expensive equipment for load-following in every country in the world. While the world will almost certainly see incremental improvements in grid-storage, old technology like batteries are unlikely to have 'game-changers'; disruptive technology is far more evident in emerging technology than in established technology. [Jason Donev, Canada]	Accepted: Text modified to ease sense of stranded assets being required. New batteries are disruptive as they are significantly improved and support PV as well as, being much cheaper due to EV growth (potential Y2G).
60848	14	1	14	11	An excellent example of a disruptive technology is oil and gas fracking. In the U.S. this has resulted in signficant production increases, that is displacing the use of coal with gas and the associated reduction in GHG emissions. Consideration should be given to this game changer. [United States of America]	Accepted: Sentence added, but not demand led disruption and provisional status of gas noted as in literature as well as by IEA.
62160	14	1	14	4	the sentence is not clear, should be split into two ideas on the need for modelling and the need for robust information… [Antoine Bonduelle, France]	Accepted: Text modified.
12202	14	2	14	3	Change this entire sentence to read "Understanding rates of change requires knowledge of, and preferably modelling of disruptive innovation as well as the sources of robustness of the socio-technical systems it disrupts." - This gets rid of a duplicate and as well as an unnecessary comma that disrupts the flow of the text. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text modified, although later revisions may have led to a different final text.
7912	14	3	14	3	Remove comma [Christopher Bataille, Canada]	Accepted: Text changed.
48322	14	3	14	3	Unnecessary comma: "Understanding rates of change requires knowledge of, and preferably modelling of disruptive innovation and 3 the sources of robustness of the socio-technical systems, it disrupts"--> "Understanding rates of change requires knowledge of, and preferably modelling of disruptive innovation and the sources of robustness of the socio-technical systems, it disrupts" [Miriam Solera Ureña, Germany]	Accepted: Text changed.
48312	14	3	14	6	Disruptive innovations are called „disruptive“ not just because they are significant but because they lead to a quantitative technical change. If they are significant incremental, accumulative or qualitative change, they just represent incremental technological progress. This is the core argument of the co-evolutionary theories of technological change. References to support this comment: Dosi, 1982, 1988; Dosi and Nelson, 1994; Pérez, 2010. Dosi, G. (1982). Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. Research Policy, 11(3), 147-162. doi:10.1016/0048-7333(82)90016-6. Dosi, G. (1988). The nature of the innovative process, in Technical change and economic theory, eds. G. Dosi, C. Freeman, R. Nelson, G. Silverberg & L. Soete (Londres: Printer Publishers), 220-238. Dosi, G. and Nelson, R. (1994). An introduction to evolutionary theories in economics. Journal of Evolutionary Economics, 4(3), 153-172. doi:10.1007/BF01236366 Perez, C. (2010). Technological revolutions and techno-economic paradigms. Cambridge journal of economics, 34(1), 185-2. doi:10.1093/cje/bep051 [Miriam Solera Ureña, Germany]	Accepted: Text modified to include co-evolutionary theories of technological change along with socio-technical transitions which largely overlap e.g. Peree, Freeman, though we focus our literature choice on new literature since AR5 as per the mandate this SR has been given.
48314	14	3	14	6	Following the former comment, it is more accurate to formulate the sentence: “Disruptive innovations are technological changes that lead to significant system change (Christensen et al., 2015; Green and Newman, 2017a; Seba, 2014) that are very hard to predict by economists and modellers as economic feasibility is a limited predictor of the success of innovations (Geels et al., 2016a; Green and Newman, 2017b).” as: “Disruptive innovations are technological changes that lead to quantitative system change (Christensen et al., 2015; Dosi 1982, 1988; Dosi and Nelson 1994; Green and Newman, 2017a; Pérez, C. 2010; Seba, 2014) that are very hard to predict by economists and modellers as economic feasibility is a limited predictor of the success of innovations (Geels et al., 2016a; Green and Newman, 2017b)”. [Miriam Solera Ureña, Germany]	Taken into account: The suggested change is not warranting any change to the text as 'significant' is as good as 'quantitative'. The whole paragraph was changed and the extra references provided were suggested to be added but may have not made the final cut. .
12204	14	5	14	6	Change the clause after (…Seba 2014) to read "that are very hard to predict by economists and modellers as economic feasibility is a limited predictor of the success of such innovations" [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: 'such' added.
12206	14	6			Add "for example, " in front of "the increase in roof-top solar…" to make the connection between the argument offered and the substantial claim more apparent. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text revised.
48324	14	7	14	8	Unnecessary commas: "The increase in roof-top solar and energy storage technology supported by digital technology, and the increase in passive housing and Net Zero Emissions buildings, may be disruptive innovations in several countries […]."--> "The increase in roof-top solar and energy storage technology supported by digital technology, and the increase in passive housing and Net Zero Emissions buildings may be disruptive innovations in several countries […]. [Miriam Solera Ureña, Germany]	Accepted: Text modified, although later revisions may have led to a different final text.
5038	14	8	14	8	Another instance of "may" to replace by a choice form the IPCC lexicon. The chapter needs to be scrubbed for this word and changes made--and so I will refrain from further mention of this need. [Michael MacCracken, United States of America]	Noted. Sometimes it is a good word if the literature is unambiguous.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
45376	14	9		9	Though this statement is true, it is changing. Many companies are proactively looking to turning the challenge into an opportunity. The group I'm working with is a small example of that the ARENA CONSORT smart grid pilot was **instigated** by the network utility- even though it is against the current utility business model. The energy sector utilities are grappling with transitioning their business models from product-based (eg selling electricity as a product) to service-based (requiring customised solutions and requiring mroe engagement that just selling a product). There are other, non-Australian jurisdictions where utility innovation like this is occuring- eg California, the Netherlands, Canada (Hydro Quebec) [Veryan Hann, Australia]	Noted: Supports text.
13150	14	10	14	11	Delete the text "Examples are 'unburnable oil' (McGlade and Ekins, 2015) and coal-fired plant assets (Caldecott, 2017; Farfan and Breyer, 2017).". [Eleni Kaditi, Austria]	Rejected
47402	14	10	14	10	Kossoy 2015 is this reference on carbon pricing suited for cite in this text on stranded assest after distruptive innovation? [Sarah Connors, France]	Noted: Carbon pricing is covered later, but this "State" contained something on innovation and disruption.
55062	14	10	14	10	Specify examples of "stranded assets" [Yamide Dagnet, United States of America]	Accept, examples are given.
57784	14	10	14	11	At the end of the phrase: "Examples are 'unburnable oil' (McGlade and Ekins, 2015) and coal-fired power plant assets (Caldecott, 2017; Farfan and Breyer, 2017)." I suggest to add: "According to the study of Hydrogen Council 'Hydrogen, Scaling up' Hydrogen – abundant, versatile, clean, and safe – can play seven vital roles to meet the challenges of the low-carbon transition: Enabling large-scale renewable energy integration and power generation; Distributing energy across sectors and regions; Acting as a buffer to increase energy system resilience; Decarbonizing transportation; Decarbonizing industrial energy use; Helping to decarbonize building heat and power; Providing a clean feedstock for industry (Hydrogen Council, 2017)." - NEW REFERENCE: Hydrogen Council "Hydrogen scaling up - A sustainable pathway for the global energy transition" (2017), <http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-Scaling-up_Hydrogen-Council_2017.compressed.pdf >. [Mario Valentino Romeri, Italy]	Accepted: Text modified. Hydrocarbons now added into storage and industry
33156	14	11	14	55	Add refernences to the risk to human rights and express the risks identified like impacts on health and food security and displacemnt as rights - right to food, right to shelter, right to health. Refer to the relevant resolutions and report of the Human Rights Council. [Tara Shine, Ireland]	Rejected, human rights, health etc. discussed in Chapter 5
12208	14	13	14	15	Unneccesary comma in the sentence, suggest changing it to "Technological change, disruptive or not, is associated with social change, such as the adoption of different business models and governance systems…" [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text modified, although later revisions may have led to a different final text.
48316	14	13	14	16	Non-disruptive technological change is mentioned (but not clarified) in line 13. It is suggested to reinforce and clarify the difference between disruptive and non-disruptive technological change. For that purpose, it is suggested to add a clarifying sentence at the beginning of the paragraph, line 13, so that the whole paragraph shall look like: "These changes (disruptive innovation) may represent a so-called new "technological paradigm" differing from incremental (non-disruptive) change, which progresses along a consolidated technology trajectory following each of the paradigms (Dosi, 1982, 1988; Dosi and Nelson, 1994; Pérez, 2010). Technological change, disruptive or not, is associated with social change, such as the adoption of, different business models and governance systems, as well as some areas of cultural change (Freeman and Perez, 2000; Geels and Schot, 2007, 2010, Perez, 2003, 2009a, 2009b). This can explain how energy transitions are happening, showing how significant socio-technical aspects of change are, and will be in driving the transition to 1.5°C (Geels, 2014; Geels et al., 2016b). In addition, strategic niche management (Kemp et al., 1998) and functional approaches through technological innovation systems (Bergek et al., 2008; Hekkert et al., 2007) can help develop policy responses to innovation challenges (Caniëls and Romijn, 2009; Geels et al., 2017c; Kilkis, 2016)." [Miriam Solera Ureña, Germany]	Accepted: Helpful addition. Text modified but also reduced so may not get into final.
48318	14	13	14	20	The social dimension of technology change should be emphasized in this paragraph (lines13-20). Otherwise the sentence beginning in line 15 "This can explain how […]" appears to be a weak claim. Therefore, it is proposed to modify the paragraph by extending it: "Technological change, disruptive or not, is associated with social change, such as the adoption of, different 14 business models and governance systems, as well as some areas of cultural change (Freeman and Perez, 15 2000; Geels and Schot, 2007, 2010, Perez, 2003, 2009a, 2009b). It is essential to highlight the relationship between technology and social change. This arises from both, ex ante predictions and patterns of diffusion and social acceptance, among others (Dosi, 1982; Freeman y Pérez, 1988; Pérez, 2010). The uncertainty in terms of economic and technological success related to the process of choosing among innovations as well as the dynamics of diffusion and self-reinforcement of the selected technologies, give significance to social agentes, factors and processes in the technology transitions. This can explain how energy transitions are happening, showing how significant socio-technical aspects of change are, and will be in driving the transition to 1.5°C (Geels, 2014; Geels et al., 2016b). In addition, strategic niche management (Kemp et al., 18 1998) and functional approaches through technological innovation systems (Bergek et al., 2008; Hekkert et al., 2007) can help develop policy responses to innovation challenges (Caniëls and Romijn, 2009; Geels et al., 2017c; Kilkis, 2016)." [Miriam Solera Ureña, Germany]	Accepted: Text modified, although later revisions may have led to a different final text.
58348	14	13	14	13	Remove the comma after "of" [Peter Marcotullio, United States of America]	Accepted: Text modified, although later revisions may have led to a different final text.
12210	14	15			The sentences begins "This can explain…" but it is unclear was "this" refers to. It feels like there is a missing sentence preceeding this sentence where the authors provide a clearer explanation of their understanding social and cultural change. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text revised.
47404	14	15	14	17	Geels 2014 and 2016b do not specifically look at 1,5°C pathways and so, can they be used to support the statement which focus on 1,5°C pathways? [Sarah Connors, France]	Accept, yes as they do have a new paper on it… Reference now added.
5040	14	17	14	17	Rather than say "transition to 1.5 C" how about saying "efforts to limit global warming to no more than 1.5 C" so that this will require significant effort is needed to pull back from where we are, rather than seem like a desired move from 1 up to 1.5 C warming? [Michael MacCracken, United States of America]	Accepted: Text changed.
37618	14	17	14	20	Please explain in less technical language. [Michiel Schaeffer, Netherlands]	Noted. We try.
10074	14	22	14	26	The decoupling hypothesis is debatable and not firmly established. There are certainly other studies that suggest decoupling may not happen given regional disparities in resources and stages of development. Further the decoupling referred to in the literature is usually meant decoupling of economic growth from energy use rather than specific from fossil fuels. Applying the concept of decoupling to climate change, the parallel would be decoupling of economic growth from GHGs emissions, in which case the problem will be emissions from fossil fuels rather than the energy produced from fossil fuels. [Saudi Arabia]	Accepted: Text modified but GHG decoupling is still in use.
12212	14	22	14	36	The information on 'decoupling' is split across two paragraphs here that should probably be combined. That new paragraph would start on what is presently line 22 with "Decoupling (Newman, 2017…" amd finish on what is presently line 26, "… (IEA, 2017c)." As the current second paragraph (line 28) starts with a counterpoint, I suggest that when thisa is stiched to the previous paragraph on line 26 you add "However, Data for 2015…" [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text changed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
30582	14	22	14	22	« Decoupling (Newman, 2017; von Weizsäcker et al., 2014) suggests that » Strange sentence. Decoupling does not suggest anything per se. It is just a concept. [France]	Accepted: UNEP (2017) added to text as decoupling is a concept from UNEp designed to 'suggest' change.
36066	14	22	14	22	Replace “von Weizsäcker et al., 2014” with 'Weizsäcker et al., 2014' [India]	Editorial
45486	14	22	14	26	Hard to say that something has decoupled on the basis of two years data. And decoupled from what if its absolute? Cant we just say they stablised/fell without implying permanence which could easily be proved wrong by teh time the report is approved! [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text modified.
51974	14	22	14	28	I am concerned that what we've seen is a move from coal to natural gas, rather than a true decoupling of carbon emissions from our economy. Please distinguish carefully the difference between an improvement to carbon intensity and a decoupling of carbon and economy. A decoupling is when one no longer relies on the other, requiring a lack of any causal relationship. An improvement to carbon intensity (which has been happening consistently in a significant fraction of the countries around the world for years) is still good, but can't legitimately be called a decoupling. [Jason Donev, Canada]	Rejected: It is decoupling GHG, not fossil fuels though references are to fossil fuels decoupling in some countries.
61966	14	22	14	26	Too implicit. Explain what is the rebound effect (there can be a link to the related section of chapter 2, possibly 2.6). [Valérie Masson-Delmotte, France]	Rejected: References are provided.
13152	14	23	14	24	Replace "fossil fuels" with "energy". [Eleni Kaditi, Austria]	Rejected: Not the logic of the paragraph.
29368	14	23	14	24	There is already evidence of decoupling in Europe - this should be referenced.https://www.sciencedirect.com/science/article/pii/S2212567116302957 [Shelagh Whitley, United Kingdom (of Great Britain and Northern Ireland)]	Reject. The paper is not in a peer-reviewed journal; it's a conference paper.
1654	14	28	14	33	It is suggested to delete " has begun in China" and next sentence " in 2017 decouping reverse…" [Wenying Chen, China]	Accepted: Text modified
6124	14	28	14	43	In line 28, 'gas' is missing between greenhouse and emissions. Please check whether you mean GHGs or CO2 in the statements regarding decoupling. Overall, the paragraph seems to accept that decoupling is taking place and will continue, which implies that global GHG emissions have peaked - this is not consitent with the literature and also seems to contradict other sections of the chapter. [Anne Olhoff, Denmark]	Accepted: This part has been changed significantly to accommodate this and other comments.
8364	14	28	14	33	“Data for 2015 and 2016 show that greenhouse emissions decoupled absolutely. This has been driven by declines in both coal and oil use, which has been happening since the early 2000s in Europe, in the past seven years in the United States and Australia, and has begun in China. In 2017 decoupling reversed due to a drought in China and subsequent increase in the use of coal-fired power though this is not expected to continue as China is phasing out coal rapidly.” 1. China is still in a slow rise in carbon dioxide emission from energy consumption, there being no absolute decoupling. 2. China registered a drop in coal consumption by about 20 million tons (of standard coal) in 2015 and 70 million tons (of standard coal) in 2016. However, oil consumption has been rising year by year without any sign of going down. The current statement is not true. 3. In 2017, China did not show “retrogression” in low-carbon development, with its changing energy consumption pattern being in line with objective laws. Although its growth has declined in China in recent years, coal consumption has not yet peaked. The statements here that the decoupling of GHG emissions and economic development “has begun” or “coal and oil consumption has begun to decline” in China are not in conformity with objective facts. It is suggested to reformulate the message as: “Data for 2015 and 2016 show that greenhouse emissions decoupled absolutely. This has been driven by declines in both coal and oil use, which has been happening since the early 2000s in Europe, in the past seven years in the United States and Australia.” [China]	Accepted: Sentence changed. Added Gao and Newman (2018) to make the point about decoupling in cities, including in China.
12214	14	28	14	29	They decoupled absolutely in 2015 and 2016? Is it fair to describe a couple of years of flat emissions and growth in the economy as "absolute" decoupling? Being overoptimistic in this respect could undermine the credibility of the report. Moreover, what exactly does absolute decoupling mean? [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Sentence modified.
18562	14	28	14	43	In line 28, 'gas' is missing between greenhouse and emissions. Please check whether you mean GHGs or CO2 in the statements regarding decoupling. Overall, the paragraph seems to accept that decoupling is taking place and will continue, which implies that global GHG emissions have peaked - this is not consitent with the literature and also seems to contradict other sections of the chapter. Is there an accepted definition of "decoupling" in the scientific literature? 1-2 years of stalled CO2 emissions seem insufficient to make such a claim. [Andrea TILCHE, Belgium]	Accepted: This part has been changed significantly to accommodate this and other comments.
31646	14	28	14	29	Decoupled relative to GDP. Greenhouse gases, not greenhouses. [Lorcan Lyons, France]	accept, changed accordingly
31648	14	28	14	29	No, the decoupling was relative not absolute (assuming absolute decoupling means reduction, although that is not stated). There was a slight increase in emissions in at least one of those years according to IEA statistics. IEA characterised this is as stagnation, not reduction. [Lorcan Lyons, France]	Accepted: For global but not for Europe, America, Australia examples. Text modified.
36068	14	28	14	28	The report cites that economic growth has decoupled absolutely from GHG emissions during 2015 and 2016. Citations need to be added to substantiate this statement. [India]	Accepted: References provided.
36958	14	28	14	36	In 2017 decoupling reversed due to a drought in China and subsequent increase in the use of coal-fired power (Tollefson, 2017) though this is not expected to continue as China is phasing out coal rapidly (IEA, 2017c). is misleading because describing in this way implies that China may be able to achieve decoupling hereafter as a long-time trend. China's phenomenon may be temporal, so a more nuanced description is needed. [Keigo Akimoto, Japan]	Accepted: This part has been changed significantly to accommodate this and other comments.
37620	14	28	14	33	To speak of decoupling of emissions from economic growth in the context of a single year or two years does not seem to be useful. Decoupling seems to imply a trend, not a point measurement in time. [Michiel Schaeffer, Netherlands]	Taken into account. Though indeed decoupling is a trend, it has been one in Europe since 1990's and the data shows 7-9 year trend in US and Australia. See Newman (2017).
37622	14	28	14	28	Reword. It is not GHG emissions that decouple, but economic development that decouples from emissions [Michiel Schaeffer, Netherlands]	Accepted: Sentence changed.
51976	14	28	14	28	Data cannot show decoupling. Interpretation of data shows decoupling. Data are a record of measurements, the researchers must put interpretation on this data. As stated in my previous comment I strongly object to this interpretation of these data. [Jason Donev, Canada]	Rejected: Decoupling is well explained as a process where economic growth and GHG begin to separate at the start of a process of transformation is of interest to everyone not just economists.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
51978	14	28	14	28	The statement that emissions decoupled absolutely is not true. It may be true that the growth appears to have decoupled, but to claim an absolute decoupling implies that they have nothing to do with each other at all. Economists think on the margins, and I think that the focus on the margins in this situation has led to people thinking in terms of only the margins, which is problematic when the entire emissions must be considered. [Jason Donev, Canada]	Rejected, see above.
60850	14	28	14	28	The statement that "greenhouse emissions decoupled absolutely" is quite sweeping. Suggest re-confirming this point and limiting it as appropriate. Further, be sure not to use the word "decoupling" in the definition of "decoupling"… [United States of America]	Accepted: Sentence modified.
62746	14	28	14	29	Does this still hold, when taking 2017 into account? [Elmar KRIEGLER, Germany]	Accepted: Text modified
13154	14	29	14	29	Replace "both coal and oil" with "energy". [Eleni Kaditi, Austria]	Rejected: No reason given
12216	14	31	14	33	So the only reason that decoupling "reversed" (if indeed it started) in 2017 is because of a drought in China? That seems like a rather simplistic analysis. Moreover, it is surely far too simplistic to say that we should expect a reversion back to decoupling simply because China might not be doing quite as much coal as once thought. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: This part has been changed significantly to accommodate this and other comments.
37030	14	31	14	33	The increase in emissions in China in 2017 is not only from drought, but rather (as stated in the cited article): "The main causes are increased activity at the country's factories and reduced hydroelectric-energy production". We have been tracking many indicators, including electricity consumption, steel production, cement production, aluminum production, coke production, etc. and they all increased in 2017. Regarding the statement "though this is not expected to continue as China is phasing out coal 33 rapidly", you need a citation. Recent trends are pointing to an increase in Chinese coal use throughout 2017 which could continue. Recent research at LBNL shows an increase in coal use in China expected until at least 2020. [Lynn Price, United States of America]	Accepted: Sentence changed. Citation was already there.
45378	14	31		33	China releases 5-year plans, and the last one stated that the 7 emission trading pilots (in 7 different provinces) would select the successful ETS pilot and roll out nationwide in 2017. It is worth keeping an eye on developments here over the final stages of the review of this special report. The national scheme is delayed but seems imminent https://www.ft.com/content/cd549b9a-e088-11e7-a8a4-0a1e63a52f9c [Veryan Hann, Australia]	Noted. No peer-reviewed literature provided. Discussion on policy instruments including carbon pricing in section 445.
48098	14	31	14	32	Cited reference does not mention drought in China. Please revise accordingly [Sarah Connors, France]	Accept. Language removed.
60852	14	31	14	33	The comment that "China is phasing out coal rapidly" should be revised. While this may be true domestically, China is agressively expanding the development and use of coal resources globally. [United States of America]	Accepted: Sentence revised though not on global activity of China - no reference given.
1656	14	32	14	33	China is phasing out coal rapidly should be reivsed to "China is phaing out backward coal capacity rapidly". [Wenying Chen, China]	Accepted: Sentence changed but then this part has been changed significantly to accommodate this and other comments.
57780	14	33	14	36	Phrase: The rate of decoupling depends on increases in efficiency (Dasgupta and Roy, 2017; Qi et al., 2016) as well as socio-technical and disruptive innovations and will need to increase rapidly if the 1.5°C challenge is to be met (Newman et al., 2017) as set out in the new 'sustainable development' scenario of the IEA (IEA, 2017c). The correct IEA reference is (IEA, 2017f) or World Energy Outlook 2017 and not the IEA ETP 2017 (c). [Mario Valentino Romeri, Italy]	Accepted: Text changed but then removed due to IEA reference.
31650	14	34	14	36	The Sustainable Development Scenario of the IEA is not a 1.5C scenario. It is a 2C scenario that focuses on energy access first (WEO-2017, Chapter 1) [Lorcan Lyons, France]	Accepted: Text altered to remove IEA reference and instead refer to Chapter 2 in this report.
47140	14	34	14	34	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	accept, changed into would need to but then this part has been changed significantly to accommodate this and other comments.
44076	14	36	14	37	large space followed by Chapter 2 on next line is this supposed to be a new paragraph? [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted.
55064	14	36	14	36	Suggest adding an example illustrating the decoupling at city level. [Yamide Dagnet, United States of America]	Accept, text altered by referring to Beijing and to Box 4.9.
58298	14	36	14	36	Incorrect reference should be IEA, 2017f rather than IEA, 2017c [Andrew Prag, France]	Accepted: Replaced.
5042	14	37	14	38	In that at the start of the chapter there is mention of global energy use increasing (page 10, line 48), how is this consistent with a reduction in energy demand mentioned here? Is what is meant per-capita demand, demand for energy from fossil fuels, or what? [Michael MacCracken, United States of America]	Accepted: Text changed to show geographical variations.
48996	14	38	14	38	Reduction of energy demand requires energy efficient technologies and energy sufficiency measures. See IEA definition of energy sufficiency for buildings in IEA publication entitled Modernising building energy codes to secure our global energy future (page 9) and for transport see the definition provided by Ursula Mauch in her paper entitled "Between Efficiency and Sufficiency. The Optimal Combination of Policy Instruments in the Mobility Sector towards Sustainable Development". I don't know about any definition of energy sufficiency in industry sector. I personally consider energy managment as energy sufficiency measures for industry (see IEA publication on energy management for industry: gaining thorugh savings) [Yamina Saheb, France]	Noted
48994	14	38	14	38	Reduction of energy demand requires energy efficient technologies and energy sufficiency measures. See IEA definition of energy sufficiency for buildings in IEA publication entitled Modernising building energy codes to secure our global energy future (page 9) and for transport see the definition provided by Ursula Mauch in her paper entitled "Between Efficiency and Sufficiency. The Optimal Combination of Policy Instruments in the Mobility Sector towards Sustainable Development". I don't know about any definition of energy sufficiency in industry sector. I personally consider energy managment as energy sufficiency measures for industry. IEA publication on energy management for industry: gaining thorugh savings provides a definition of energy management in industry but does not refer to it as energy sufficiency [Yamina Saheb, France]	Noted
40434	14	43	14	43	This section (4.3 Assessment of current and emerging adaptation and mitigation options) is bias towards mitigation. Differences in adaptation efforts needed between a 1.5°C world and a 2°C world are not addressed. This should be an important goal of this section. [Pedro Alfredo Borges Landaez, Venezuela]	Noted. Adaptation is included as well, quite significantly, and we have improved the bias. The mitigation challenges, however, is greater for 1.5C, while for adaptation it is smaller. There is also more literature on mitigation.
51980	14	44	14	44	The lack of proper treatment of hydropower in this section is appalling. Just like the lack of nuclear power, the literature has not been reviewed and must be. This means that the authors must set aside the prejudices associated with large hydropower projects. Many jurisdictions have hopes of making new hydropower projects around the world. Some of these projects are small, some are large. Some will expand the electrical generating capacity of large countries with extensive electricity, some will provide micro-hydro generation for poor people in rural communities. Hydro-power is an under-discussed technology that is playing into this game. Hydropower has generated almost half of the non-GHG emitting electricity for the past few decades and ignoring it is unacceptable. To look only at 'wind and solar' as the future of electrical generation is to fail to see what successes we have already have with renewable energy. [Jason Donev, Canada]	Rejected. We explain why we don't discuss hydropower (not many developments since AR5) and nuclear is discussed in 4.3.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
51982	14	44	14	44	The lack of proper treatment of nuclear in this section is appalling. Nuclear power plants have been improving their efficiencies in a number of countries, increasing the amount of electricity that they produce, with no new builds! Many exciting start-ups are working on game-changing technologies for the deployment of new types of nuclear reactors. Even if the authors don't believe that these technologies will ever have significant impact, one must review the literature and explain *why* they won't. It is insufficient to merely find a paper that states that nuclear isn't reasonable, one must review the literature properly, looking at papers that disagree with the reader's preconceptions. Alternatively, finding additional authors who have a firm grounding in this literature could provide considerably more flexibility to the possible 1.5C paths. Nuclear power has generated almost half of the non-GHG emitting electricity for the past few decades and ignoring it is unacceptable. [Jason Donev, Canada]	Rejected. We explain why we don't discuss hydropower (not many developments since AR5) and nuclear is discussed in 4.3.
7740	14	46			I'm astounded that this report now contains no reference I can find to efficient (vs electrified or more productively used) light-duty vehicles (or heavy road vehicles). The old standard analyses like USNAS/NRC used in most IAMs are very far from exhausting the potential, which is ~2–3x without or ~4–8x with electrification. For example, my 4-24:34–36 FOD comment cited a peer-reviewed Intl J Veh Design paper (Cramer & Lovins 2004) showing 3–6x efficiency gain in an uncompromised SUV designed in 2000 with two Tier One engineering firms and found by a Tier One's detailed cost analysis, later confirmed with granular McKinsey data, to pay back against US fuel prices in ~2 y at 50,000 unit/y volume. My presentation at the Jan 2018 National Academies' Transportation Research Board annual meeting, also cited in the same FOD comments, showed that the automotive efficiency potential is severalfold bigger and cheaper than canonical incremental-supply-curve methodology reveals, and can be discovered only by whole-vehicle designs, of which I gave several examples designed by OEMs and Tier Ones. I cannot understand why the authors continue to ignore such evidence. Of course electrification is valuable too (if generation is decarbonized), and it is not independent from radical tractive-load reduction, which on the contrary can speed electrification by saving most of the costly batteries or fuel cells. Thus I drive a lightweight BMW i3 whose carbon fiber, says BMW, is paid for by needing fewer batteries. Electrification and platform fitness (reducing tractive load by designing out mass, drag, and rolling resistance) have some identical and some differentiated benefits; all are valuable, and a sound strategy will aim to achieve both kinds synergistically rather than trading them off against each other. [Amory Lovins, United States of America]	Accepted. A new section on transport has been added with a fresh emphasis on vehicle efficiency. The recent Kennedy et al (2018) paper has been added to make the point for the urban context of this section. There is limited recent peer reviewed literature on this, an observation that we note in the feasibility assessment. There was, in the discussions, some apprehension that more efficient vehicles could deliver the rate and scale of change required for 1.5C consistent pathways given the rapid uptake in vehicle ownership in Africa and Asia.
36070	14	46	32	3	All strategies for feasability and identifying trade-offs and synergies with other objectives have been covered. Also add a segment on - strategies specifically required in areas where little is happening and more needs to happen and evaluation of the identifed strategies. [India]	Noted. It is a good idea but literature is lacking on precisely these aspects.
50088	14	46	35	22	This whole section 4.3, with the exception of 4.3.8 and 4.3.9) is supposed to discuss the feasibility of different options. That would be useful if it would discuss the potential of options used in the IAM studies covered in ch2, as that would be a "reality check" on those results. However, the section is mostly a qualitative discussion of options without much quantification. That does not add anything to what ch 2 already provides. To make things worse, the discussion in this section then culminates in a rather intransparent and superficial evaluation of the feasibility of options in section 4.5.2 and in figure 4.5. I don't think this makes a contribution to the assessment of options that are being analysed in the IAM studies in chapter 2. [Bert Metz, Netherlands]	Accept. We have made the assessment in section 4.5. much more robust and transparent. See also supplementary material 4.D. We have also improved the representation of the sectoral targets coming out of chapter 2's IAMs in Table 4.1, and have brought some of that in into section 4.3.
57892	14	46	41	46	The assessment of the potential of bio-energy should updated in light of Booth, M. 2018: Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy. Environmental Research Letters. https://doi.org/10.1088/1748-9326/aaac88 - a publication not assessed by the SOD. [Hunter Cutting, United States of America]	Taken into account. Even though space constraints keep us from going into details, we have added a qualifying statement saying that the carbon intensity of bioenergy depends on a number of factors, also citing the suggested reference. Please note that the bioenergy section has moved to the energy section (4.3.1.2).
60854	14	46	14	46	This title does not accurately reflect the categories of response options discussed in the section. It presents solar radiation management in addition to mitigation and adaptation. Consider to change to "current and emerging response options". Is SRM a separate category distinct from mitigation? [United States of America]	Accepted. 4.3 title changed to "Systemic changes for 1.5C-consistent pathways"
62750	14	46			I think the Section could be more quantitative, e.g. maybe something like Table 4.1. could serve as benchmark values to compare accelerated transitions and related options to. [Elmar KRIEGLER, Germany]	Accepted. Table 4.1 has been improved to take this point into account.
62756	14	46			Table 4.2 holds useful categories for the feasibility of implementation of accelerating options / transitions. This is, of course, different from the question whether accelerating a transition / option makes 1.5°C feasible. Care should be taken to distinguish these two different things in the text. If something is labelled as 1.5°C consistent, it would need to be clarified how this is determined. [Elmar KRIEGLER, Germany]	Noted. The approach lay-out of this section has been significantly changed to address comments and this section done away with. Your important observation has been addressed in revised text that distinguishes between feasibility of pathways, feasibility of options and enabling conditions.
62768	14	46			Compare Table 2.8 in Chapter 2 for a list of mitigation options. It would be good if this Table and Section 4.3 relate to each other. [Elmar KRIEGLER, Germany]	Accepted. We have made a comparison between chapters 2 and 4 for that table. The difference is that in chapter 4, we only assess options for which much new information is available since AR5. In chapter 2, the table includes all options to see whether the IAMs include them or not.
12218	14	48	14	48	This section isn't a discussion of the feasibility of 1.5c. It's mainly a discussion about the concept of feasibility, with a vague paragraph on how a few things such as lowering tech costs might make things easier. Could remove to shorten the report. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. 4.3 has been changed to dealing with systems and identifying options. Feasibility assessment has been moved to 4.5.1.
49048	14	48	35	22	These sections in Chapter 2 addressing a range of sectoral options and opportunities only inconsistently address adaptation and resilience issues. They should be thoroughly gone through to ensure that adaptation implications are incorporated. [David Waskow, United States of America]	Noted. See 4.5.3 for detailed feasibility assessment and related supplementary material D. See also response to comment 40434.
62748	14	48			The discussion in Section 4.3 seems to be sometimes about the feasibility of accelerated transitions, sometimes about the feasibility of options for accelerating transitions. These are two different things, and it would be good to disentangle the two more clearly in the assessment. [Elmar KRIEGLER, Germany]	Noted. Section 4.3 should be about mitigation and adaptation options in the context of system transitions. We will make sure they are separated.
12220	14	50	14	51	This line states that 1.5C pathways involve reaching zero emissions by 2060-2080, whereas page 10 line 41 states "zero by mid-century and net negative thereafter." There should be consistency on this point throughout the report. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised to 'mid-century' in newly written feasibility Section 4.5.1.
39226	14	50	15	25	This is very important information but very difficult to understand. Lines 11-16 especially could be written more clearly so policy makers really appreciate the co-benefits of climate action. Right now, reading is tough going. [Lindsey Cook, Germany]	Accepted. Text revised in relocated section on feasibility 4.5.1.
51984	14	50	16	25	The use of the word risk in this section is problematic. The word risk means carries different meaning in different contexts and different disciplines. The statements about risk are unclear and potentially misleading. [Jason Donev, Canada]	Accepted. Text clarified.
55850	14	50	14	51	Perhaps this sentence can also reference Ch. 3 for the adaptation options. [Debora Ley, Guatemala]	Noted. This section has been removed, but 4.3.5 has been enhanced to address adaptation.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
62752	14	50	14	51	What do you mean with zero emissions? Carbon neutrality is reached earlier, around mid century. Zero emissions, including all gases, is never reached, as some residual emissions, particularly CH4 and N2O from the ag sector and some CO2 from transport remain. [Elmar KRIEGLER, Germany]	Accepted. Text revised in relocated section on feasibility 4.5.1.
48658	15	1	15	6	Gender is missing in the adaptation and mitigation indicators [Yamina Saheb, France]	Noted, but adopted from Chapter 1. Gender features elsewhere in Chapters 4 and 5.
6126	15	2	15	6	Table 4.2: Many of these indicators, particularly the ones on adaptation, are very undefined and the chapter does not seem to offer any definition of e.g. resilience, risks mitigation potential, etc. [Anne Olhoff, Denmark]	Noted. See expanded discussion on feasibility in 4.5.1
12222	15	2	15	5	How does new data on damage functions make 1.5c more feasible (as opposed to desirable)? Also is there a plain english version of "polycentric leadership of climate responses" and an explanation of how exactly this makes 1.5c more feasible? [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text removed, except for multi-level and poly-centric governance literature that is covered in 4.4 (enabling environments for rapid change).
18564	15	2	15	6	Table 4.2: Many of these indicators, particularly the ones on adaptation, are very undefined and the chapter does not seem to offer any definition of e.g. resilience, risks mitigation potential, etc. [Andrea TILCHE, Belgium]	Noted. See expanded discussion on feasibility in 4.5.1
28478	15	2	15	7	While the table presents a reasonable overview of indicators against which adaptation and mitigation options can be assessed, the actual assessment of options in sections 4.3.2-4.3.8 is intransparent. In more general terms, the notion of feasibility is itself problematic and was explicitly avoided in the AR5. As a large body of literature makes clear, risk perceptions, development priorities and sociocultural contexts are so different that such expert judgement that does not make explicit the value judgements behind the evaluation may not be compatible with the high standards of the IPCC. Please consider revision. [Germany]	Accepted. Actual feasibility assessment now moved to section 4.5
40390	15	2	15	4	In Table 4.2, «interspecies ethics» should be inserted as an adaptation indicator for Environmental (characteristic), and «improved socio-ecological systems» should be included as a mitigation indicator (for the same characteristic). [Erick Pajares, Peru]	Rejected. This was not featured in Chapter 1 discussion on feasibility.
40436	15	2	15	2	Table 4.2: -An important economic feasibility dimension for mitigation, that is not considered here, is the trade-off in resource allocation for mitigation and adaptation. Resources invested in mitigation are not available for adaptation. This is especially important for developing countries that may face pressing and urgent adaptation needs in contrast with mitigation possibilities that do not have an immediate or clear effect on their vulnerability and risk to Climate Change impacts. (See Moser .2012. Adaptation, mitigation, and their disharmonious discontents: an essay, Climatic Change, 111(2) 165–175 https://doi.org/10.1007/s10584-012-0398-4 and references therein) [Pedro Alfredo Borges Landaez, Venezuela]	Noted, but adopted from Chapter 1. Synergies and trade-offs are dealt with as part of feasibility in 4.5
55066	15	2	15	6	Table 4.2: cwould be good to add a column illustrating or showing some corresponding responses/possible measures [Yamide Dagnet, United States of America]	Noted. Response measures are provided in 4.5 based on systems discussed on 4.3.
60856	15	2	15	6	The things listed in Table 4.2 aren't really "indicators". They aren't quantitative or even specific variables. They are better described as "dimensions" of feasibility. Also, the caption is misleading. These aren't really used in most of the sections in 4.3.2 through 4.3.8. It is odd to call out 4.3.9 as different since none of these sections really do this. [United States of America]	Accepted. Section have been re-organised.
60858	15	2	15	6	Although this table derives from Chapter 1, the dimensions and indicators presented on page 1-48 don't match the ones presented in Table 4.2. [United States of America]	Noted. See expanded discussion on feasibility in 4.5.1
62802	15	2	15	6	In table 2 under economic/adaptation indicators, suggest to add poor people vulnerability [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	Noted. See expanded discussion on feasibility in 4.5.1 and reference to distributional impacts. See also Chapter 5.
3902	15	5	15	5	Table 4.2. Economic dimension, Mitigation indicator: 'Absence of distributional effects' This might be usefully clarified as 'absence of negative distributional effects' (if I have interpreted the intention correctly). [Emily Tyler, South Africa]	Accepted. Text revised.
7450	15	5	15	5	Adaptation indicators should include cost-effectiveness, like for mitigation (in box 4.11 below, you use cost-effectiveness as main criterion) [Axel Michaelowa, Switzerland]	Noted. Cost-effectiveness and scalability are considered in the overall assessment taking into account all indicators as they are very site and context specific
34702	15	5	15	6	It would be useful to break down the indicators by examples of the variables that could be used. [Mexico]	Accepted. See feasibility application in 4.5.1.
35520	15	5	15	6	Why is "legal, regulatory and civil society acceptability" not listed under mitigation? Similarly, why is administrative feasibility not listed under adaptation? [Ashok Sreenivas, India]	Accepted. Text revised.
35522	15	5	15	6	Why is only reduction of air pollution mentioned and not other forms of pollution (water, land) [Ashok Sreenivas, India]	Accepted. Text revised.
35524	15	5	15	6	Why are only education and health listed as social benefits? Why not (say) intra-generational equity, access to safe water and sanitation etc.? [Ashok Sreenivas, India]	Noted. Education and health are understood to be (more) systemic drivers than the other options you list.
51986	15	5	15	5	How are 'political acceptability' and 'social acceptability' different? I can see some difference, but I'm not sure what's meant. This should be explained. [Jason Donev, Canada]	Noted. See full application of feasibility in Section 4.5. which illustrated the difference given that countries have varying degrees of democracy and overlap between the two concepts. (Political acceptability reflects ease with which policy makers can adopt a measure, while social acceptability reflects the experience and perception of public users of an option).
51988	15	5	15	5	What does 'absence of risk' mean in this context? Nothing has no risk. What is risk? Environmental (like the killing of bats by wind turbines - that's a risk, although probably one that can be mitigated with further study, it is still a risk), economic (CCS could prove to be incredibly costly), societal? Risk is managed, not eliminated. [Jason Donev, Canada]	Noted. See full application of feasibility in Section 4.5. which illustrated the criteria through their application.
62754	15	5	15	5	Table 4.2: This is a good table, but it is not really used in the subsequent discussion in Section 4.3 to assess feasibility of options / transitions. Maybe shift to Section 4.5? [Elmar KRIEGLER, Germany]	Noted. Section moved to 4.5.1 where it is used.
16446	15	9	15	16	Suggest expand paragraph to provide more explanation for how these co-benefits arise. [Australia]	Noted. Text revised in new section in 4.5.1. See also synergies and trade-offs section and revised section 4.3.
45488	15	9	15	11	All but 1 of these references is well before Paris. Would the conclusion still stand at 1.5 ambition. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text revised in new section in 4.5.1.
49756	15	9	15	16	co-benefits on outdoor air pollution too can be a major driver for climate action. See e.g. von Schneidemesser, E., Monks, P.S., 2013. Air quality and climate – synergies and trade-offs. Environ. Sci. Process. Impacts 15, 1315. doi:10.1039/c3em00178d [Fabio Monforti-Ferrario, Italy]	Noted. See substantially revised text.
62046	15	9	15	16	More enphasis should be put on effects that energy policy would have on non-climate related impacts, such as eutrophication, resource depletion as well as the other impacts normally included in a life cycle assessment. [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Noted. See new references to co-benefits in SPM and revised text.
44078	15	11	15	11	Sates " Hekkert et al., 2007).Co-benefits..." needs space at beginning of sentence [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
51990	15	11	15	11	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
47406	15	12	15	13	Reference Colebrander 2017 mentions flooding but does not talk about co-benefits, which is the topic of this section of text. Is this the correct reference to use? [Sarah Connors, France]	Accepted. Text revised.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
58302	15	14	15	14	OECD 2017a (Investing in Climate Investing in Growth) is an important reference supporting the point on economic growth [Andrew Prag, France]	Rejected. Too late for new grey literature inclusions.
33104	15	15	15	15	add a reference to human rights after justice - UNEP (2015) Human rights and climate change. Robinson, M. & Shine, T. (submitted) Achieving a climate justice pathway to 1.5oC. Nature Climate Change. Mary Robinson Foundation – Climate Justice (2015a) Right for Action: Putting People at the Centre of Action on Climate Change. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-Rights-for-Action-edition-2.pdf Mary Robinson Foundation – Climate Justice (2015b). Zero Carbon Zero Poverty the Climate Justice Way: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Available online at https://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Noted. This is dealt with elsewhere in Chapters 4 and 5. The historical peer-reviewed evidence of links between human rights and short term feasibility remains difficult.
47408	15	20	15	21	Is Geels 2016b correct here? Is it actually Geels 0217 that should be cited instead? [Sarah Connors, France]	Accepted. Text revised.
12224	15	23	16	8	This paragraph discusses feasilbility but focusses only on examples which suggest achieving 1.5C is more feasible since AR5. A more complete and balanced assessment is needed here if the authors want to comment on overall feasibility. For instance, studies on additional carbon release from permafrost, on continued high emissions since 2013 and/or the lack of change in NDCs may all suggest 1.5C is less feasible. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Full feasibility assessment now moved to 4.5.1
45490	15	23	16	8	a whole pargraph consisting of single sentence. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text revised.
8366	15	25	16	8	This paragraph elaborates on the progress made since AR5, including technological advances and so on, which indeed increases the feasibility of 1.5?. However, it does not mean that the required social and economic costs are declining. This statement fails to distinguish developing countries from developed ones in terms of the varying difficulty posed by the 1.5? pathway, which is likely to make policymakers mistakenly believe that the 1.5? pathway is easy to achieve. It is suggested to balance the references to relevant literature to objectively evaluate the difficulty in this connection. [China]	Noted. Revised text to distinguish between low carbon and decarbonisation.
12226	15	25	16	1	The budget of Millar et al differs from that summarised in chapter 2 (page 16). You can't say their budget makes it easier when it's not the budget of this report. [United Kingdom (of Great Britain and Northern Ireland)]	Rejected. Millar et al is a part of the literature reviewed in this report.
62758	15	25	16	8	I would not include "Increased budgets" in the list of items that may have enhanced the feasibility of 1.5°C pathways. This is very different in nature than actual events on the ground. The list is lacking information on policy implementation and phasing out fossil fuels which speak against enhanced feasibility of 1.5°C pathways. I suggest to provide a more differentiated picture listing trends supporting and opposing 1.5°C implementation. [Elmar KRIEGLER, Germany]	Accepted. Text revised and term removed.
18566	15	47		50	solar is not only highly competitive in sunny areas: see IRENA report "Renewable Power Generation Costs in 2017" [Andrea TILCHE, Belgium]	Accepted: Text changed.
13158	16		16		Section 4.3.2.1 should include drawbacks in regards to renewable energy sources, such as on matters related to reliability and affordability. [Eleni Kaditi, Austria]	Noted. This is addressed in the feasibility discussion of 4.5.1.
28480	16		31		Currently, Ch 4 focuses on the transport sector in the context of urban development, and for maritime and international aviation. We suggest to add a dedicated section that addresses the whole transport sector, in particular the important areas of national and regional (commercial) transport and freight, and transport in rural areas. References can be made to subchapters 4.3.2 (Energy) or 4.3.4 (Urban) to avoid redundancies. The current framing does not sufficiently cover the wide range of problems (and potential solutions) of the transport sector as a whole. Additionally a separate section would offer a more coherent and comprehensive view, and would help the reader navigate the chapter. [Germany]	Reject. We have made a choice to discuss systemic changes and the consequence is that individual sectors are not discussed as such. We do discuss all relevant transportation options. The urban, mobility and buildings options need to be seen together in order to make the systemic change for 1.5C.
47410	16	1	16	2	Jonas 2014 does not discuss technology costs, which is the topic of the text it is being cited in. [Sarah Connors, France]	Accepted. Text removed.
45492	16	4	16	8	do these sources all directly refer to this specific asserion and do they actually refrer to 1.5 degrees- not sure the High-leve commission did [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted. This section has been removed and rewritten under Section 4.5.1
6128	16	5	16	8	This seems to contradict other sections of the paper, where such pathways are assessed to be associated with higher costs. [Anne Olhoff, Denmark]	Noted. See section 4.2.2 for discussion on costs, and Section 4.5.1 and supplementary material for application of costs and disclaimers about regional variability.
18568	16	5	16	8	This is a strong statement. If it is robust it deserves to be expanded upon, for example by linking to relevant findings throughout this chapter (and potentially the rest of the report). If it is not robust it should be qualified accordingly. See also comment on page 11. [Andrea TILCHE, Belgium]	Noted. See section 4.2.2 for discussion on costs, and Section 4.5.1 and supplementary material for application of costs and disclaimers about regional variability.
13156	16	6	16	8	Delete the text ", challenging the assumption that ambitious decarbonisation and climate adaptation will impose additional economic and social costs (Gouldson et al., 2015; OECD, 2017a; Stiglitz et al., 2017)". [Eleni Kaditi, Austria]	Rejected. This is what this literature reports.
47412	16	7	16	7	Goulden 2015 - working paper, reference is missing some information. [Sarah Connors, France]	Editorial.
6130	16	10	16	26	While these are very relevant statements, they come across as highly fragmented and more like SPM style. [Anne Olhoff, Denmark]	Noted. Text significantly revised in new feasibility section 4.5.1
18570	16	10	16	26	While these are very relevant statements, they come across as highly fragmented and more like SPM style. [Andrea TILCHE, Belgium]	Noted. Text significantly revised in new feasibility section 4.5.1
1598	16	12	16	14	Studies estimating the use of renewable energy in the future… Please add the following worldwide studies on 100% clean renewable energy for all energy sectors: (1) Jacobson, M.Z., and M.A. Delucchi, A path to sustainable energy by 2030, Scientific American, November 2009; (2) Jacobson, M.Z., and M.A. Delucchi, Providing all Global Energy with Wind, Water, and Solar Power, Part I: Technologies, Energy Resources, Quantities and Areas of Infrastructure, and Materials, Energy Policy, 39, 1154-1169, doi:10.1016/j.enpol.2010.11.040, 2011; (3) Delucchi, M.Z., and M.Z. Jacobson, Providing all global energy with wind, water, and solar power, Part II: Reliability, System and Transmission Costs, and Policies, Energy Policy, 39, 1170-1190, doi:10.1016/j.enpol.2010.11.045, 2011; (4) Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, and B.V, Mathiesen, Matching demand with supply at low cost among 139 countries within 20 world regions with 100% intermittent wind, water, and sunlight (WWS) for all purposes, Renewable Energy, 2018, http://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/WorldGridIntegration.pdf [Mark Jacobson, United States of America]	Noted, but not included due to space constraints.
33106	16	15	16	15	Draw on the literature on climate change and gender to expand on the points in this paragraph. [Tara Shine, Ireland]	Noted, but not included due to space constraints.
1600	16	19	16	19	Several countries have adopted targets of 100% renewable energy. Please add that at least 55 cities U.S. cities (e.g., https://www.sierraclub.org/ready-for-100) and over 115 international companies (http://there100.org/companies), have adopted 100% targets. [Mark Jacobson, United States of America]	Noted. See references to cities section in Chapter 5 and in Section 4.3.3. Evidence of the change lags the commitments, but this section in this global assessment has been revised.
31510	16	19	16	20	The current version of the sentence does not tell us why and how "In the context of uncertainty, retaining the capacity to respond to a wide range of climate change contingencies represents an important component of feasibility." Specific examples on the response to a wide range of climate change contingencies need to be added (described) in order to clarify the meaning of the sentence. [Japan]	Noted. Text revised and this section has been removed.
36072	16	19	16	19	Add - Citations to substantiate the sources of these uncertainties. [India]	Noted. Text revised and this section has been removed.
60860	16	19	16	21	Also acknowledge opportunity costs of not retaining capacity to respond to a wide range of new and existing global issues. [United States of America]	Noted. Text revised and this section has been removed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
60862	16	23	16	26	What does it mean to "identify options and ambition beyond IAMs"? [United States of America]	Noted. Text revised and this section has been removed.
51992	16	25	16	25	What new risks? Don't leave it vague, explain it! [Jason Donev, Canada]	Noted. Text revised.
5046	16	29	16	36	I am surprised that there is not a subsection, or paragraph in a subsection, dealing with improving the world's electric grids so that energy can be efficiently and cost efficiently transmitted across continents. The installation of high-voltage/direct current transmission lines is starting and having continental scale networks would allow moving energy around on spatial scales than weather systems that can create intermittency for solar and wind technologies. There was an important paper in Nature in January 2016 by Alexander MacDonald and colleagues that provided an analysis of what an HV/DC overlay network atop the existing AC distribution system could accomplish in the US (including allowing for the electrication of the transport sector), indicating that being able to move energy around would allow a much, much greater potential for decarbonizing the US energy system in the near-term and relatively inexpensively. Ealsewhere, this would seem to be very beneficial for China, and also for moving solar energy, for example, from northern Africa to the European grid. I would thus urge also mentioning that not just the technology matters, but what can be done to move it around over much longer scales than is possible with AC transmission. I would also note that there are a number of potential co-benefits, especially if the involved cables are buried, which would reduce their vulnerability to extreme weather, solar EMP, terrorism, and even EMP from nuclear explosions by rogue nations. [Michael MacCracken, United States of America]	Accepted: HVDC comment added and new paper reference.
18572	16	29			4.3.2 In this section, bioenergy is oddly represented. It is mentioned mostly in the context of electricity, although it is not efficient for electricity, and better alternatives are available for that. It is more suitable for heat and, perhaps, process energy (where renewable enelectricity is not suitable), but that is not mentioned. Biofuels for surface transport are notable for their absence, which is well-justified, but their incompatibility with 1.5 could be noted. [Andrea TILCHE, Belgium]	Accepted. Bioenergy repositioned in new feasibility section 4.5.1
29754	16	29	20	20	It is unfortunate that the section on energy system transformation still makes no reference to the growing literature on supply-side climate policy directed towards the restriction of fossil-fuel production. This is an area that has received a marked increase in attention since AR5 and that is more relevant for 1.5 pathways than for 2C pathways due to the strong imperative of a more rapid phasing-out of fossil fuels. Within economics, Harstad (2012) has shown how the reduction in available supplies of coal might complement demand-side policies in order to reduce leakage (https://doi.org/10.1086/665405) while Faehn et al (2017) has shown that fossil-fuel producing countries may increase the cost-effectiveness of climate policy by combining reductions in demand and supply of fossil fuels (https://doi.org/10.5547/01956574.38.1.tfae). A broader approach to supply-side policy is found in a forthcoming special issue of Climatic Change, edited by Michael Lazarus and Harro van Asselt. The issue takes up topics such as the influence of norms to limit fossil-fuel supply (Green, https://doi.org/10.1007/s10584-017-2134-6), coal mining moratoria as a policy tool (Blondeel & Van de Graaf, https://doi.org/10.1007/s10584-017-2135-5) and the mitigation potential of limiting fossil fuel production in a national context (Erickson & Lazarus, https://doi.org/10.1007/s10584-018-2152-z). The potential for supply-side restrictions on fossil fuels could usefully be placed in the context of broader regime transitions, in particular as the transition literature increasingly recognize the need to confront incumbent actors within existing regimes in order to achieve transition (cf. Geels 2014, https://doi.org/10.1177/0263276414531627). IAM approaches typically do not include policy tools to restrict fossil fuel production. It is therefore important that these options are duly reflected in this chapter, as they fall outside the scope of chapter 2. [Bård Lahn, Norway]	Accepted. Supply side changes were added to later sections, this section is on mitigation options. Section 4.4.5 is on policy instruments.
35526	16	29	16	29	It is not clear to me how the "Energy systems transitions" section actually assesses them based on the indicators given earlier. Perhaps the linkages between the indicators and the transitions assessment could be made clearer. [Ashok Sreenivas, India]	Accepted: Text revised.
36074	16	29	20	20	In technology terms – the operational use of hybrid systems and its impact– i.e. RE with coal in combo or hydro with RE is spoken of. This may be included in SPM as well. [India]	Taken Into Account. The types of renewables including hybrids were removed as a space saving edit and indeed the list had become much longer but still probably incomplete. It was also unnecessary as we focus on only a few rapidly growing ones for this report.
36076	16	29	18	23	Section 4.3.2 - More examples from developed countries as well as developing countries need to be added. [India]	Accepted. Other examples added.
57798	16	29	17	19	The failure of this section to assess the contribution of off-shore wind given the dramatic changes in feasibility since AR5 major omission. This failure trickles up through the document all the way to the SPM findings on feasibiity, undermining the creditbility of all those sections. Auction prices in 2017 are astonishingly lower than prices found in AR5. [Hunter Cutting, United States of America]	Accepted: Text Changed
60864	16	29	45	15	Section 4.3 would benefit from more graphical presentation of the issues presented. Figure 4.3 is a useful example of the kind of graphic that is helpful in distilling complex information so that it may more easily be assimilated. [United States of America]	Taken into account. That would be great, however, while this could be done for CDR options, it was much harder for other mitigation and adaptation options.

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57800	16	29	20	20	This section critically fails to asses numerous publications which identfies critically important opportunities for transition in the energy system to enable the limiting of warming to 1.5 degrees. See in particular: - 2016 Renewable Energy Data Book, December 2017. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. - Abramczyk et al. 2017: Positive Disruption: Limiting Global Temperature Temperature Rise to Well Below 2 ? C. Rocky Mountain Institute, 2107. - Gahleitner, Gerda 2013: Hydrogen from renewable electricity: An international review of power-to-gas pilot plants for stationary applications. International Journal of Hydrogen Energy https://doi.org/10.1016/j.ijhydene.2012.12.010 - Ram et al, 2017: Global Energy System based on 100% Renewable Energy – Power Sector. Lappeenranta University of Technology and Energy Watch Group, 2017. - Breyer, et al.: Solar photovoltaics demand for the global energy transition in the power sector. Progress in Photovoltaics Research and Applications, 2017. DOI 10.1002/pip.2950 NB: It appear the almost none of the voluminous research put out by the research group led by Breyer (e.g. Two papers above) is reviewed by this IPCC report Pyndyck, Robert, 2017: The Use and MisUse of Models for Climate Policy. Review of Environmental Economics and Policy, volume 11, issue 2, Winter 2017, pp. 100-114 IRENA, Renewable Power Generation Costs in 2017. http://www.irena.org/publications/2018/Jan/Renewable-power-generation-costs-in-2017 BNEF, State of Clean Energy Investment, http://www.irena.org/publications/2018/Jan/Renewable-power-generation-costs-in-2017 BNEF, New Energy Outlook, https://about.bnef.com/new-energy-outlook/ Lazard, Levelized Cost of Energy 2017 https://www.lazard.com/perspective/levelized-cost-of-energy-2017/ McDonald et al, 2016: Future cost-competitive electricity systems and their impact on US CO2 emissions. Nature Climate Change volume 6, pages 526–531 (2016) doi:10.1038/nclimate2921 University of Minnesota Energy Transition Lab, Strategen Consulting, and Vibrant Clean Energy, 2017: Modernizing Minnesota's Grid: An Economic Analysis of Energy Storage Opportunities. Minnesota Energy Storage Strategy Workshop Final Report. D. Steinberg, D. Bielen, J. Eichman, K. Eurek, J. Logan, T. Mai, C. Mcmillan, A. Parker, L. Vimmerstedt, E. Wilson, 2017: Electrification &	Taken Into Account. Large numbers of extra references have been added.
62766	16	29			Section 4.3.2: Relate to Section 2.3.3.4 in Chapter 2, which provides a discussion of alternative energy transitions that are not well covered by IAMs. Associated options (synthetic fuels, 100% RE and electrification etc.) may be interesting to take up here. [Elmar KRIEGLER, Germany]	Noted. Text revised.
45494	16	31	16	31	It is important to highlight that the application of the "feasibiity" term here is shifting from the feasibility of achieving 1.5 as a target and the feasibility of individual options that make up a portfolio of resposes. We can have a pile of individually feasible options that dont add up to a feasible 1.5 [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text changed.
60866	16	31	43	52	These sections (4.3.2 - 4.3.9) are long and don't seem to do what intended. The section says up front that they will assess options and discuss feasibility, but for the most part they don't discuss feasibility. Additionally, much of this isn't specific (or even tied) to 1.5°C. Much of the text could be deferred to the AR6. For anything that can be tied directly to the 1.5°C pathway, go through the dimensions of feasibility highlighting concerns with the option. The BECCS and ARM sections come close to this. The others need a lot of work. Separate adaptation and mitigation options. [United States of America]	Noted. See revisions to 4.5.2 and supplementary material D1 that presents full line of sight. In section 4.3, we now don't intend to discuss feasibility anymore but to discuss the literature on the current state of play for mitigation and adaptation options in a systemic context.
1644	16	32	16	33	From 2 degree to 1.5 degree,the role of BECCS for mitigation is expected to be much more significant as shown in Figure 2.20 and 2.21. And the feasibility of such large scale deployment of BECCS should be one of the focus of this chapter. Please delete "biomass" from "...like hydropower and biomass...". [Wenying Chen, China]	Noted - the feasibility of BECCS is assessed in detail in a dedicated section on Carbon Dioxide Removal (4.3.7, former 4.3.8), while 4.3.1 (former 4.3.2) covers bioenergy now (previously located in former 4.3.3, but we agree it fits better here and have therefore moved it).
62760	16	32	16	35	What is meant with options consistent with 1.5°C? Does it mean hydropower is not consistent with 1.5°C? Individual options are difficult to generically link to 1.5°C, it depends on their deployment levels and the deployment levels of other options. Maybe simply speak of decarbonisation options here? [Elmar KRIEGLER, Germany]	Accept. The IPCC created a standard way of using 1.5 strategies.
12228	16	39	17	10	Could more discussion be given here to the mitigation potential of renewables (and similarly other technologies/sectors in following sections)? And would be good ot have specific figures for the pathways. E.g. renewables account for x% of total primary energy supply in 2030/2050 (median followed by range) [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Chapter 2 has more of this and more data was added in chapter 4 as well.
14062	16	39	17	19	Either change sub-heading to "renewable electricity" or preferably include discussions on heating/cooling and transport. To avoid bias towards solar and wind in the discussion (both I agree with good potential but from a low base), then suggest a figure or table showing present shares of primary and/or end-use energy (with fossil fuels, renewables, nuclear for electricity, heat, transport) should be included - see REN21 Global Status report 2017 for example. I donlt think heat is mentioned in all of 4.3.1 and 4.3.2. Surprising also that IPCC SRREN is not referenced, even if from 2011 (though IPCC CCS report from 2005 is referenced so being a few years old should not be a constraint to including SRREN). Is also no mention of possible climate impacts on renewable energy resources - eg more cloud cover, changes to wind patterns, biomass growth, hydro water shortages. [Ralph Sims, New Zealand]	Accepted: "Renewable Electricity" added (REN 21 (UNEP, 2017b)).
21550	16	39	32	5	These sections are more technical than really exploring the socio-economic impacts of climate change policies on human societies and economies [Nathalie HILMI, France]	Noted. See the revised ES for headline messages on socio-economic impacts and the linked underlying sections in Chapter 4

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28482	16	39	17	19	please add reference to trade-offs among renewable energy systems and sustainable management of natural resources, considering the interlinkages among Water, Energy and Food Security systems such as possible impacts of large hydropower systems on water security. [Germany]	Accepted - synergies and trade-offs for each mitigation and adaptation option are described in Section 4.5.4
34704	16	39	32	3	Valuable information was detected in the different sub-indices. It would be useful to standardize the information presented in order to be able to compare the mitigation options by sub-sector. [Mexico]	Accept. We have, in Supplementary material D, made the assessment in 4.5 more transparent. Our aim was not to allow for comparison of mitigation options but to see what is keeping them from implementation.
55068	16	39	17	19	Tidal and Wave energy have not taken off much. It woud be good highligh why (identify the barriers), compared to other renewable energy. Especially since ocean, is the resources we will have the most (the one that is increasing with all the damage that it may create). [Yamide Dagnet, United States of America]	Noted: No space.
60868	16	39	17	19	Section 4.3.2.1 on renewable energy should address the relative differences between 1.5 and 2°C scenarios, and assess the degree of progress and potential scalability of this technology in relation to the RE mix in 1.5°C scenarios. [United States of America]	Noted: Context for whole 1.5C report taken up by Ch2 and in Table 4.1, but at sector level, not technology level.
1646	16	40	17	19	China experienced very fast grow of wind and PV in recent years. But high wind and PV curtailment rate (for example around 30% in Xinjiang) was observed. Please kindly add one or two sentences for it to explain the fast development of renewable also require fast development of infrastructure (power grid, storage...). [Wenying Chen, China]	Accepted: Sentence changed.
11050	16	40	16	45	Although solar and wind are growing rapidly, they are still well below the rate required for 1.5 / 2 pathways. [Wilfried Maas, Netherlands]	Noted. The rates of change are extremely fast and with exponential growth are likely to surprise most people in the industry as happens with disruptive innovations. Chapter 2 has assumed substantial growth rates globally but these are being exceeded in many parts of the world.
14060	16	40	16	40	Why is bioenergy excluded from this list which has a far greater contribution to end-use energy (heat, biofuels as well as electricity) than most of the others in the list? But why the need to list renewables yet again? [Ralph Sims, New Zealand]	Accepted: However, it is about growth rate and transfer.
16448	16	40	16	41	Why is bioenergy not menitoned in this sentence? In chapter 2 it is a significant contributor to mitigation trajectories. [Australia]	Accepted - Bioenergy was previously assessed in 4.3.3 (now 4.3.2), but we agree that it fits better into the energy section and have therefore moved the assessment to this section.
18574	16	40	16	41	It is striking that bioenergy is not even listed, although it is the biggest source of renewables. [Andrea TILCHE, Belgium]	Accepted - Bioenergy was previously assessed in 4.3.3 (now 4.3.2), but we agree that it fits better into the energy section and have therefore moved the assessment to this section.
30584	16	40	16	45	What about biogaz, wood-energy and biofuels ? [France]	Accepted - Bioenergy was previously assessed in 4.3.3 (now 4.3.2), but we agree that it fits better into the energy section and have therefore moved the assessment to this section.
36078	16	40	16	45	Renewable energy - Add 'tidal energy' also [India]	Taken Into Account. The types of renewables were removed as a space saving edit and indeed the list had become much longer but still probably incomplete. It was also unnecessary as we focus on only a few rapidly growing ones for this report.
49636	16	40	16	41	it is striking, in the light of chapter 2, that bioenergy is not even mentioned here (e.g. chapter 2, pg62ln18). These chapters need to be reconciled. [Karlheinz ERB, Austria]	Accepted - Bioenergy was previously assessed in 4.3.3 (now 4.3.2), but we agree that it fits better into the energy section and have therefore moved the assessment to this section.
49758	16	40	16	41	biomass/biofuels is missing. [Fabio Monforti-Ferrario, Italy]	Accepted - Bioenergy was previously assessed in 4.3.3 (now 4.3.2), but we agree that it fits better into the energy section and have therefore moved the assessment to this section.
51994	16	40	16	45	Framing this conversation specifically in terms of renewable as opposed to emission free is extremely problematic. Nuclear power has contributed extensively to GHG free electricity, as have biofuels (which are a sort of renewable energy which aren't listed, but certainly are used extensively in developing countries). [Jason Donev, Canada]	Accepted: Bioenergy and Nuclear expanded.
51996	16	40	16	45	Once again, it seems like economists are thinking on the margins again. Hydro has already done a herculean amount to reduce our GHG emissions (as, for that matter, nuclear power, which I am curious why the authors ignore). To claim that hydropower has not already contributed to the solution is grossly inaccurate. Yes, hydropower is unlikely to grow at the percentage growth rates that solar and wind grow at, but solar and wind would need to continue to grow at these surprising and unprecedented (and possibly unsustainable growth rates), but hydropower has done a great deal and should be maintained as a continuing part of the solution. [Jason Donev, Canada]	Taken into account. We of course don't intend to say that hydro has not contributed, but that its contribution to the further reductions required are not as great given its maturity and diminishing potential . Nuclear has a section in 4.3.1 and is also included in 4.5.
51998	16	40	16	45	Wind and solar have shown incredible growth rates in the past decade. Why solar is now contributing more than 1% of global electricity! I must confess, that I didn't believe that solar would ever hit numbers like 1% of global electricity, but the number is still *very* small. One statement that is implied, but not explicitly mentioned is that solar power must continue to grow (and wind likewise) at these shocking rates. The more solar and wind that exists the harder it is to grow at the shocking percentage rates. Doubling the amount of solar when it was only 0.05% of the world's grid is a lot easier than doubling solar if it is at 5% of the world's grid. Evidence needs to be provided that these growth rates are sustainable. Many growth rates can look exponential for a time, but they are never maintained indefinitely. Even the human population's growth rate seems to be slowing down because other forces that weren't obvious 50 years ago are coming into play. As solar and wind become larger fractions of the grid, other factors will come into play and limit their growth. This must be addressed. [Jason Donev, Canada]	Rejected: Data is wrong and this report is about potential for transformative change based on rapid growth rates.
53140	16	40	17	19	The section gives the mistaken impression that RE is only helpful for off-grid and mini-grid systems in the developing world and that rooftop solar only has potential for residential or commercial users in the developed world. Rooftop solar has great potential for on-grid applications and in developing world cities, where users can also be' prosumers'. This is the case in places such as India. Please see: Westphal, M.I., Martin, S., Zhou, L., D. Satterthwaite. 2017. Powering Cities in the Global South: How Energy Access for All Benefits the Economy and the Environment. World Resources Institute, Washington, DC. http://www.wri.org/publication/towards-more-equal-city-powering-cities-global-south [Westphal Michael, United States of America]	Accepted: This is the meaning of the text so some words added to text as suggested.
45380	16	41		41	Osmotic energy is not a major player and is not really appropriate to mention it here; i.e. mention specifically the major players first, solar PV; solar thermal; off- and on-shore wind; biomass.. [Veryan Hann, Australia]	Accepted. Osmotic energy removed.
62762	16	41	16	45	The IEA has been very conservative on the prospect of RE, much more conservative than other sources. Not sure the IEA is the right reference here. Also - how do you judge that a technology is on track for 1.5°C or 2°C? And how do you deduce a statement on ocean power from Chapter 2, as it is not included in the pathways due to its perceived limited potential? [Elmar KRIEGLER, Germany]	Accepted: Reference changed to (UNEP, 2017b; IRENA, 2017). Statement on ocean power removed.
58352	16	42	16	43	It would be helpful to eablorate on what it means to "contribute significantly to a 2 C pathway to 1.5 scenarios". First, I'm not sure what this means. Second, can we specify what significant is, particularly in the context of "dramatic growth". Do we have numbers, percentages, anything quantitative? [Peter Marcotullio, United States of America]	Accepted: Text changed, "contribute significantly" removed.
916	16	43	16	43	2°C pathway to 1.5°C scenarios' what does this mean?? [Robert Shapiro, United States of America]	Accepted: Text changed, "contribute significantly" removed.
6132	16	43	16	43	What is meant by "are on track to contribute significantly to a 2 degree pathway to 1.5 degree scenarios"? [Anne Olhoff, Denmark]	Accepted: Text changed, "contribute significantly" removed.
7914	16	43	16	43	What does this mean; "...are on track to contribute significantly to a 2°C pathway to 1.5°C scenarios" ??? [Christopher Bataille, Canada]	Accepted: Text changed, "contribute significantly" removed.
12230	16	43	16	43	contribute significantly to a 2C pathway to 1.5C scenarios. - unclear what this means. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text changed, "contribute significantly" removed.

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18576	16	43	16	43	What is meant by "are on track to contribute significantly to a 2 degree pathway to 1.5 degree scenarios"? [Andrea TILCHE, Belgium]	Accepted: Text changed, "contribute significantly" removed.
47922	16	43	16	43	Kindly check: IEA (2017) reference is not available in the reference list. [Sarah Connors, France]	Accepted: Added another reference as well (UNEP 2017b; IEA, 2017f)
58306	16	43	16	43	Citation should be IEA (2017f) - World Energy Outlook [Andrew Prag, France]	Accepted: Text changed.
60870	16	43	16	43	This sentence is unclear. Please clarify what is meant by "on track to contribute significantly to a 2°C pathway to 1.5°C scenarios." [United States of America]	Accepted: Text changed, "contribute significantly" removed.
8080	16	44	16	44	Offshore wind cost already have already decrease dramatically. See IRENA report for example on renewable tender ("renewable energy auctions, ISBN 9789295111080) [Quentin Perrier, France]	Accepted: Text changed.
16450	16	44	16	45	Point not clear; doesn't reflect chapter 2: note that chapter 2 highlights strong expectations for bioenergy and BECCS [Australia]	Accepted - Bioenergy was previously assessed in 4.3.3 (now 4.3.2), but we agree that it fits better into the energy section and have therefore moved the assessment to this section.
19724	16	44	16	44	An unquestioned increase use of hydropower and bioenergy for 1.5° scenarios should be avoided due to uncertainties in ist socio-ecological implications. [Jennifer Morgan, Netherlands]	Noted
47142	16	44	16	44	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted. Text changed.
62162	16	44	16	45	The portfolio of renewable energy does not have to be complete to be successful. Ocean energy or concentrated solar power are not "needed" and the money can well be used in the solar and wind tracks. This sentence suggests a path of policies with a "balance" that will not exist. Maybe write the sentence with "have different maturing rates" , [Antoine Bonduelle, France]	Accepted: Text changed.
49670	16	45	16	45	The presence of renewable energies in Nationally Determined Contribution should be mentioned, for instance with a sentence and bibliographic reference such as: "Renewable energies play a role in the majority of Nationally Determined Contributions submitted under the Paris Agreement, but they continue to have an untapped potential (IRENA, 2017)". Full quote for the bibliography: IRENA (2017), Untapped potential for climate action: Renewable energy in Nationally Determined Contributions, International Renewable Energy Agency, Abu Dhabi. The report indicates that "of the 194 Parties to the United Nation Framework Convention on Climate Change (UNFCCC) that submitted NDCs, 145 referred to renewable energy action to mitigate and adapt to climate change, while 109 Parties included some form of quantified target for renewables. While 85 Parties to the UNFCCC have not included quantified targets for renewables in their NDCs, many of them have ambitious national energy plans in place". But the shorter version without numbers is more in line with the style of the rest of the paragraph. [Valentino Piana, Italy]	Accepted: Added ref to text.
30586	16	47	16	47	The latest growth factor since AR5 has been the dramatic reduction is strange formulation. We suggest to rephrase it. [France]	Accepted: Added "Parameter" in renewable energy.
36080	16	47	16	49	The reference is not representative of the overall scenario. More citations required to substantiate a global scenario. [India]	Accepted. (IRENA, 2017) added.
36712	16	47	17	2	Both onshore and offshore wind have also experienced significant cost reductions and performance improvements that should be acknowledged in this paragraph. For example, the cost of generating electricty from onshore wind has declined by two-thirds in the U.S. since 2009 and the cost of offshore wind in Europe has declined by 32% or more between 2010 and 2016 and current prices are projected to decline 67% by 2025 as described in 1) Onshore wind: Wiser and Bolinger. 2016 WInd Technologies Market Report, U.S. Department of Energy, Offfice of Energy Efficiency and Renewable Energy. and 2) Several sources for offshore wind cost reductions are described in this article: https://www.utilitydive.com/news/getting-to-head-spinning-low-prices-for-us-offshore-wind/515188/ [Steve Clemmer, United States of America]	Accepted: Text added.
45966	16	47	16	47	The latest cost data and analysis for renewable power technologies originally comes from the IRENA costing database. Latest data can be accessed from here: http://www.irena.org/publications/2018/Jan/Renewable-power-generation-costs-in-2017 [Deger Saygin, Turkey]	Noted
58356	16	47	16	55	Perhaps add "in renewable energy" prior to "since AR5". Is it possible to define "dramatic reduction in the cost of solar PV" in quantitative terms? There is evidence to demonstrate the rapid decrese in costs and the resultant competitiveness of solar in Australia and in other rural developing areas? Are there any numbers of the remote areas that now have electricity due to solar and mini-grid systems? These are important statements and would be more powerful with empirircal evidence than simply with citations. [Peter Marcotullio, United States of America]	Accepted: Text changed.
62804	16	47	16	55	CSP has also experienced robust growth in countries where CSP can be deployed eg countries with high solar insolation. Some countries (eg Morocco) are prioritizing CSP because of falling prices and battery storage [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	Rejected: CSP not as rapid as PV
6404	16	48	17	2	The paragraph only considers implications of the rapid cost reduction of solar PV for decentralised small-scle, off grid and on grid, appications. However, the bulk of deployment still is for large-scale,on-grid applications, notably ground-based utility-scale solar power plant, but also relatively large-scale commercial applications. In 2016, utility scale had cumulative capacity of 162 GW, commercial 89 GW, while residential had 45 GW and off grid only 3 GW globally. By 2022 the proportions are likely to remain roughly the same. Source: IEA 2007, Renewables 2017, Market Report Series, OECD/IEA, Paris. [Cedric Philibert, France]	Noted: Growth rates much lighter on solar pv. Added line on utility scale solar.
12232	16	50	16	54	But are costs for these community renewables lower overall (and in all circumatances)? [United Kingdom (of Great Britain and Northern Ireland)]	Noted: (IRENA, 2017) suggests they are.
57216	16	50	16	54	Bertheau et al., 2017 (doi:10.3390/en10111899) shows how entire Sub-Saharan Africa could be electrified by SHS and mini-grids and grid extensions. [Christian Breyer, Finland]	Accepted: Added to text.
45382	16	54		55	Another, 2018 example of a small-scale distirbuted energy storage project is one I am working on, published in Feb 2018 https://www.sciencedirect.com/science/article/pii/S2214629617303158 [Veryan Hann, Australia]	Noted, not included because of space constraints.
58310	16	54	16	54	Suggest to add: Minigrids are also likely to play an important role in providing universal energy access in line with SDG 7 (IEA, 2017a - Energy Access Outlook) [Andrew Prag, France]	Accepted: Added to text.
58314	17	4	17	10	Important to also mention the role of system integration in increasing the feasibility of higher proportions of variable renewbales. See IEA 2017 Getting Wind and Sun onto the Grid [Andrew Prag, France]	Accepted: Added 'system integration' sentence.
58360	17	5	17	6	Can we specifiy the "technological advances and policy instrucments" that make renewable energy options increaasingy attractive? [Peter Marcotullio, United States of America]	Accepted: Paragraph expanded a little.

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33108	17	7	17	10	attention to human rights can reduce the riks of community opposition to climate actions. Add a refenece to human rights. See Mary Robinson Foundation – Climate Justice (2015a) Right for Action: Putting People at the Centre of Action on Climate Change. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-Rights-for-Action-edition-2.pdf and this database of human rights violations and renewable energy installations https://business-humanrights.org/renewable-energy-human-rights [Tara Shine, Ireland]	Accepted: Sentence added. Need non grey lit reference though.
39228	17	8	17	9	Important point to explain in greater detail for policy makers [Lindsey Cook, Germany]	Accepted: However, no more space in this section. Covered in later paragraphs.
37236	17	8	17	13	While we would agree that there are challenges around the implementation of lessons around the importance of comprehensive public engagement and communication of CCS, we would challenge the idea this means that the social feasibility of CCS low. We have seen marked improvements in the public outreach activities of CCS projects internationally and there is strong evidence from the current collection of active CCS projects that when effort and best practice is applied to CCS projects public understanding, approval and acceptance of CCS improves. A critical challenge to public acceptance of CCS is improving awareness of the technology and changing political representations of the technology from a high cost, unknown technology, to a safe, proven technology essential for meeting emission reduction targets. (Ashworth et al., 2010, GCCSI, 2016.) [John Scowcroft, Belgium]	Taken Into Account. These conditions apply to many of the opportunities that are not being taken and chapter 4 has made a fair assessment of CCS as not been as successful in the years since AR5 as would have been hoped.
54422	17	8	17	8	If necessary, consider illustrating negative local responses to wind energy projects by citing Stokes (2016). Stokes, L.C., 2016. Electoral Backlash against Climate Policy: A Natural Experiment on Retrospective Voting and Local Resistance to Public Policy. American Journal of Political Science, 60 (4), 958–974. [Conor Little, Ireland]	Accepted: Reference added.
7726	17	12	17	19	Focusing on the debate over 100%-renewable power generation is a red herring. The missing key conclusion is that largely (~70–90%) renewable generation is clearly feasible and cost-effective (see e.g. Lovins, “Reliably integrating variable renewables: moving grid flexibility resources from models to results,” El.J. 30(10):58–93 (Dec 2017), http://dx.doi.org/10.1016/j.tej.2017.11.006, for both analytic and practical examples)—whatever exists is possible. It is not necessary to know today the exact mix of available resources that can be used to achieve even higher levels around mid-century. The difference between current and very largely renewable generation, and the rapidly emerging trajectory to follow that pathway in at least most of the world, is vital to 1.5C? futures, but the later difference between say 90% and 100% is not, and should not dominate this current conversation. [Amory Lovins, United States of America]	Accepted: Reference added.
37628	17	12	17	17	Potential for high-penetration RE ssytems, especially with variable RE such as wind and solar, depends on total system integration characteristics. Cite Hirth et al 10.1016/j.eneco.2013.02.004; Ueckerdt et al. 10.1016/j.renene.2015.03.002; Ueckerdt et al. 10.1016/j.energy.2015.07.006; Ueckerdt et al. 10.1016/j.energy.2013.10.072 [Michiel Schaeffer, Netherlands]	Noted
49760	17	12	17	19	The relevant and extensive work of the group of prof Christian Breyer from Lappeenranta University should also be mentioned. [Fabio Monforti-Ferrario, Italy]	Noted
52000	17	12	17	19	The cited papers of Jacobson, Clack and Heard were clearly not read but skimmed. Read what these papers and report what the literature is actually claiming, not just what the abstracts say. [Jason Donev, Canada]	Noted
57214	17	12	17	15	the two following literature pieces should be added documenting that a 100% renewables scenario till 2050 is possible as part of a least cost scenario: DOI: 10.1002/pip.2950 and Ram et al. (2017) (ISBN: 978-952-335-171-4) link: https://www.researchgate.net/publication/320934766_Global_Energy_System_based_on_100_Renewable_Energy_-_Power_Sector - biomass is used only from waste and residues source, but energy crops have been blocked - the scenario still shows declining cost for the total energy system compared to the 2015 reference case [Christian Breyer, Finland]	Noted
19728	17	13	17	14	Because of this considerable debate the increased use of bioenergy through biomass and biofuels should not be projected as a unquestioned part of 1.5° solution pathways by this report. [Jennifer Morgan, Netherlands]	Noted
62164	17	13	17	13	The whole section has much improved from FOD. But this sentence relies still on old littérature. A fully renewable system at the local and national level is now a demonstrated option. At issue is the possibility of a global generalized système and the cost of associated flexibility (storage, grids, associated technologies...). The sentence should be replaced from "considerable debate exist on whether..." to "the speed of implementation for a fully renewable energy system is still in debate". [Antoine Bonduelle, France]	Accepted Text modified.
30588	17	15	17	16	They also depend on the proper combination of policy instruments (ie, national targets, regulatory and fiscal instruments, risk mitigation, price guarantees...), which vary according to the energy systems and local and national circumstances. [France]	Noted
6406	17	17	17	17	Hard to see why "dirusptive innovation" here is narrowed down to "roof-top solar"; while the "considerably greater growth than expected". Indeed roof-top is in itself more disruptive to traditional utility business model than large-scale plants, but here what is talked about is the very rapid improvement in PV technology that has led to this greater than expected growth - and again the bulk of it has been in utility-scale plants. [Cedric Philibert, France]	Noted: Bulk is not in utility scale plant, bulk is rooftop.
19760	17	17	17	19	Approaches have consistently underestimated the deployment of renewable energy and fail to take into account disruptive trends in the electricity sector and technologies capable of exponential growth. https://www.rmi.org/wp-content/uploads/2017/08/RMI_Report_Positive_Disruption_2017.pdf. On solar specifically, see https://www.nature.com/articles/nenergy2017140.epdf?referrer_access_token=24nnff3WFpD3GAxujAdI3dRgN0jAjWel9jnR3ZoTv0MwubtPHaj9zPdI8QQdt_62Nf5urePRubvGnv689V1YjulS9gFrLjkI1HDh5Ouz6lmUnnoltYEF3HukClj2cmyu86hoBVAvUOCYbbx5mxSRG6gWEMa1Wsr2K1BtGc42qVrSmd_NsKZZu2sU-d_rddJPRxVs1A6E21yg3zf4bGnKn2DTWny_oNOgUF_z-4cniQbS0AdTel2Un9QaTUWC--vl83PIlZ3AEtF9FW88bMEh_XBb6tzo9dR5YRBeUsYzzEY%3D&tracking_referrer=www.vox.com. [Jennifer Morgan, Netherlands]	Noted. We are citing the Creutzig paper.
31006	17	19	17	19	The sentence is too generic and some explainations would help to complete the framework of renewable energy. [alberto fichera, Italy]	Noted
52002	17	19	17	19	The line about countries adopting 100% renewable targets is grossly misleading. First off, many of these countries are including hydropower and geothermal power in this, which is usually not considered renewable in the course of this paper. Second of all, in the absence of grid-level storage (which is still at the 'science fiction' stage, in terms of implementation at large scale), 100% renewable energy relies on reliable energy from other countries. This is the same 'free-rider' problem that was discussed earlier in this chapter, but a target of 100% wind and solar requires somebody, somewhere to be burning natural gas. [Jason Donev, Canada]	Accepted: Text added.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
50734	17	20	17	20	In the reviewer´s opinion a reference should be made to power electronics. Power electronics is the key technology for interfacing renewable energies with the load and the power network. It has been very relevant for all the renewable energies, but n the case of wind power generation, power electronics has been instrumental in the consolidation of this technology. Power electronics brings added value to the use of renewables in the context of a power network, because of reactive power compensation (including harmonic compensation) and the easy interfacing with energy storage (normally batteries). Same applies for the energy conditioning for fuel cells. A relevant citation to this point (because of hsitorical reasons) is "(Blaabjerg et al. 2004) Blaabjerg F; Chen Z; Kjaer S B. Power Electronics as Efficient Interface in Dispersed Power Generation Systems. IEEE Transactions On Power Electronics, IEEE Service Center, Piscataway, NJ, US. Vol. 19. Nº - 5. 2004-09-01. Pág. - 1184 - 1194. ISSN 0885-8993". To confirm the importance of power electronics a further citation from the U.S. Climate Change Technology Program can be added. In page its report "Technology Options for the Near and Long", dated 2003 there are several references to the relevance of power electronics. There is at least a slightly more recent version dated September 2005 (a kind of compendium), but I have not been able to retrieve it from internet. The 2003 version can be found here http://www.ewp.rpi.edu/hartford/~stephc/ET/Other/Miscellaneous/USDOE-USCCTP-Report.pdf. Since the report was published, power electronics has become more performant, efficient and also cheaper, what has amplified the importance when combined with renewable energies. [Francisco Javier Hurtado Albir, Germany]	Accepted: Text and reference added.
50736	17	20	17	20	In the same part of the report, a reference to the smart grids supporting and allowing optimal renewable electrical power generation should be introduced. When used in combination with renewable energies, smart grids have the same advantages as for any other kind of generation and make renewables much more competitive. But they have the added value of allowing the coordination of renewable generation with the charge of electric and hybrid vehicles, that can act also as energy storage for a power network. An interesting reference at this point would be IRENA (International Renewable Energy Agency) 2013, "Smart Grids and Renewables" http://www.irena.org/documentdownloads/publications/smart_grids.pdf [Francisco Javier Hurtado Albir, Germany]	Accepted: Added to text at start of 4.3.2.
4280	17	22			Section 4.3.2.2 clearly refers to "Energy storage" and not only to "Electricity storage". I suggest you change title [Abanades Carlos, Spain]	Accepted: Section title changed.
6410	17	22	17	43	It would be helpful to distinguish storage needs by durations. Batteries and the use of Evs are nice to make short term storage. Medium term storage is more effective with pumped hydro plants. Synthetic gas and liquids are options for long term storage - typically adressing inter-seasonal imbalances. [Cedric Philibert, France]	Accepted: Text changed.
7728	17	22	17	35	This text is improved but still misframed. “Grid flexibility resources” are indeed the right framing, and have already taken several EU countries not rich in hydropower to upwards of half-renewable (not just in “the near future”—see http://dx.doi.org/10.1016/j.tej.2017.11.006). Yet that broad framing disappears after the first sentence into a discussion of bulk electricity storage, chiefly in batteries. The authors should instead be thinking about a supply curve of grid flexibility resources, of which utility-scale batteries are the costliest of ten options: largely or wholly renewable electricity doesn’t need them and won’t wait for them. (I would paste a drawing here but don’t think your Excel format allows that.) That said, batteries are indeed getting much cheaper, and in my view, lithium chemistries are likely to be overtaken rapidly by nonflammable, nontoxic, similar-or-higher-energy-density, and order-of-magnitude cheaper chemistries like MnO2/Al or /Zn, or their air-side variants, using Ionic Materials’ solid polymer electrolyte. (The cited Dhar et al 2017 reference has some useful content but in this fast-moving field it has become outdated.) But the point is not the vitality of battery innovation and scaling but that the prevalent vision of a need for lots of cheap batteries is mythical. That’s because of how the grid works: one generator does not serve one load (save on a desert island); rather, all generators serve the grid, and the grid in turn serves all loads. It would be discouraging if IPCC propagated the bulk-storage myth at the very time when the nine cheaper-than-today’s-batteries options were showing their startling potential. For example, in the Texas grid (ERCOT), demand response alone could more than eliminate PV’s “duck curve,” save a fourth of nonrenewable capacity, make PV power one-third more valuable, cut power-sector CO2 emissions 23%, and pay back in ~5 months (Goldenberg & Dyson, “Pushing the Limit: How Demand Flexibility Can Grow the Market for Renewable Energy,” 14 Feb 2018, https://rmi.org/news/demand-flexibility-can-grow-market-renewable-energy/). [Amory Lovins, United States of America]	Noted: Mentioned GFR's (got from web RMT) in text.
36716	17	22	17	43	Please add a few sentences describing whether and how energy storage is included in the IAMs and scenarios described in Chapter 2, and how models with more detailed temporal and geographic resolution are needed to capture the value, multiple benefits, and multiple use cases of energy storage. These limitations likely underestimate the potential role of energy storage as well as the contribution of wind and solar to the energy mix and emission reductions. [Steve Clemmer, United States of America]	Noted. We should not discuss this here but chapter 2 discusses this. Also, there is little literature on this matter.
52006	17	22	17	40	Pumped hydro is mentioned, but not the possibility of expanding pumped hydro further. Why was this literature not reported on? [Jason Donev, Canada]	Accepted. All renewable energy forms were deliberately removed from the list other than those rapidly growing.
52004	17	22	17	40	Electricity is, at some level, reliant on very specific numbers. The worldwide pumped hydro storage is ~150 GW (which can be a little misleading as a straight number because there are limitations to the number of GWh that can be stored in this pumped storage), but that is the only number actually provided in this section. This is a gross oversight and significantly erodes the credibility of the entire report. This report is relying heavily on the deployment of wind and solar as carbon free sources of energy (as opposed to hydropower and nuclear power which are dispatchable and have a high capacity factor). This means that quantifying the amount of grid level storage that is possible is essential. Without numbers this section is not just hand-waving, but extremely problematic. The ambiguity decimates the feasibility of the rest of the report on 1.5C paths being plausible. This portion of the report is quite possibly the most problematic in any chapter of the entire report. The grid-level storage is the Achilles heel of wind and solar and if we are going to deploy them at the numbers that are argued for here we cannot ignore the harsh reality that this is a critical piece of non-existant technology. [Jason Donev, Canada]	Rejected: New projects are showing strong potential. Commercial products from solar and wind continuous dramatic growth with nuclear stagnant. The report seeks to those growth areas.
60872	17	22	17	35	The discussion of electricity storage in 4.3.2.2 is quite general and should provide more quantitative estimates of potential scalability over time and how that would relate to the pathways described in Chapter 2. [United States of America]	Accepted: Text amended. Some quantitative data.
11048	17	23	17	35	Lithium is not the issue - focus needs to be on metals such as nickel and cobalt, important components within the battery. [Wilfried Maas, Netherlands]	Accepted: Text Changed. Still not a concern.
52008	17	23	17	35	Germany brought coal back on-line to introduce wind and solar power, increasing not only the cost of their electricity but their carbon footprint. Why is this not discussed here? [Jason Donev, Canada]	Noted
52010	17	23	17	35	This is a strange report to site, rather than the IEA. Which places and why aren't they mentioned? Is this true for anyone other than the hyper-connected European grid? Are these countries producing their own electricity or importing it from other countries? Are these countries relying on the grids of other countries to store their electricity? [Jason Donev, Canada]	Noted
52012	17	23	17	25	This sentence is very awkward. Break it into several sentences. [Jason Donev, Canada]	Accepted: Text changed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
58364	17	23	17	25	Can we define "grid flexibility resources" and "European places"? What do these mean? It seems, from this sentence that this growth in storage has been targeted to increase renewable power in Europe. Was this a result market forces or a policy? Is this the correct reading? Can we clarify this? [Peter Marcotullio, United States of America]	Accepted: Text changed.
60874	17	23	17	24	Why does the statement focus on Europe? Clarify statement on Europe or expand to all relevent locations. [United States of America]	Accepted: Text changed.
62806	17	23	17	35	I will suggest to also look at the findings of World Storage conferences recently held (oct 17) in the UK [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	Noted
52014	17	25	17	40	Can the amount of lithium production be quantified? Can the amount of lithium needed be quantified? What other resources are required for these batteries than lithium? While we need more aluminum, copper and steel as we build a larger, more connected 'smart-grid'? [Jason Donev, Canada]	Accepted: Text revised to mention other metals.
52016	17	25	17	26	I'm sorry, but this sentence doesn't make sense. [Jason Donev, Canada]	Accepted: Text revised.
31512	17	26	17	29	Quantitative information (numbers) on cost reductions are beneficial to policy makers as well as general public, so we recommend adding specific numbers related. [Japan]	Accepted: Quantitative data added where possible.
36714	17	26	17	29	Stationary utility-scale deployment of energy storage, primarily lithium ion batteries, has also increased significantly in the past few years that is also driving cost reductions along with electric vehicles. [Steve Clemmer, United States of America]	Accepted: Text revised.
6408	17	27	17	27	You may want to replace "growth feature" with "development feature": in absolute numbers of capacity or even more energy the growth of pumped-storage hydropower since AR 5 has exceeded by far the growth in battery storage. [Cedric Philibert, France]	Noted: Growth rates are not absolute amounts. Key Point.
58366	17	29	17	29	Should we be careful of using policy prescriptive descriptions such as "increasingly positive" in terms of costs and technical maturity of battery storage. Can or should we and I'm not sure where the IPCC is on this issue, be more objective and simply supply the evidence for the costs and technical maturity of the technology? [Peter Marcotullio, United States of America]	Accepted: Text revised to discuss growth rates.
60876	17	29	17	33	Given the statement on availability of resources and the following statement about lithium not being limited, perhaps add one more sentence that other elements are limiting or that different technologies could be constrained. [United States of America]	Accepted Text revised.
918	17	31	17	31	a crustal element' should be 'a crucial element' [Robert Shapiro, United States of America]	Rejected: Text now explains.
16452	17	31	17	33	Statement that most lithium comes from Western Australia appears to misrepresent the DMP source that states that Western Australia is the largest lithium producer. Australia as a country is the largest single producer but USGS numbers in the 'Ministeral Yearbook Lithim 2015' indicate Australia produces less than 50% of global mine production. https://minerals.usgs.gov/minerals/pubs/commodity/lithium/myb1-2015-lithi.pdf [Australia]	Accepted: Text changed. New data shows very large increase in production in Western Australia as noted in US Geol Survey data.
45384	17	31		31	lithium, a crustal element could be changed to "lithium, a common element in the earth's crust" because non-geologists may not necessarily think 'crustal' refers to commonly occuring elements on the earth's surface. [Veryan Hann, Australia]	Accepted: Text changed.
5044	17	33	17	35	An important new electricity storage (battery) technology is based on graphene ultracapacitors. Using graphene as the conducting material in the ultracapacitors, the surface area of the conductors is greatly increased such that the energy density can come close to that of lithium batteries; the charge storage not being based on a chemical reaction, these ultracapacitors can go through many more cycles without degradation than chemical batteries; being capacitors, charging can be rapid and techniques have been developed to allow controlled discharge; also, these ultracapacitors do not require lithium or other rare and pricy metals. Searches will turn up articles on ultracapacitors, and if one goes to http://www.microtrontec.com you can find how such capacitors are starting to enter the transport sector, where they should overcome quite a number of the problems that lithium batteries present for vehicles. Whether this is the way to go for storing energy on the grid is not clear, but it might be worth giving some citations to new approaches to batteries to give a sense that it is not just about finding slightly different compositions of chemical battery components, but about whole new approaches that it would seem could really transform present efforts. [I have no financial interest in the particular technology/web site company indicated, though a friend does at it certainly seem as if this technology could be very significant.] [Michael MacCracken, United States of America]	Accepted: Text revised to comment on new technologies.
17726	17	33	17	35	This part is mentioning only the high performace system for the emerging battery technologies. These developing trend is for electric vehicle. For the ESS system, there are a lot of effort to devlopt low cost, long cycle life, and safe systems. Some of the examples are sodium ion batteries and redox flow battery systems. It is necessary to mention both trend for developing the batteries for EV and ESS. [Republic of Korea]	Accepted: Text revised.
52018	17	33	17	35	Non-Lithium ion batteries are mentioned, but not by name. What kind of batteries are being talked about? Are improvements expected in these technologies as well? [Jason Donev, Canada]	Accepted: Text revised.
4282	17	36			A comment on energy thermal energy storage and thermochemical energy storage is needed, as such methods of energy storage may be essential in some scenarios of 100% renewables (see debate on Jacobson-Clack mentioned earlier). A possible recent reference with a good citing record: A review on high temperature thermochemical heat energy storage, Renewable and Sustainable Energy Reviews Volume 32, April 2014, Pages 591-610; Pardo, P., Deydier, A.; Anxionnaz-Minvielle, Z.; Rougé, S.; Cabassud, M.; Cognet, P. [Abanades Carlos, Spain]	Accepted: Reference added.
7732	17	36			I wish the report addressed somewhere a flaw that appears to exist in all or nearly all IAMs: they assume no economic dispatch or equivalent mechanisms. They therefore tacitly assume that a coal- or gas-fired power plant will run at its rated capacity for its rated life, rather than being gradually pushed up the load-duration curve and thus running fewer hours as it becomes less competitive with efficiency, renewables, or, in the case of coal, gas-fired generation. The result is a large but unquantified overstatement of projected power-sector CO2 emissions. Correcting that methodological error is equivalent to sequestering more projected emissions. [Amory Lovins, United States of America]	Noted
2096	17	37			as above ignores power-to-liquids, which can be more easily stored [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text added.
4284	17	37	17	39	Major error regarding the reference to "synthetic gas". You should emphatize that Synthetic gas should be "renewably derived" regarding BOTH the source of energy AND THE SOURCE OF CARBON. Since the carbon will normally be released as CO2 when the fuels is used, it is essential that the source of carbon is renewable (i.e. the atmosphere or biomass). The literature on synthetic gases, or CO2 converstion to fuels, contains too often this great missconception , as pointed out by the works of von Der Assen et al (a Life-cycle assessment of carbon dioxide capture and utilization: Avoiding the pitfalls. Energy and Environmental Science 6, 2721-2734, doi:10.1039/c3ee41151f (2013)) and Abanades et al (2017) referred elsewhere. [Abanades Carlos, Spain]	Accepted: Text revised.
6412	17	37	17	37	Why privilege gas over liquids, easier to store, and not necessarily less efficient than gas? [Cedric Philibert, France]	Accepted: Text revised (added methanol).
7730	17	37	17	43	EVs yes: Danish and Californian data confirm that fully monetizing EVs' value to the grid, including storage without compromising the driving capability or experience, could repay up to about half the EVs' current purchase price. But syngas from surplus power is dicier: especially for synthetic methane, I've never seen a business case. In contrast, direct electrolysis to H2 using e.g. surplus windpower may pay in many circumstances, especially if demand-response value is counted, but it would require the sort of understanding of complete H2 systems offered in the references at the end of my FOD comments on 4-20:37. [Amory Lovins, United States of America]	Accepted: Text changed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12234	17	37	17	43	No mention here of hydrogen as a potential mode of storage, despite the interest of several governments and investigation in many studies. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text changed.
52020	17	37	17	40	Compressed Air Energy Storage (CAES) has been ignored here. That seems strange. CAES is being explored in the jurisdiction in which I live and has shown significant promise on the front of storing wind energy. This should be investigated. [Jason Donev, Canada]	Noted
52022	17	37	17	37	The claim that this is increasingly seen as viable seems misleading. While there may be people who believe that this is viable, I strongly suspect at there are many who don't believe that this is viable. I think it would be more appropriate to say that this technology may prove feasible with considerably more study and development. [Jason Donev, Canada]	Accepted: Text changed.
52024	17	37	17	37	What is synthetic gas here? Methane? Gasoline? [Jason Donev, Canada]	Accepted: Methane and mixtures of other combustible gases. Text changed.
52026	17	37	17	43	Would this synthetic gas be used as a heat source instead of electricity? What sorts of efficiencies are involved? [Jason Donev, Canada]	Noted
57220	17	37	17	43	the claim that synthetic gas would be still lab-scale is wrong. Commercially available plants are in used, such as the Werlte plant of Audi. The technology is not yet matrue, but available for the markets at commercial scale, which is definitely something else than 'lab-scale'. Wording needs to be adjusted accordingly. [Christian Breyer, Finland]	Accepted: Text changed.
57218	17	37	17	43	the role of synthetic gas is shown in the two following literature pieces for the case of a 100% renewable power system till 2050 as part of a least cost scenario: DOI: 10.1002/pip.2950 and Ram et al. (2017) (ISBN: 978-952-335-171-4) link: https://www.researchgate.net/publication/320934766_Global_Energy_System_based_on_100_Renewable_Energy_-_Power_Sector - the global average of synthetic gas is required for about 1.0% of demand, the match of variable supply and load demand can be matched by lower cost options - all shown for full hourly resolution and the world structured in 145 regions. Both literature shows how a portfolio of storage and dispatachable renewable energy options constitiute least cost pathway options. Detailed analyses can be found in literature for country cases such as Turkey (http://dx.doi.org/10.1016/j.solener.2017.09.030), Iran (10.1016/j.egypro.2017.09.484), Saudi Arabia (doi:10.3390/w10010003), Ukraine (10.1016/j.egypro.2017.09.513), India (https://doi.org/10.1016/j.est.2017.11.012) and Pakistan (https://doi.org/10.1016/j.energy.2018.01.027). [Christian Breyer, Finland]	Accepted: Reference added.
13160	17	39	17	40	Delete the text "The use of EVs as a form of storage has been evaluated very positively (Dhar et al., 2017).". [Eleni Kaditi, Austria]	Noted: This is a statement of fact.
36572	17	39	17	40	Please define the acronym EV' [Snaliah Mahal, Saint Lucia]	Accepted: Text changed.
52028	17	39	17	40	The use of EVs will also dramatically increase our electricity demand, calling for a considerably higher electricity demand which is not addressed here. Storage may take care of some portion of the indeterminacy problem, but could create a lack of availability for transportation energy use. How do I drive to work in the morning if the solar power stored in my car's battery has been used to make my coffee? [Jason Donev, Canada]	Noted
52030	17	39	17	40	While the use of EVs as storage has been evaluated positively, I have heard reports but not read reports, I admit that this is outside of my area, but at conferences this idea has been hotly contested by people who seemed experts in front of me. Is this feasible or wishful thinking? [Jason Donev, Canada]	Noted
37630	17	40	17	42	Sentence meaning is very unclear [Michiel Schaeffer, Netherlands]	Accepted: Text changed.
49762	17	40	17	43	This sentence is weird. It seems some words are missing. [Fabio Monforti-Ferrario, Italy]	Accepted: Text changed.
52032	17	40	17	43	The phrase 'the fossil fuel regime is destabilizing' is both politically charged an inaccurate. Oil is still, by far, the most traded commodity in the world. We still get more electricity from coal and natural gas (each individually) than everything else combined, and will be for the next few years into the future (high evidence). Terms like 'regime' are the terminology of political activism which erodes the credibility of this report (even if I agree with those activists, we must be both prosaic and clear). [Jason Donev, Canada]	Accepted: Text changed.
52034	17	40	17	43	The selection bias of looking only at these two papers is problematic. Other reports cited, even within this chapter (like the IAE 2017c) predict very strong futures for fossil fuels for a while yet. To pick these two reports is wishful thinking at best. [Jason Donev, Canada]	Noted: Text is about potential upscaling and growth trajectories.
52036	17	40	17	43	This sentence is very awkward. Break it into several sentences. [Jason Donev, Canada]	Accepted: Text changed.
60878	17	40	17	40	What does "evaluated very positively" mean? [United States of America]	Accepted: Text changed.
7916	17	41	17	41	Add comma after 'remain" [Christopher Bataille, Canada]	Accepted: Text changed.
920	17	42	17	42	socio-technical are increasingly being surmounted' socio-technical ?what? [Robert Shapiro, United States of America]	Accepted: Text changed.
3252	17	42	17	42	The phrase "socio-technical are increasingly being surmounted as the fossil fuel regime is destabilising" is very unclear [Vassilis Daioglou, Netherlands]	Accepted: Text changed.
13162	17	42	17	43	Delete the text "; socio-technical are increasingly being surmounted as the fossil fuel regime is destabilising (Geels et al., 2017c).". [Eleni Kaditi, Austria]	Accepted: Text changed.
52038	17	42	17	42	What is meant by socio-technical in this context? Can this be explained and expanded on? [Jason Donev, Canada]	Accepted: Text changed.
58372	17	42	17	43	I think this fragment, starting with "socio-technical.." doesn't belong here? [Peter Marcotullio, United States of America]	Accepted: Text changed.
60880	17	42	17	42	Is the word "challenges" missing after "socio-technical"? [United States of America]	Accepted: Text changed.
7918	17	43	17	43	Rework sentence, very unclear. It is an exaggeration to say the fossil fuel system is "destabilizing". It would be more accurate to say that renewables are proving themselves to be competitive with the fossil fuel system, especially in electricity generation, and potentially via electrification in transport. [Christopher Bataille, Canada]	Accepted: Text changed.
50738	17	44	17	44	A similar reference to the previous one should be also done here (much smaller, since the core aspects would have been already depicted in the renewables area) for power electronics and smart grids, and for the same reasons. [Francisco Javier Hurtado Albir, Germany]	Noted
62764	17	46			Here a link to Chapter 2, Section 2.3.4, last paragraph on CCS deployment in 1.5°C pathways and the projected deployment rates would be useful. Maybe add discussion of sustainability concerns about CCS (leakage, micro-earthquakes, groundwater safety)? [Elmar KRIEGLER, Germany]	Accept. This section also discusses CO2 storage estimates, which is useful. After checking whether the section number remains the same, the reference will be made. For the other issues, see other comment responses.
13970	17	46	18	23	This section doesn't seem to consider the new evidence that induced seimicity can occur in regions that are thought to be safe, revising the debate about the safeness of CCS. (e.g. [Natalie MAHOWALD, United States of America]	Reject. Although relevant and indeed new work has come out (no reference is given, but looking into it we located a review article dated December 2017 in Applied Energy (Aminu et al 2017 AE 208), and reference therein) we don't have space to go into this matter. Will be incorporated in AR6!
16454	17	46		23	The analysis of CCS for the power sector rests heavily on the technical issues of CCS. While an attempt is made to argue that some of this is due to a lack of policy or commercial incentive, it is not explicitly made. In many multilateral forums, including the Clean Energy Ministerial, a key issue for all nations that are attempting to deploy CCS is a lack of technology-neutral policy settings across all low to zero emission technologies. This could be outlined more explicitly in the document. [Australia]	Taken into account. This aspect is indeed addressed in a more generic way in section 4.4.5.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
40438	17	46	17	46	The potential risk of CCS, which should be evaluated in relation to its feasibility, is not considered in its full perspective in this section. See for example Schneider and Winkler .2016. Threats to the Quality of Water Resources by Geological CO2 Storage: Hydrogeochemical and Other Methods of Investigation: A Review. 40. 31-51. 10.1007/698-2013-232.) [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account. The chapter cited here reviews the well-known (and in the IPCC Special Report on CCS already discussed) trapping mechanisms and potential risks if leakage pathways emerge. It does not provide new information, judging by the abstract (the full paper could not be retrieved).
60882	17	46	18	23	The discussion of CCS should provide more detail about the pace, scale, and scope of technology deployment that would be needed to scale the technology to the levels compatible with 1.5°C pathways. [United States of America]	Taken into account. This is in the field of chapter 2.
1648	17	47	17	49	Here just state IPCC SR CCS and AR5 assgin great potential to CCS. It is suggested to add some words like "much more potentials for CCS in particular biomass CCS would be expected to achieve 1.5 degree based on the findings from Chapter 2." [Wenying Chen, China]	Taken into account. These numbers can be found in the respective relevant sections referred to.
10076	17	47	17	54	Why the scale up concerns considered as a reduction of feasibility for CCS though other renewable technologies faces similar scale up issues but have not been described as less feasible ? The next concern is about co-benefits: what is meant by it does not offer much in terms of co-benefits? If meant health (air quality) and energy security then one may argue that both will be served by scaling the use of CCS. [Saudi Arabia]	Accept. Text is revised to balance the text better.
17666	17	47	17	54	Suggest providing the estimated amount of CO2 emission in 2016 (UN Emission Gap Report 2017, Executive Summary, Section 3: https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf) for comparison with the amount of CO2 stored by CCS. The energy requirement to achieve the amount of CO2 captured and stored should also be revealed/discussed so that the readers can have a broader picture of the cost-effectiveness of the technology. [Sai Ming Lee, China]	Reject. The total CO2 number is not fully relevant (not all sources are prone to CCS, and this is only power sector), and it is cited in chapter 1 and 2 already. On energy requirement, our understanding is that no major changes have been established since AR5, and we only have space for citing updates'
58318	17	47	17	54	Suggest starting this CCS section by stating that most 1.5C pathways rely on CCS in some form and in some sectors; this would put the following text on slow progress to date into stark contrast [Andrew Prag, France]	Accept. See also comment 62764. The reply to this will be combined with that response.
62048	17	47	17	47	assigns [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Reject. Two reports are cited.
1560	17	50	17	52	… it does not offer much in terms of co-benefits that might increase feasibility. This characterization of CCS technology is biased and written without any evidence. It certainly contradicts the facts that CCS, whether pre-combustion decarbonization, or post-combustion CO2 capture, would also help reduce other air pollutants as these other air pollutants are also captured. Further, for nations that will continue to consume their abundant hydrocarbon resource, CCS offers not only feasibility but flexiblity as well for their natural resource base. [Arthur Lee, United States of America]	Accept. The first part will be incorporated, the second is not really co-benefits, but it does affect political/institutional and economic feasibility. The sentence also does not read well, so revisions will be made. See also response to comment 10076.
37228	17	50	17	52	The statement that “CO2 capture in the power sector, and transport and storage of CO2 in general, however, face numerous barriers that reduce their feasibility.” is misleading as it implies that the barriers to deployment are significantly different to and more difficult to manage than other industrial developments. Experience at the Boundary Dam CCS facility, the Petra Nova Facility and at various other proposed power facilities that failed to reach a positive Financial Investment Decision demonstrates that this is incorrect. The barriers faced by CCS projects are essentially the same as are faced by any large industrial project. The primary barrier faced by CCS is the lack of a strong business case for investment due to the lack of climate policy of sufficient ambition or effectiveness to reward the investor for the abatement achieved. Where the combination of policy and business opportunity was sufficient to create a business case for investment (ie Boundary dam and Petra Nova), the investment was made; all other risks or barriers were managed in an identical fashion to any other large industrial project. Where proposed CCS power facilities did not reach FID, the cause was the inability for the project proponents to reach financial close due to the lack of sufficient reward for incurring the additional cost necessary to achieve the abatement – ie, the business case for investment did not stack up. Further, the statement referenced above is particularly egregious with respect to transport and storage of CO2 given the operation, for decades of thousands of kilometers of CO2 pipelines in the United States. Transport and storage of CO2 is a mature technology. [John Scowcroft, Belgium]	Noted. Of solar and wind energy, the verdict also always used to be: there is an absence of climate policy so there is no business case. There is still an absence of climate policy, yet solar and wind now have a business case. The difference is that CCS needs climate policy for a business case, and that makes is different from other mitigation options that can deliver other value than CO2 reductions. At the same time, we don't want to be misleading so the phrasing will be viewed again with this comment in mind.
60884	17	50	17	52	‰Û_ it does not offer much in terms of co-benefits that might increase feasibility. This characterization of CCS technology is biased and written without any evidence. It certainly contradicts the facts that CCS, whether pre-combustion decarbonization, or post-combustion CO2 capture, would also help reduce other air pollutants as these other air pollutants are also captured. Further, for nations that will continue to consume their abundant hydrocarbon resource, CCS offers not only feasibility but flexiblity as well for their natural resource base. [United States of America]	Accept. See response to comment 1560
16456	17	51			From 4.3.2.3 we suggest a new line is added where feasability of carbon capture storage (CCS) is discussed: “For regions that choose to use fossil fuels CCS may still be feasible in the power sector notwithstanding the inherent barriers” [Australia]	Taken into account - revise text to make this clearer. See also response to comment 10076.
37230	17	51	17	51	It is unclear what this clause means: “while apart from more cost-effective achievement of shorter- to mid-term emission reduction goals”. The previous clause implies that CCS is unimportant in achieving our long-term goal of stabilizing the climate. Modelling by the International Energy Agency demonstrates that CCS is an important part of the least-cost technology mix required to achieve climate stabilization at 2 degrees above pre-industrial temperatures. Further, IEA modelling demonstrates that higher levels of ambition such as their Beyond 2 degrees scenario, requires CCS to deliver a much larger proportion of abatement. That is, CCS becomes more important at higher levels of emissions abatement. Reference: IEA Energy Technology Perspectives 2017, June 6, 2017. [John Scowcroft, Belgium]	Accept. The statement is about CCS in the fossil fuelled power sector . Beyond 2050, in 1.5C scenarios, the role of CCS in the fossil power sector is limited - it's all biomass + CCS or RE/nuclear. Text will be revised to accommodate these points.
37632	17	51	17	52	…feasibility. Apart from more cost-effective achievement of shorter- to mid-term emission reduction goals, CCS does not offer … [Michiel Schaeffer, Netherlands]	Accept, text revised in the meantime which made this editorial comment obsolete.

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37232	17	52	17	52	The statement that CCS "…does not offer much in terms of co-benefits that might increase feasibility" is incorrect. CCS plays a significant role in achieving the United Nations Sustainability Goals. As demonstrated by modelling by the IEA and others, CCS plays an essential role in delivering a low emissions energy system and least cost, contributing to the achievement of the Affordable and Clean Energy Sustainability Goal. CCS can be applied to new industrial infrastructure or can be retrofit to existing infrastructure such as steel, cement and fertiliser production to make it sustainable and consistent with a low emissions future. CCS is actually the only proven technology that can mitigate the direct process CO2 emissions created by these industries. CCS contributes to the United Nations' Industry, Innovation and Infrastructure Sustainable Development Goal. CCS allows the continued use of massive global fossil fuel resources ensuring sufficient supply of low cost energy and industrial feed stocks essential to fuel economic growth and development whilst reducing emissions and achieving climate targets. As the world adopts more stringent climate policies, CCS can reduce the damaging economic and social disruption that would otherwise arise in communities that depend upon fossil fuel production or utilization as a primary source of employment, protecting and creating skilled and high value jobs. In fact, the CCS industry itself can become a significant employer and source of wealth generation. To meet climate targets, the global CCS industry in the middle of this century will be as large as the global gas industry is today. CCS contributes to the United Nations' Industry, Decent Work and Economic Growth Sustainable Development Goal. [John Scowcroft, Belgium]	Noted. This paragraph is about CCS in the power sector. For the interaction with the SDGs, chapter 5 is the place where this is assessed.
37200	17	53	17	53	The statement .."30 Mt CO2 are stored" is incorrect. It is 30 Mt of CO2 capable of being captured (not all CO2 is always stored). [John Scowcroft, Belgium]	Accept. Will be taken into account.
48100	17	53	17	53	Please check 2.4 Mtpa from the demonstration projects - is this from the Global CCS Institute report? [Sarah Connors, France]	Noted. Yes, it is.
52040	17	53	17	54	It's good to know that CCS is working at the 30 MT annually level. This is 1/1000 of what we need and presenting the absolute number with no scale is misleading. CCS will need magnificent improvements in their grid scale applications before being a significant player in our mitigation efforts. [Jason Donev, Canada]	Accept. A sentence will be added to the paragraph indicating how much will need to be captured according to chapter 2.
52042	17	53	18	23	The Global CCS institute is not a neutral source of information on CCS. They have a significant conflict of interest in presenting information about CCS and should only be used as a last resort. Does no one else publish data on CCS? Citing institutes with such clear vested interests erodes the credibility of this report. [Jason Donev, Canada]	Noted. MIT used to keep a list but has stopped doing this on Sept 30, 2016. As far as we know, the GCCSI is the only comprehensive source.
54020	17	53	17	54	Several projects included in the Global CCS Institute report are in reality Enhanced Oil Recovery (EOR) projects, and are thus increasing the CO2 emissions, so this calculation is erroneous since EOR contributes to increases in global warming. The sentence about the amount of CCS projects in operation must be qualified, to indicate the extremely low feasibility of CCS. [Elenita Daño, Philippines]	Taken into account. The question is whether the EOR projects are increasing emissions; see the later statement (and reference) on this towards the end of this sub-subsection. And comment 37200
18578	18	1		13	No comments about the incompatability of CO2 underground storage and possible fracking is made. [Andrea TILCHE, Belgium]	Noted. We are not aware of literature on this issue. We do know of a paper that highlights the possibility of using supercritical CO2 for fracking (Middleton et al, 2015, AE 147) and another that looks at fossil energy services and CCS (Scott et al, Nature, 2015).
36718	18	1	18	3	It's also because most cost projections were based on engineering studies that greatly underestimated the initial costs of deploying CCS at scale in the power sector. It should be acknowledged that there is a high level of uncertainty if the level of cost reductions identified in the IPCC and IEA reports can be achieved in practice. [Steve Clemmer, United States of America]	Noted. Unfortunately, no reference is given for this statement.
42814	18	1	18	23	One view of industrial CCS (i.e. hydrogen production, ethanol production, natural gas production) as "low hanging fruit." Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security (U.S. Department of Energy, August 2016). [Kristin Campbell, United States of America]	Taken into account. For industrial CC(U)S, we refer to section 4.3.5 in the SOD (4.3.4 in the Final Draft).
43060	18	1	18	23	CCS should be expanded to CCUS. Global CO2 Initiative, Global Roadmap for Implementing CO2 Utilization ("CO2 curing of cements offers a superior product and superior price and should be able to move quickly if the following strategic actions are taken: • Ensure financing for conversions of precast concrete facilities. • Focus on converting the practices of incumbents rather than creating competitive companies. • Identify the most cost effective places to capture CO2 for this purpose. • Build an infrastructure to deliver CO2 – pipelines ultimately, but probably rail, ship or truck initially."); Pan S., et al. (2015) An Innovative Approach to Integrated Carbon Mineralization and Waste Utilization: A Review, Aerosol and Air Quality Research ("In addition to the 'green' cement, the carbonated alkaline solid waste can function as construction aggregate to partially replace sand, gravel, and crushed stone. Many industrial waste materials can potentially be used as economical and environmentally friendly sand substitutes for cementitious building products."). In addition, see one view of industrial CCS (i.e. hydrogen production, ethanol production, natural gas production) as "low hanging fruit." Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security (U.S. Department of Energy, August 2016). [Durwood Zaelke, United States of America]	Taken into account. See response to comment 42814.
52044	18	1	18	4	Costs not coming down in the past 10 years despite the technological maturation is a deeply disconcerting assertion (and one that I believe). What are these costs? Do we have reason to believe that they will come down? [Jason Donev, Canada]	Noted. Good questions, but if we start reporting on costs here, we need to do that for the different incarnations of CCS in the power sector and we don't have space for this. A full update will be provided in the AR6 report. Chapter 2 does not report costs, but the modelling results indicate clearly that CCS can be more competitive in some settings than other options in the power sector.
52046	18	1	18	4	How do the CCS costs compare with the costs of implementing other GHG reduction technologies like nuclear reactors, hydropower, solar power or wind? Is there a huge veriation over the different geographic regions? [Jason Donev, Canada]	Noted. See response to comment 52046

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53268	18	1	18	3	relevant to * Implausibility of deployment of BECCS for actual mitigation* The report frequently uses language that makes it sounds like the model results are real. This creates an impression that magical thinking about BECCS, for instance, is actually going to work. The report should be rewritten so that the reader is constantly reminded that these are *just modeling results.* For instance, this section states, “In most cases, CDR reduces atmospheric CO2 concentrations more quickly than would naturally be the case, and the response of the natural system is not necessarily the same per unit removed CO2 as it is per unit emitted CO2 during the emission regime.” It and so many other sections should be rewritten to say, “In most cases, the models assume that CDR reduces atmospheric CO2 concentrations more quickly than would naturally be the case,” etc. The report does discuss mitigation scenarios where BECCS is not used, reporting that emissions fall more quickly when this so-called option is eliminated (for instance, Chapter 2 at page 65 states “Higher use of BECCS in 1.5°C mitigation pathways is correlated with higher fossil fuel demand, which requires CO2 emissions reductions from BECCS to compensate for the fossil fuel-related emissions that are not captured by CCS. Conversely, lower use of BECCS in 1.5°C mitigation pathways is correlated with lower fossil fuel demand.” . It is important to highlight *in the section discussing bioenergy and BECCS* that the models that don’t include BECCS or limit it end up reducing fossil fuels faster. This is only good news. E.g., from (Rose, Kriegler et al. 2013) :” We find that constraining biomass supply not only affects the cost of stabilization, but also the cost-effective emissions trajectory. For the 450 policy, with biomass supply constrained, seven of the models must reduce fossil fuel and industry CO2 emissions significantly more quickly in the near-term, and subsequently less in the latter half of the century (Fig. 5). Constraining biomass supply constrains the opportunity for negative emissions, and forces an increase in near- term emissions reductions.” [Mary Booth, United States of America]	Noted. This comment seems intended more for the section on BECCS (in 4.3.8 SOD; 4.3.7 in the Final Draft), and similar comments have been made there. The responses to similar comments by the same reviewer in that section are valid here too. We will keep the advice in mind though to not treat IAM results as reality.
4286	18	2			If your unpublished reference to Bui et al 2018 is not accepted on time, consider the highly cited (700 cites) overall review of CCS in the same journal: M. E. Boot-Handford et al Carbon capture and storage update, Energy Environ. Sci., 2014, 7,130. DOI: 10.1039/c3ee42350f [Abanades Carlos, Spain]	Noted. Thank you for the suggestion, but Bui et al was accepted.
37234	18	2	18	2	The statement “but costs have not come down over the past ten years due to limited learning in commercial settings and increased energy and resources costs” is incorrect, due to its source (2015) not reflecting current experience. Actual capital cost per unit capture capacity for the Petra Nova CCS power facility that commenced operation in 2017 were approximately 20% less than the actual capital cost per unit capture capacity of the Boundary Dam CCS power facility that commenced operation in 2014. To Illustrate, Boundary Dam capture plant capital cost was approximately AUD750 million for a capture capacity of 1 million tonnes per year CO2 (or AUD750 million per million tonnes of CO2 capture capacity); Petra Nova capture plant capital cost was approximately AUD830 million (including an 80MW gas turbine to provide power) for a capture capacity of 1.4 million tonnes per year CO2 (or AUD593 million per million tonnes of CO2 capture capacity). [John Scowcroft, Belgium]	Accept. No reference was provided, but the dates have been changed to avoid making the claim that the statement applies to the two projects mentioned too.
13336	18	3	18	5	For detailed discussion of global CO2 storage capacity estimates, supporting available pore space theoretically exceeding mitigation requirements see Scott et al 2015 Fossil Fuels in a trillion tonne world https://www.nature.com/articles/nclimate2578 [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Reference included (and sentence shortened).
14222	18	4	18	4	The year of publication for the author "Bui et al" is missing [United Republic of Tanzania]	Accept. It was not yet published at the time of writing.
31008	18	4	18	4	The year of the reference misses. [alberto fichera, Italy]	Accept. It was not yet published at the time of writing.
36082	18	4	18	4	In reference for Bui et al. (); year needs to be added [India]	Accept. It was not yet published at the time of writing.
44080	18	4	18	4	reads "and Bui et al. ()" needs date [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accept. It was not yet published at the time of writing.
47924	18	4	18	4	Kindly check: Bui et al. (), the year is missing [Sarah Connors, France]	Accept. It was not yet published at the time of writing.
52048	18	4	18	6	This is talking about 2C, could a statement be made about 1.5C? [Jason Donev, Canada]	Accept. This sentence had overlap with chapter 2 and was removed for that reason.
54712	18	4			Bui et al. () reference correction [Qudsia Zafar, Pakistan]	Accept. It was not yet published at the time of writing.
55854	18	4	18	4	Second reference is missing the year [Debora Ley, Guatemala]	Accept. It was not yet published at the time of writing.
58376	18	4	18	4	Remember to place a data with "Bui et al ()" [Peter Marcotullio, United States of America]	Accept. It was not yet published at the time of writing.
60886	18	4	18	5	pore space exceeds CO2 storage amounts – does this imply that there is adequate physical/spatial capacity for CO2 storage? Should spell out the implication for non-expert readers. [United States of America]	Accept. In fact, this has overlap with chapter 2 and for that reason, the sentence was removed.
62050	18	4	18	4	Reference incomplete (Bui et al. ()) [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Accept. It was not yet published at the time of writing.
922	18	5	18	5	that pore space exceeds' what is 'pore space' [Robert Shapiro, United States of America]	Noted. We don't need the word and it's causing lack of clarity, so the text was revised to avoid using this word.
12236	18	5	18	5	pore space exceeds the CO2 storage amounts required in below 2°C pathways… but no mention of 1.5ºC? Presumably because the literature does not come to a conclusion about it, but this should be referenced. [United Kingdom (of Great Britain and Northern Ireland)]	Accept. See response to comment 52048
7920	18	7	18	7	Add comma behind "sufficient" [Christopher Bataille, Canada]	Accept. Text modified.
12238	18	8	18	9	“The social feasibility of CCS is considered low because of public acceptance issues” – it would be useful to evidence this and perhaps unpack it more. From my understanding, public acceptance issues has been an issue in mainland Europe (Germany in particular) but given the limited deployment of CCS I think it is hard to assess the public acceptance globally. It should also be noted that not all CO2 storage sites will be onshore, and will be offshore. [United Kingdom (of Great Britain and Northern Ireland)]	Accept. A review article is now cited that has looked at 42 studies all over the world, and the predictors and relevant factors of CCS social acceptance are listed.
13338	18	8	18	13	This statement is perhaps over-simplistic - public mistrust has been strong in some places, but more favourable in others. The caveat 'particularly in populated onshore regions' used p.36 line 14-15 should perhape be repeated or moved here. [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Text is revised to balance the text better.
32684	18	8	18	9	No, it is highly dependent on the region. As the CCS demo projects in North America show, it seems to work there. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Reject. There have been cases of public resistance in the United States as well (e.g., BP's DF-2 project in California). The projects that have been going through have been better at managing public acceptance. There is no paper that supports the claim that North Americans accept CCS more readily than others.
51194	18	8	18	13	This framing represents a highly instrumental attitude towards public acceptance. Concerns around safety and stability of storage should be taken seriously rather than attempted to be suppressed through social engineering. [Linda Schneider, Germany]	Taken into account. Looking into the literature on this, these concerns are taken seriously and the text here does so too.
60888	18	8	18	9	feasibility of CCS is considered low due to public acceptance issues – is there a citation for this? Not obvious that all data and surveys would agree with this statement. [United States of America]	Accept. Text revised to make it more factual, and reference is added.
52050	18	9	18	9	The framing of this statement is quite disconcerting. Rapid CO2 release from Lake Nyos certainly killed. Has the safety of CCS been established? This is not mentioned in this report. There is a decoupling of the risk of technology from the fear of the technology (see for example solar power killing many more people than nuclear power in the world, or peoples discomfort with flying (which I'm ironically doing as I type this) and driving which is far more dangerous, but less scary). To frame this only as public buy-in and ignore an establishment of the safety case borders on advocacy in a way that erodes the reliability of this report. [Jason Donev, Canada]	Noted. The safety issue is extensively discussed in earlier IPCC reports. Text is added on the role of risk perception in social acceptance of CCS.

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52052	18	9	18	9	What about the economical issues? [Jason Donev, Canada]	Accept. Sentence revised to include "perception of benefits", which includes potential compensation. Studies have shown that this can be important.
57334	18	9	18	9	Expand on the reasons for low public acceptance and literature on risks and managing risks. [Hans Poertner, Germany]	Accept, more detail given on public perception, but safety aspects are already treated extensively in other IPCC reports (including the SRCCS of 2005). We don't have the space to go into that here. There is no literature indicating that this is essential for 1.5C.
37634	18	10			strike, "in order" [Michiel Schaeffer, Netherlands]	Accept. This part between brackets was however removed anyway.
60890	18	12	18	13	What does "decisionmakers are not consistently implementing the lessons" mean? [United States of America]	Noted. That there is still a lack of awareness of what could be done to develop CCS projects with support by people living close by.
16458	18	13			Suggest amended as follows: "Project stakeholders are not consistently implementing the lessons, although good practices have been observed in some projects." [Australia]	Accept. Text revised.
36720	18	15	18	17	It's also because the incremental costs of CCS were much higher than projected and because the cost of other zero carbon alternatives like wind and solar have declined significantly and have been more cost effective. [Steve Clemmer, United States of America]	Taken into account. The project cost overruns are reported later in this paragraph.
52054	18	15	18	17	OK, this is true, I've heard it directly from power companies, but once again, quantify the need. What levels would be needed? Are the costs competitive with nuclear, wind, etc? [Jason Donev, Canada]	Noted. Although relevant, this report cannot do a full-blown quantitative comparison - this is up to the AR6 report.
62052	18	15	18	23	The CCS feasibility is also connected to the need of a transport infrastructure [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This is mentioned in line 16.
37196	18	20	18	21	On enhanced oil recovery, it should be mentioned that EOR-Plus (EOR+) can result in net negative emissions (IEA. 2015. Storing CO2 through Enhanced Oil Recovery, OECD/IEA: Paris) [John Scowcroft, Belgium]	Reject. The reference indicates that aiming for EOR+ in various forms can lead to better storage of CO2, but negative emissions can only be reached if the source of CO2 is recently removed from the atmosphere.
14080	18	21	18	21	Suggest adding the following sentence: "However, CO2 for enhanced oil recovery could repreesent an economic incentive that leads to much needed development of cost-effective CCS technology." [Aage Stangeland, Norway]	Accept with modifications: to save words, the message of this sentence was embedded in the existing text.
37198	18	22	18	23	The statement "power sector have been cancelled over the years, mainly because of economic reasons, or have experienced cost overruns" is incorrect. First, the Global CCS Institute, 2017 was referenced, but this was not stated in the Institute's report. In contrast, the Global CCS Institute, 2017 states that along with technology and capability, cost is NOT a reason for cancellation of a project (Global CCS Institute, 2017; page 11). More often, changes in policy moving the economic feasibility of a project is the reason for cancellations as was the case for Zerogen in Australia. (Garnett et al 2013 Case History - ZeroGen IGCC with CCS). Also, the Petra Nova CCS Project was completed on time and on-budget (Global CCS Institute, 2017 Global Status of CCS: 2017). [John Scowcroft, Belgium]	Accept. Sentence removed.
52056	18	23	18	23	No effort is made to discuss the future of CCS. At the moment some CCS is used for enhanced oil recovery, will that be allowed to continue? This entire section has been insufficiently researched and is poorly presented. The conclusions as they pertain to possible 1.5C paths must be stated clearly. Is this a major unknown to the feasibility of these paths? If so, they must be stated explicitly. Many other sections of this report rely heavily on the efficacy of CCS, to fail to deliver a concise statement on what the known limits and feasibility of CCS is fails the entire report. [Jason Donev, Canada]	Accept. A brief sentence is added to reflect this.
63234	18	24	18	24	Add paragraph: Opportunities for reducing costs and increasing public acceptance in mitigating CO2 from point sources might be found in methods that do not make and store concentrated CO2. These include abiotic methods of spontaneously converting waste CO2 to (bi)carbonates (Rau and Caldeira 1999, Rau 2011, Global CCS Ins. 2016) http://www.globalccsinstitute.com/sites/www.globalccsinstitute.com/files/content/page/122975/files/Skyonic%20Carbon%20Capture%20and%20Mineralisation%20Project.pdf) as well as using algae to consume waste CO2 (Beal et al 2018). Strategy for the reduction of CO2 from conventional power and industrial sectors, not to mention CDR-relevant biomass energy, could benefit from a broader search and R&D support for CO2 mitigation solutions that extend beyond conventional CCS (Maddali et al 2015). new refs: Maddali, V. Tularam, G. A. & Glynn, P. Economic and time-sensitive issues surrounding CCS: A Policy Analysis. Environ. Sci. Technol. 49, 8959–8968 (2015). Beal, C. M., Archibald, I., Huntley, M. E., Greene, C. H. and Johnson, Z. I. (2018), Integrating Algae with Bioenergy Carbon Capture and Storage (ABECCS) Increases Sustainability. Earth's Future doi:10.1002/2017EF000704. Global CCS Inst. 2016 https://www.globalccsinstitute.com/news/skyonics-texas-carbon-capture-facility-will-turn-co2-baking-soda . Rau, G.H., 2011. CO2 Mitigation via Capture and Chemical Conversion in Seawater. Environ. Sci. Technol. 45, 1088–1092. doi:10.1021/es102671x. Rau, G.H., Caldeira, K., 1999. Enhanced carbonate dissolution:: a means of sequestering waste CO2 as ocean bicarbonate. Energy Convers. Manag. 40, 1803–1813. doi:10.1016/S0196-8904(99)00071-0 [Greg Rau, United States of America]	Taken into account. These aspects are addressed in section 4.3.4 (industry) and 4.3.7 (CDR).
3294	18	26	18	43	Reference is needed. [Xiu Yang, China]	Accepted: Reference added.
7734	18	26	18	35	As I previously commented (FOD, 4-20:37 and :39), this discussion understates the literature's findings on practical efficiency potential and overemphasizes aviation biofuels while unsupportedly rejecting ample industry assessments of and experiments with LH2 cryoplanes. I can't tell whether the author(s) don't understand these issues or have uncited contrary evidence. [Amory Lovins, United States of America]	Noted
8258	18	26	18	43	This section on international transport options should include a paragraph on the potential for carbon pricing in reducing emissions from aviation and shipping. Below is suggested litterature to include: - World Bank (2018), "Regional carbon pricing for international maritime transport" - M. Keen et al. (2013), "Planes, ships and taxes: charging for international aviation and maritime eissions", Economic Policy , 28 (76), pp. 701-749 - T. Lee et al. (2013), "Economy-wide impact analysis of a carbon tax on international container shipping", Transportation Research part A, 58, pp. 87-102 [Kelsey Perlman, France]	Taken Into Account. The carbon pricing issue was taken up later in the chapter.
32700	18	26	18	43	The section on international transport does not reflect the specific growth dynamics of international maritime transport and aviation, which is higher than any other sector, which makes decarbonization even more challenging. I suggest adding one sentence to highlight the specific challenge in these sectors. See e.g. Cames et al. (2015): Emission Reduction Targets for International Aviation and Shipping, http://www.europarl.europa.eu/RegData/etudes/STUD/2015/569964/IPOL_STU(2015)569964_EN.pdf [Martin Cames, Germany]	Accepted: Text changed.
32702	18	26	18	43	The section on international transport does not take into account the specific responsibility structure in both sectors. If governments unilaterally introduce policies with the view to reduce emissions, they risk that ships/planes are flagged out to evade this regulation. Such regulation would just result in distortion of competition unless policies are introduced at the global level, which requires consensus among all countries. This has led to a significant delay of mitigation efforts in these sectors so that efforts for de-carbonization may need to be even more drastically than in other sectors. [Martin Cames, Germany]	Accepted: Text changed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
32704	18	26	18	43	The section on international transport only focusses on technological options for reducing emission in these sectors. However due to the growth dynamic, technological change will not suffice unless it is accompanied by a strong reduction of demand. See e.g. Bows-Larkin, A.: All adrift: aviation, shipping, and climate change policy; in: Climate Policy, 2014 [Martin Cames, Germany]	Accepted: Text changed.
38716	18	26	18	43	It may also be mentioned - and assessed - that alternative climate friendly routing of aircraft has been studied as a way to reduce the climate impact of this sector. See e.g.: Grewe et al: Feasibility of climate-optimized air traffic routing for trans-Atlantic flights. Environ. Res. Lett. 12 034003 [Jan Fuglestvedt, Norway]	Noted
38718	18	26	18	43	The Aviation sector could receive some more attention. A recent overview paper: Brasseur et al. BAMS April 2016 [Jan Fuglestvedt, Norway]	Accepted: References added.
53578	18	27	18	43	the contribution of international transport to global emissions would be an interesting fact to include, if studies exist. Or a link to the figures in other chapters. [Sumetee Pahwa Gajjar, India]	Noted
12240	18	28	18	29	Is there additional support for these efficiency savings. Most models don't assume such high values. If this is true then it's something that IAMs need to capture. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text modified.
60892	18	28	18	29	In what time frame could "aviation emissions ... be reduced by between a third and two-thirds by energy efficiency measures"? [United States of America]	Accepted: Text modified.
60894	18	29	18	30	Could high-speed rail scale to provide cost-effective freight transport to replace the growing demand for air freight? [United States of America]	Noted: AR6 topic.
5048	18	30	18	31	There is also research on electric-powered airplanes over short-ranges. The aforementioned advances in ultracapacitor batteries would make this more plausible in that the battery recharge time is very short (minutes rather than hours) so substituting chemical batteries would not be needed. [Michael MacCracken, United States of America]	Noted
6414	18	30	18	36	With respect to maritime transportation, the option for ammonia is rated more positively than that of all other alternatives by Llyod's Register - and for good reasons, see https://www.lr.org/en/insights/global-marine-trends-2030/zero-emission-vessels-2030. With respect to aviation, biofuels may co-exist with electrofuels made of recycled carbon and renewables-based hydrogen, and/or with "electro-biofuels", combination of biomass-based carbon and hydrogen, as envisioned by Hannula, 2016, Hydrogen enhancement potential of synthetic biofuels manufacture in the European context: A techno-economic assessment, Energy 104: 199-212 [Cedric Philibert, France]	Accepted: Text modified.
12242	18	30	18	31	The Jacobson article does not provide any substantive support for the feasibility of commercial electric aircraft (and certainly not on the timescales relevant here). It simply references an article in the popular press (bloomberg) about prototype aircraft. A feasibility assessment of the emission reductions in aviation implied by the modles in chapter 2 shouldn't just be a generic set of statements about some tentatively optimistic developments. It should be a rigorous and considered investigation of whether it appears possible that the scenarios are achievable. For example, as a basic point, airlines are currently buying hundreds of new fossil fuel powered planes that will be in use for 20-30 years. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text modified.
52058	18	31	18	31	Jacobson is cited here on advances in the use of electricity in planes and shipping, this is not his area of expertise, nor the focus of this paper. What did he cite to claim this? Can you go back to the primary literature as opposed to synthesizing synthesis literature on this front? I, for one, would really like to know what these advances are? Can these advances be quantified in any meaningful way? There are planes that fly with electricity but are commercial passenger planes feasible? Might emission free blimps be possible? This is worth looking extensively at the literature to find out rather than citing Jacobson. [Jason Donev, Canada]	Accepted: Text modified AR6 mostly.
60896	18	31	18	35	How does this discussion of biofuels in transport connect with the discussion on page 2-76? [United States of America]	Noted
58320	18	33	18	33	IEA 2017f (World Energy Outlook) also a good ref here on biofuels in international transport [Andrew Prag, France]	Accepted: Added to text.
4502	18	34	18	35	The text says "the life-cycle emissions of such bio-based jet fuels and marine fuels can be considerable (Budsberg et al., 2016; Cox et al., 2014)". I have checked those two literatures but I couldn't find detailed data for marine fuels. Please delete "and marine fuels" from here. Also Budsberg et al. paper is calculated on the assumption to use natural gas. If new technology can be found not to use fossil fuel to produce bio jet fuel, situation will change drastically. In this sense, please add at the end of this sentence "without tecnological improvement that does not depend on fossil fuel to produce bio-jet fuel". [Mitsutsune Yamaguchi, Japan]	Accepted: Text changed.
16460	18	34	18	35	Does not accurately reflect published literature which shows a range of results that are dependent on feedstock, conversion technology. It would be more accurate to say: life cycle emissions of bio-based jet fuels and marine fuels can vary considerably depending on how and where they are produced, including the feedstock and its management, and the assumptions applied in the assessment (eg de Jong, S., Antonissen, K., Hoefnagels, R., Lonza, L., Wang, M., Faaij, A. and Junginger, M., 2017. Life-cycle analysis of greenhouse gas emissions from renewable jet fuel production. Biotechnology for biofuels, 10(1), p.64. and studies cited in slide 8 of http://www.ieabioenergy.com/wp-content/uploads/2016/11/P13-Economic-and-environmental-performance-perspectives-of-alternative-aviation-fuels-Malina.pdf [Australia]	Accepted: Reference added.
31514	18	34	18	35	The text says "the life-cycle emissions of such bio-based jet fuels and marine fuels can be considerable (Budsberg et al., 2016; Cox et al., 2014)". However, detailed data for marine fuels cannot be found in two literatures. Please delete "and marine fuels" from here if such data is not mentioned. Also Budsberg et al. paper is calculated on the assumption to use natural gas. If new technology can be found not to use fossil fuel to produce bio jet fuel, situation will change drastically. In this sense, it would be better to add at the end of this sentence "without technological improvement that does not depend on fossil fuel to produce bio-jet fuel". [Japan]	Accepted: New references provided.
49764	18	34	18	35	Biofuels imply also indirect emissions [Fabio Monforti-Ferrario, Italy]	Noted
3254	18	35	18	35	A more recent reference, which goes further than (Elshout et al, 2014) by hilighting the location specific the life-cycle emissions of biofuels as well as their overall availability is Daioglou et al (2017). Link to paper: https://www.nature.com/articles/s41558-017-0006-8 [Vassilis Daioglou, Netherlands]	Accepted: Reference added.
1288	18	37	18	38	I think that mention of using renewables to isolate hydrogen is another fuel source that should be mentioned when the author mentions renewables being used to create syngas, methanol, ect. . . There are large facilities in Idaho isolating hydrogen with wind energy. [Elizabeth Aldrich, United States of America]	Accepted: Text changed
4288	18	37	18	38	It is important to write this sentence between commas ",created from renewably derived electricity and CO2," so that these synthetic fuels are genueinly relevant for climate change mitigation.As noted above, if energy or carbon are of fossil origin, there is no climate change mitigation potential in these fuels. You should emphatize that transporting renewable energy using synthetic fuels requires that the carbon mass cycle is genuely closed (i.e. the CO2 has to be returned to the fuel manufacture plant after capturing it from the plant where the fuel is used, or after capturing it from air direcly or via biofuels). [Abanades Carlos, Spain]	Accepted: Text changed
39230	18	37	18	40	Is this true? Windgas is being produced and sold in Germany https://unearthed.greenpeace.org/2016/09/02/power-gas-storage-solution/ [Lindsey Cook, Germany]	Noted: Not a reference.
60898	18	37	18	43	This discussion should be more explicitly anchored in a quantitative assessment. [United States of America]	Noted: Space prevents more.

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47144	18	38	18	38	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested alternative '...Party submits information…' [Sarah Connors, France]	Accepted: Text changed.
28484	18	39	18	41	The transition to non-carbon fuels in the maritime sector is not only held up by governance issues but also by financial constraints and non-market barriers. Rehmatulla et al., 2015, https://doi.org/10.1016/j.oceaneng.2015.09.030 [Germany]	Accepted: Text changed.
16462	18	42	18	42	Should that be "replacing marine fuels.." rather than "removing marine fuels…"? [Australia]	Accepted: Text changed.
28486	18	42	18	43	There are other ways to reduce black carbon and sulphur dioxide emissions in ports apart from onshore power supply. In general, onshore power supply is a very costly option. Naming one options while omitting others could be considered policy-prescriptive. Please clarify why exactly this option is mentioned here, also in the light of its potentially small impact on GHG emissions. [Germany]	Accepted: Text changed.
44082	18	42	18	43	reads "Removing marine fuels with zero-emission options " perhaps should read "Replacing marine fuels with zero-emission options" [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: Text changed.
62166	18	43	18	43	This part has much improved from FOD. Maybe for international shipping line 43 add the issue of "lock in effect" for ship motorization. [Antoine Bonduelle, France]	Noted
1652	18	46	20	20	It is suggested to change "4.3.2.6 Nuclear" to "4.3.2.5 Nuclear" and "4.3.2.5 Options for adpating…" to "4.3.2.6 Options for.". [Wenying Chen, China]	Taken Into Account. The section was completely revised to make a better flow.
45496	18	46	19	55	Nothing specifically wrong with this section, but a lot of quite low level, manageable impacts - the volume fo material is large compared to mitigation for the energy sector. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, the balance of this section has been reworked and balanced.
46404	18	46	18	46	In section 4.3.2.5, may be added this as well "In developing countries, need of additional capacities to meet increased demand under higher GMST and heat wave conditions would aggravate financing issues." [Ijaz Ahmad, Pakistan]	Rejected - The section discussed adaptation to climate change impacts in general, specific risks and impacts are described in Ch. 3.
55070	18	46	19	55	The section "Options for adapting electricity system to 1.5, should come before the internatinal option and CCS in power sector. It should come right after electricity storage, to remain on the theme of electricity. In the same vain, the section on nuclear energy could come after renewable energy. [Yamide Dagnet, United States of America]	Taken Into Account. The section was completely revised to make a better flow.
60900	18	46	19	55	This section is unnecessarily long. It also doesn't really identify options to assess. Instead it just discusses impacts on the electric grid. Many of these papers are not specific to 1.5°C and there isn't much discussion of whether you'd expect the same effects (or much smaller). [United States of America]	Taken into account, two specific adaptation options are described: resilience of power infrastructure (independently of the generation source) and water cooling and management practices.
60902	18	46	18	46	Its unclear why section 4.3.2.5 comes before section 4.3.2.6 on Nuclear. It would be more appropriate to start with the energy technologies (renewable, nuclear, CCS) then move to energy storage, and end with tranport and adaptation. [United States of America]	Taken Into Account. The section was completely revised to make a better flow.
62054	18	47	18	47	need to be planned in the design [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
60904	18	52	18	55	The sentence states that transmission and distribution grids take longer to be restored, but it is unclear what they are being compared to. Please clarify. [United States of America]	Accepted, text has been removed
30590	19	2	19	2	Other suggestion for a reference: Nahmmacher (doi:10.1016/j.eneco.2016.09.002) [France]	Accepted, reference has been added
47146	19	5	19	5	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested alternative "Indicate a need for"? [Sarah Connors, France]	Accepted, text has been revised.
45386	19	9		12	Agreed that islanded micro-grids increase resilience, adding residential batteries will increase this further, and is certainly part of a hybridized future. [Veryan Hann, Australia]	Accepted, residential batteries has been included
57336	19	12	19	17	Unclear use and introduction of theoretical concepts of resilience/"resiliency". [Hans Poertner, Germany]	Accepted. Definition is in the glossary
7048	19	18	20	25	The diplition of the ozone and the quality of air for humans [Cate Tuitt, United Kingdom (of Great Britain and Northern Ireland)]	We find the comment unclear and hence difficult to respond to.
46406	19	19	19	22	It may be added "Decreased river flows in South Asia during second-half of this century is expected resulting in low electricity production.". [Ijaz Ahmad, Pakistan]	Rejected - there is evidence of both decreased and increased river flows in different regions of South Asia.
58378	19	19	18	22	Can we clarify what "main concerns" references? Is it the future expansion, or efven use of the technology as a solution? [Peter Marcotullio, United States of America]	Taken into account, 'main concerns' refers to impacts expected within hydroelectric generation plants. One of the options proposed are hybrid systems with hydroelectric and non-hydroelectric generation sources.
30592	19	20	19	20	Not clear what you mean by hybrid. [France]	Taken into account, hybrid systems
18580	19	33		39	water scarcity is also an issue for thremal power plants powered by nuclear fission. [Andrea TILCHE, Belgium]	Accepted, Section 4.3.2.5 applies to all forms of electricity generation.
48102	19	33	19	35	Check sentence. Should 'CCS' be deleted? [Sarah Connors, France]	Accepted, text has been rewritten, although CCS is still mentioned-
55072	19	33	19	55	This part of the section goes beyond the electricty sector and tend to consider water management - this could be aseparate section (which makes 4.3.2.5 less imbalanced compared to others) although the link with the need to adapt elctricity system could be made. [Yamide Dagnet, United States of America]	Taken into account, the text has been rewritten and the section has been better balanced. Water cooling and management remains a part of the adaptation options subsection.
58326	19	33	19	33	Suggest to add after first sentence: "Interactions between water and energy are complex, as detailed in IEA 2016 (World Energy Outlook 2016)." [Andrew Prag, France]	Accepted, text and reference have been added
28488	19	34	19	35	The interlinkage between fossil fuel-based CCS and water shortages remains unclear. Please specify. [Germany]	Accepted - text has been revised to clarify this.
31516	19	35	19	35	We recommend modifying "need to consider increasing water shortages" to "need to consider increasing water shortages, taking into account other factors such as ambient water resources and demand changes in irrigation water (Hayashi et al., 2018)". Together, the study below needs to be added to Reference. Hayashi, A., Sano, F., Nakagami, Y., and Akimoto, K. (2018). Changes in terrestrial water stress and contributions of major factors under temperature rise constraint scenarios. Mitigation and Adaptation Strategies for Global Change, in press. [Japan]	Accepted, text and reference have been added
13164	19	36	19	39	Delete the text "The technological, economic, social and institutional feasibility of that option is very high, though improving efficiency in fossil-fuelled thermoelectric power plants is insufficient to limit temperature rise to 1.5°C (van Vliet et al., 2016).". [Eleni Kaditi, Austria]	Rejected - text remains but has been reworded.
52060	19	38	19	39	Several studies have showed that an increased use of nuclear power with saline cooling (ocean water) can provide increased desalination for a water stressed world. This co-benefit could be absolutely imperative to helping with the water shortages faced by many jurisdictions in the MENA region. Specifically, the literature on small modular reactors (SMRs) is rife with examples on different nuclear reactors that can provide water purification or even desalination. (In addition to other co-benefits like medical isotopes for treating cancer and diagnostic purposes). [Jason Donev, Canada]	Taken into account - synergies and trade-offs for each mitigation and adaptation option are described in Section 4.5.4
1650	19	41	19	44	It is suggested to add paper (Huang W, Ma D, Chen W, 2017. Connecting water and energy: Assessing the impacts of carbon and water constraints on China's power sector. APPL ENERG, 185:1497-1505.) as a reference for cooling technology and water consumption for power. [Wenying Chen, China]	Accepted, reference has been included
35528	19	41	19	41	Do the cooling technologies studied include dry cooling technologies? [Ashok Sreenivas, India]	Yes, they do include dry cooling.

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36084	19	41	19	48	Several recent studies on water use in power sector including a multi-model study indicate various pathways as well as the role of various cooling technologies. More citations are required to substantiate this statement. [India]	Taken into account, additional text water cooling has been removed.
51508	19	47	19	47	reduced water consumption for bioenergy is debatable and not demonstrated. In fact, the biomass and bioenergy projects submitted to GCF in recent months show high water usage which has high impacts for small countries, LDCs and small island countries. [Souparna Lahiri, India]	Accepted, text has been removed
36086	19	48	19	48	The reference cited here seems inadequate to support the conclusions being drawn. Please add more citations to substantiate. [India]	Accepted, text has been removed
39232	19	50	19	54	Serious concern as the way this is written, links CCS, bio-energy and nuclear energy to 'sustainable energy' which would contradict sections of the this SR1.5C report on concerns over unsustainable use of water and land (bio-energy), enabled continuation of unsustainable fossil fuels (CCS), while creating an assumption that radioactive waste from nuclear power plants is somehow 'sustainable'. [Lindsey Cook, Germany]	Accepted, text has been removed
17846	20				In the part of Agriculture. agricultural problem in Mid-Latitude should be also explained. The mid-latitude zone can be broadly defined as part of the hemisphere between 30°–60° latitude. This zone is home to over 50 % of the world population and encompasses about 36 countries throughout the principal region, which host most of the world's development and poverty related problems. /Moon, J., Lee, W.K., Song, C., Lee, S.G., Heo, S.B., Shvidenko, A., Kraxner, F., Lamchin, M., Lee, E.J., Zhu, Y., Kim, D., Cui, G. 2017. An introduction to Mid-Latitude ecotone: Sustainability and environmental challenges. Sib. J. For. Sci. N. 6:41-53./Wang, S.W., Lee, W.K., Son, Y. 2017. An assessment of climate change impacts and adaptation in South Asian agriculture. International Journal of Climate Change Strategies and Management 9(4):517-534./ Kafatos, M., Kim, S.H., Lim, C.H., Kim, J., Lee, W.K. 2017. Responses of Agroecosystems to Climate Change: Specifics of Resilience in the Mid-Latitude. Sustainability. 9(8):1361./Lamchin, M., Lee, W. K., Jeon, S. W., Wang, S. W., Lim, C. H., Song, C., Sung, M. 2017. Long-term trend and correlation between vegetation greenness and climate variables in Asia based on satellite data. Science of the Total Environment./Lim, C.H, Kim, S.H., Choi, Y., Kafatos, M.C., Lee, W.K. 2017. Estimation of Virtual Water Content of Main Crops on the Korean Peninsula Using Multiple Regional Climate Models and Evapotranspiration Methods. Sustainability 9:1172. [Republic of Korea]	Rejected - outside of the scope of the chapter. If mid-latitude would be covered in this way, the chapter would have to cover other latitudes as well, what would increase the size of covering of agriculture to a complete chapter.
1602	20	1	20	20	Please clarify that a significant problem with nuclear power is that it takes 10-19 years between planning and operation (Jacobson, M.Z., Review of solutions to global warming, air pollution, and energy security, Energy & Environmental Science, 2, 148-173, doi:10.1039/b809990c, 2009), so has virtually no chance to contribute to the large-scale reduction in emissions needed by 2030 (only 12 years away), even if it were cost competitive. Example times for planning to operation: A) Hinkley Point planning began in 2008, and the plant has not yet broken ground for construction. In 2017, its expected completion was given as 2025-2027, so its overall time from planning to operation will be no less than 17-19 years. https://en.wikipedia.org/wiki/Hinkley_Point_C_nuclear_power_station B) Olkiluoto 3 nuclear power reactor in Finland was proposed in December 2000. It latest proposed completion time is May 2019. Thus, its overall time from planning to operation will be no less than 18.5 years, and this was on an existing nuclear reactor site, not a new site. https://en.wikipedia.org/wiki/Olkiluoto_Nuclear_Power_Plant C) Vogtle 3 and 4. These reactors were proposed in August 2006 to be added to an existing reactor site, not even a new site. Construction has started. If it is completed, it will be completed no sooner than 2019-20, giving it a planning to operation time of no less than 13-14 years. https://en.wikipedia.org/wiki/Vogtle_Electric_Generating_Plant D) Haiyang 1 and 2, China. In September, 2007, Westinghouse received authorization to construct these reactors. http://www.world-nuclear-news.org/NN-Haiyang-1-pumps-operated-at-full-power-1410165.html This means that site locating and planning must have started at least 2 years before, possibly more. Assuming planning started in 2005, and the fact that they won't be operating until at least 2018 http://www.world-nuclear-news.org/NN-Haiyang-1-pumps-operated-at-full-power-1410165.html means a MINIMUM of 13 years between planning and operation, again well within the 10-19 year time frame. E) Taishan 1 and 2, China. In 2006, Areva competed in a bidding process for the Taishan 1 and 2 reactors https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/EPR_(nuclear_reactor).html Contract with Areva signed November 26, 2007. http://www.new.areva.com/EN/operations-2404/china-taishan-12.html Excavation started August 2008. Operation has been delayed to at least 2018-2019. https://en.wikipedia.org/wiki/Taishan_Nuclear_Power_Plant	Rejected. The examples do not mean that no nuclear will be built in future. Many nations are constructing and planning nuclear power facility and it contributes to GHG cuts toward 1.5C
1628	20	1	20	20	It would be better to summarize some recent development of nuclear technology including HTR in China in this section. [Wenying Chen, China]	taken into account. We considered this but did not feel this was relevant to 1.5C in the same way as the current text in the FGD (which is modified considerably since the SOD). .
7738	20	1	20	20	An important missing argument in this otherwise good section is that nuclear newbuild is not only slower to deploy than renewables (Lovins et al, "Relative deployment rates of renewable and nuclear power: a cautionary tale of two metrics", in press, Energy Research and Social Science, Feb 2018) but also so costly that it displaces severalfold less carbon than similar investments in efficiency or renewables could do sooner, and thus worsens climate change. Indeed, the same climate opportunity cost often applies to just operating existing nuclear plants (id.; Lovins, "Do coal and nuclear generation deserve above-market prices?", El. J. 30(6), 22–30 (2017), doi:10.1016/j/tej.2017.06.002. I can provide preprints of these or other new citations on request. [Amory Lovins, United States of America]	Rejected not because this point is non interesting or irrelevant but, given the high level of controversies in this field and the dependence of the result to the national context, given also the space constraints that prevent a discussion elaborated enough not being accused to be biased, we preferred to stick to uncontroversial arguments

Comment No	From Page	From Line	To Page	To Line	Comment	Response
31518	20	1	20	20	We would suggest to add and consider the aspects of energy mix and energy security, including comparative risk analysis, to make the assessment more balanced. Example references are: - "Why nuclear energy is sustainable and has to be part of the energy mix, Sustainable Materials and Technologies" (Brook, B.W., et al., 2014) https://www.sciencedirect.com/science/article/pii/S2214993714000050 - "Assessment of the actual sustainability of nuclear fission power, Renewable and Sustainable Energy Reviews" (Verbruggen, A., 2014) https://www.sciencedirect.com/science/article/pii/S1364032114000185 - "Find the differences and the similarities: Relating perceived benefits, perceived costs and protected values to acceptance of five energy technologies" (Visschers, V.H., et al., 2014) http://www.sciencedirect.com/science/article/pii/S1364032115001288 - http://www.world-nuclear.org/information-library/economic-aspects/externalities-of-electricity-generation.aspx . - "Health effects of technologies for power generation: Contributions from normal operation, severe accidents and terrorist threat, Reliability Engineering and System Safety" (Hirschberg, Stefan, et al., 2016). https://www.sciencedirect.com/science/article/pii/S095183201500277X - "An international comparative analysis of public acceptance of nuclear energy, Energy Policy" (Kim, Y., et al. 2014) and "Public acceptance of constructing coastal/inland nuclear power plants in post-Fukushima China, Energy Policy" (Wu, Y., 2017). For Negative learning, additional reference to provide different perspective is: - Lovering, J. R., Yip, A., & Nordhaus, T. (2016). Historical construction costs of global nuclear power reactors. Energy Policy, 91, 371–382. https://doi.org/10.1016/j.enpol.2016.01.011 [Japan]	(Brook, B.W., et al., 2014): taken into account. text modified. however, literature is not added as this issue has been covered in AR5 already. (Verbruggen, A., 2014) : taken into account. text modified. however, literature is not added as this issue has been covered in AR5 already. (Visschers, V.H., et al., 2014) : taken into account. text modified. however, literature is not added as this issue has been covered in AR5 already. (Hirschberg, Stefan, et al., 2016): accepted. text modified. literature added. (Kim, Y., et al. 2014) , (Wu, Y., 2017): : taken into account. text modified. however, literature is not added as this issue has been covered in AR5 already. Lovering, J. R., Yip, A., & Nordhaus, T. (2016): accepted. literature added
32038	20	1			It would be important here to distinguish between building new nuclear plants, and extending current ones, as issues and costs are very different. [France]	Taken into account. Text modified.
32658	20	1	20	20	Nuclear fusion. Just one indirect reference in table 4.7 p67 and not covered in section on nuclear energy in 4.3.2.6 on p20. Work on the experimental nuclear fusion project ITER is advancing (see press release from December on passing 50% mark https://www.iter.org/doc/www/content/com/Lists/list_items/Attachments/759/2017_12_Fifty_Percent.pdf and director's statement https://www.iter.org/doc/www/content/com/Lists/list_items/Attachments/757/2017_12_Dr_Bigot_statement.pdf). Expects to reach "first plasma" in 2025, deuterium-tritum plasma in 2035, with first plants coming on line in 2040. Sorry cannot point to scientific literature but if this proceeds to plan it would be transformational - unlimited free safe energy. Surely worth a mention even if hedged with scepticism. (Is Ch 2 more appropriate? Also mention in SPM?) (Good summary from a year ago in New York Times at https://www.nytimes.com/2017/03/27/science/fusion-power-plant-iter-france.html) [Jonathan Lynn, Switzerland]	Taken into account. Text added. Literature suggested is not added as it is covered inAR5.. Reference to AR5 is made.
37090	20	1	20	20	The nuclear section is too much negatively biaced to nuclear technology. For example, Sustainable Development Scenario of the WEO 2017 expects nuclear to occupy 15% of the wolrd total power generation in 2040. Such literatures as "why nuclear energy is sustainable and has to be part of the energy mix, sustainable materials and technologies" (Brook et al 2014) also support the crucial role of nuclear. [Jun Arima, Japan]	taken into account. text modified. however, literature is not added as this issue has been covered in AR5 already.
37124	20	1	20	20	This "4.3.2.6 Nuclear energy" paragraph is not sufficiently adressing the issue of the role of nuclear energy in the potential responses against global warming. On the contrary it is focussing on the constraints which nuclear is facing, such as "public concerns in specific countries", "negative learning", countries which "stop considering nuclear energy as an option, while in larger developing countries reactors are still coming online", or whether the international community should propose "a world governance of nuclear risks that goes beyond the facilitative role of the International Atomic Energy Agency". This is not adressing the main issue of this chapter and it is not comprehensive, nor objective and balanced compared to paragraphs related to other clean and non-carbon energy sources. I am proposing to add at the end of this unchanged § "4.3.2.6 Nuclear energy" (or in replacement of it) the following: "As proposed in several scenarios and publications, the present contribution of nuclear power to emission reduction can potentially increase significantly in the near and longer term future. Present and novel nuclear technologies are proposing several responses and options (including generation III and IV reactors, breeder reactors, new uranium and thorium fuel cycles, small modular reactors, nuclear cogeneration for urban heating, etc). These nuclear solutions are adaptable to many regional and national situations and to their different geopolitical, technical, economical and socio-cultural contexts." [Jean-Luc SALANAVE, France]	accepted text modified
52062	20	1	20	20	CCS is limited by public acceptance, but that public acceptance is talked about in terms of 'educating the public'. Why is educating the public about risk factors with nuclear power not considered in this report? [Jason Donev, Canada]	Noted. However the details of acceptance is beyond the scope of this section. Education of risks is covered in AR5
52064	20	1	20	20	Food irradiation prevents extensive spoilage, thereby reducing the GHG from the agricultural industry. Nuclear technology has the amazing co-benefit of providing safe food for people with a longer shelf-life, which will become increasingly important as climate change limits the available food supply. Weather events will require more food shipping to prevent famine and the need for nuclear technology to help prevent spoilage will increase. [Jason Donev, Canada]	Taken into account. Text modified to include cobenefits and reference is made to AR5.
52068	20	1	20	20	Nuclear power plants in the United States spent years getting half of their power by burning old nuclear weapons. Nuclear power plants are a wonderful way of disposing of nuclear bombs. This co-benefit was not explored. [Jason Donev, Canada]	Taken into account. Text modified to include cobenefits and reference is made to AR5.
52070	20	1	20	20	Surgical equipment sterilization is often done with isotopes from nuclear reactors. Cobalt 60 from commercial nuclear reactors is responsible for halting the spread of infectious diseases in surgeries. This co-benefit was not explored. [Jason Donev, Canada]	Taken into account. Text modified to include cobenefits and reference is made to AR5.
52072	20	1	20	20	The current state of nuclear waste disposal is grossly misrepresented in this document. The literature was not reviewed and the misunderstanding of the state of nuclear waste storage could be construed as advocacy against an emission free source of energy. This sort of bias erodes the overall efficacy of this report. This report should not 'pick winners' and the authors should attempt to educate themselves or find experts on all subjects including topics that they know little about. Nuclear waste is safely stored right now, has always been safely stored and has never lead to any mortality in the entire history of the nuclear industry. This cannot be said for other types of energy waste. [Jason Donev, Canada]	Taken into account. Text modified and reference made to AR5
52076	20	1	20	20	There are co-benefits of nuclear science and technology like the creation of useful isotopes for both medical and industrial use. Why are these co-benefits not explored in this section? We have an opportunity for GHG free electricity that doesn't rely on CCS (an unproven technology) and grid storage (a practically non-existent technology) that has the side benefit of creating other useful materials stimulating clean industry and healthier populations? [Jason Donev, Canada]	Taken into account. Text modified and reference made to AR5

Comment No	From Page	From Line	To Page	To Line	Comment	Response
52066	20	1	20	20	Nuclear power is hardly the focus of Bruckner et al. The presentation in this section of even Brucker et al is misleading, and Bruckner et al is hardly extensive or authoritative. Once again, it seems that the literature was not properly reviewed on this subject matter, nor were experts on the subject consulted. I am concerned that this paper fits the preconceptions of the authors and insufficient effort was put into seeing the potential for emerging nuclear technology. Great pains and optimism were put into disruptive technology for wind, solar, electric vehicles, grid storage, biofuels and CCS (and CDR more generally), but not into investigating nuclear technology. Subject matter experts were extensively consulted on all of these other areas, in some cases people with considerable vested interests and biases were quoted, but I find no evidence of any nuclear experts being consulted at all in the writing of this report. This is evident in this cursory treatment of the extensive nuclear sector. [Jason Donev, Canada]	Taken into account. Text modified regarding the reference to (Bruckner et al 2014; that is part of IPCC 2014)
52074	20	1	20	20	The safe disposal of waste from solar panels has not been addressed in this report. The construction of solar panels have many mining tails and chemical byproducts, why are those not discussed? Why are the environmental consequences of the waste stream of wind power not discussed? Why is nuclear the only waste stream that is considered problematic? There are no harmful emissions to the environment with the nuclear waste stream. Nuclear waste is a stable solid, not a liquid, making it easier to store, contain, monitor and control. Nuclear waste is safe, why is it being talked about like this? [Jason Donev, Canada]	rejected, not because this remark is irrelevant but because this section is about strengthening action. It does not discuss in depth the ultimate limits of each technology and the hot controversies about waste nuclear disposals? Ultimately this is a problem of political judgement amongst opposite view. We focus on the limits of each technical, option in the first decades of the low carbon transition
52078	20	1	20	20	There is a conflating of how 'scared' people are of nuclear with how much danger people are in with nuclear power. The recent Fukishima disaster failed to release enough radiation to have any negative consequences on human life or wildlife. The misconception that nuclear accidents cause significant human mortality or morbidity could be addressed by public education, why is this not addressed? [Jason Donev, Canada]	Taken into account. Text modified on acceptance, and reference made to AR5
52080	20	1	20	20	Why are the expenses for nuclear power not compared to the expenses of other options? Nuclear power has safely provided power for hundreds of millions of people for decades. Sensationalism has led to an incredibly inflated fear of radiation and nuclear science and technology (sometimes leading to people refusing medical treatments because of the fear of radiation). Alleviating this fear would have the co-benefit of improving diagnosis and treatment for many deadly diseases like cancer. [Jason Donev, Canada]	Taken into account. Text modified on acceptance, and reference made to AR5
52082	20	1	20	20	Why are the health consequences of nuclear accidents not quantified here? Why are these health effects not compared to the health effects of other sources of power like hydropower? Nuclear power kills fewer people per TWh than *any* other source, so why is this not quantified here? [Jason Donev, Canada]	Accepted. Text modified and literature added.
54102	20	1	20	21	This paragraph quotes outdated information: the post-Fukushima reviews of modern pressurized reactors have shown that most of them can be made safe even in the case of a core-meltdown due to tsnamis or earthquakes. Actually, post-Fukushima upgrades ensure that any core meltdown in countires like France or Sweden reults into controlled and timed radioisotope release at does known to be harmless for wildlife and human health. The current phrasing implies that entire countries are vulnerable to Fukushima-like disasters when the real impact is more similatr to that of Three mile Island (minimal radioactivity released, no impact on wildlife, no need for evacuation, minimal impact on agriculture and cattle). references: http://www.unscear.org/docs/publications/2016/UNSCEAR_WP_2016.pdf, http://www.irsn.fr/FR/Actualites_presse/Actualites/Documents/IRSN_Shamisen-recommendation-guide_201709.pdf [Stephan Savarese, France]	Taken into account. Text modified and reference made to AR5
57222	20	1	20	20	role of nuclear energy: the two following literature pieces should be added documenting that a full decarbonisation of electricity supply, mainly based on solar energy is doable - WITHOUT any need of new nuclear as part of a least cost scenario: DOI: 10.1002/pip.2950 and Ram et al. (2017) (ISBN: 978-952-335-171-4) link: https://www.researchgate.net/publication/320934766_Global_Energy_System_based_on_100_Renewable_Energy_-_Power_Sector [Christian Breyer, Finland]	rejected, not because this remark is irrelevant but because this section is about strengthening action and that the issue you raise is treated in chapter 2
12960	20	2	20	8	extensive - not particularly neutral and would suggest deleting - seems a little self-congratulating in an IPCC report about another IPCC report. Note that none of the authors or editors listed in Bruckner et al. (2014) have a background in nuclear science and engineering. An absence of scientists from this field also questions AR5's authority and ability to present all energy technologies in a balanced way and summarise the literature available on nuclear energy accurately and fairly. It might be worth considering inviting an expert from UNSCEAR to participate in the development of IPCC reports in the future to improve credibility and also provide a quality control on the information that is presented. [Jessica Callen, Austria]	taken into account in the final draft that has been deeply revised. An effort has been made to quote literature published in peer-reviewed journal and to consult experts in the field, including engineers
12962	20	2	20	8	There are erros in Bruckner et al. (2014), for example, the linear no-threshold model (LNT) is included but Bruckner et al. (2014) actually misrepresents the recommendations of UNSCEAR on page 550 "such estimates are neither endorsed nor disputed by UNSCEAR (Balonov et al., 2011)". In fact, UNSCEAR clearly states that making such estimates based on LNT at low doses is inappropriate (UNSCEAR 2000; 2012; 2015). UNSCEAR (established by the General Assembly of the United Nations to assess the effects of exposure to ionizing radiation) and also the International Commission on Radiological Protection (ICRP) both state that it is inappropriate and do not recommend using LNT to estimate deaths from very low exposures (ICRP 2007; UNSCEAR 2015). [Jessica Callen, Austria]	Not applicable. This comment is not directed to the current draft but former report.
5050	20	3	20	5	Is not another issue the time that it takes to bring nuclear plants on-line compared to the need for rapid phaseout of fossil fuel plants? And then there is the issue of performing best when running steadily as baseload and not fluctuating as demand varies. [I do see these are covered in the next paragraph, although text tends to obscure the issues a bit tersely.] [Michael MacCracken, United States of America]	Not applicable. Text deleted
8368	20	5	20	7	"The 2011 Fukushima incident seems to have negatively influenced public perception in many places such as South Korea (Roh, 2017) but not China (Yuan et al., 2017)." The statement on China is not correct. It is suggested to delete "but not China". [China]	Taken into account. Text modified.
12244	20	5	20	5	Not a balanced assessment of the public attitude impact of Fukushima. It has had negative impacts in some places, but not in others. In the UK it had no impact https://www.sciencedirect.com/science/article/pii/S0301421513008082 [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Text modified.
12964	20	5	20	5	seems to have is speculative and not appropriate for a scientific report. [Jessica Callen, Austria]	Accepted text deleted
39234	20	5	20	20	Two statements of concern - 'some papers indicate that impacts of a nuclear accident would cross borders, but nuclear safety depends upon the sovereignty of nation-states' is confusing. Impacts do cross borders, this is a repeated experience, and linked to this, safety concerns are not only perceptions, but experienced based positions. Also line 5-6, nuclear energy is not only constrained by public conern but also by goverment concerns. Why is this solely attributed to citizens? [Lindsey Cook, Germany]	accepted text modified
52084	20	5	20	8	The listed countries have not created a ban on nuclear power, they have made political statements about phasing out nuclear power. All of the listed countries still produce a significant fraction of their GHG-emission free electricity from nuclear power. The alleged ban is a political statement, not a technical one. These intentions to remove nuclear power plants have not happened in a way that is implied by this sentence. [Jason Donev, Canada]	accepted text modified

Comment No	From Page	From Line	To Page	To Line	Comment	Response
52086	20	5	20	8	There is a reduction in the intention to use nuclear power, increasing the need for hydro, solar, geothermal and wind. This makes the paths to 1.5C harder, even if they remain possible. This idea needs to be stated explicitly and explored. The process of removing nuclear from the grid is the process of decreasing the availability of GHG-emission free electricity and that is problematic, even comparing it to a situation where no nuclear power plants are built. [Jason Donev, Canada]	Taken into account. Text modified to explicitly mention that nuclear is low carbon .
7736	20	6	20	7	I don't have Yuan et al. 2017, but the statement about Chinese public sentiment, though not without basis (doi:10.1080/13669877.2012.726251), is outdated (e.g. https://www.reuters.com/article/us-china-nuclear-protests/public-trust-crisis-threatens-chinas-nuclear-power-ambitions-idUSBRE96H1BT20130718), and Chinese nuclear policy is shifting toward rather strong skepticism: see S. Thomas, "China's nuclear roll-out facing delays", China Dialogue, 16 Oct 2016, https://www.chinadialogue.net/article/show/single/en/9341-China-s-nuclear-roll-out-facing-delays, and C.F. Yu. "China: Beijing Rethinks Nuclear's Role in Energy Mix", Nuclear Intelligence Weekly, 8 Dec 2017. [Amory Lovins, United States of America]	Taken into account. Text on acceptance modified and reference made to AR5. However, the literature is not added as not being peer reviewed
18582	20	6			The argument that public perception has not been negatively influenced in China is not correct. See NEA Report "Impacts of the Fukushima Daiichi Accident on Nuclear Development Policies" © OECD 2017 NEA No. 7212 [Andrea TILCHE, Belgium]	Taken into account. Public perception is well covered in AR5 and reference to AR5 is added
32850	20	6	20	6	I suggest inserting the phrase " and many developing countries" between the bracket and but [Kenya]	taken into account text modified
4538	20	7	20	8	Phase-out might be a more appropriate term than "ban" in this context [Florian Rabitz, Lithuania]	accepted text modified
8370	20	7	20	8	"It has resulted in a ban on nuclear energy in countries like Germany, Italy, Sweden, Switzerland, South Korea and Taiwan." Taiwan is a province of China and not an independent country. The current formulation is a serious mistake. It is suggested to delete "and Taiwan". [China]	Accepted. Text modified
12966	20	7	20	8	Some of this paragraph is factually incorrect: Sweden has not banned nuclear, it voted in 1980 to phase out, but in June 2010 this was repealed by parliament. Furthermore, Sweden has recently taken actions to help its nuclear industry by phasing out a tax that discriminates against the technology, with the tax being phased out by 2019. South Korea is an exporter of nuclear technology and currently building several units in UAE - note that the current South Korean president has planned to phase out nuclear, but it is therefore not a blanket ban and could potentially change in the next government, particularly considering it is an exporter of the technology. I strongly recommend re-naming 'Taiwan' as a country - it should be Taiwan (PRC), or IPCC may face criticism from China. [Jessica Callen, Austria]	accepted text modified
37092	20	7	20	8	Sweden did not ban on nuclear energy after Fukushima nuclear accident. Rather, it har recently granted replacement of existing nuclear power plants on the ground that there is no feasible alternative for CO2 emissions reduction. While this section states that feasibility [Jun Arima, Japan]	accepted text modified
62808	20	7	20	8	The word ban seems a bit strong. I will rather use phasing out. The nuclear plants are still in operations in the countries quoted but they will be phased out. [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	accepted text modified
1658	20	8	20	8	Delete "Taiwan". [Wenying Chen, China]	accepted text modified
12970	20	8	20	8	This paragraph is biased against nuclear as it is only negative, for the purpose of balance it should be noted that other countries intend to proceed and build nuclear plants. For example: "On the other hand, some countries, such as the UK, are proceeding with construction of nuclear power plants, with about 19 GWe of new-generation plants expected to be online by 2025." [Jessica Callen, Austria]	accepted text modified
12246	20	10	20	12	This does not reflect the system in the UK (and potentially other countries). Monopoly or stated owned isn't reflective of actual situation [United Kingdom (of Great Britain and Northern Ireland)]	accepted text modified
32040	20	10	20	12	The question of the competitiveness might also be adressed. eg. Linares (doi: https://doi.org/10.1016/j.eneco.2013.09.007) [France]	accepted text modified to include comparative cost assessment and reference made to AR5
36722	20	10	20	20	Like CCS, the cost of building new nuclear plants in the U.S. and other countries has been much higher than expected, which has limited the development of this technology compared to other alternatives. For example, both the costs of the Vogtle and V.C. Summer plants in the U.S. more than doubled and are several years behind schedule. [Steve Clemmer, United States of America]	accepted text modified and literature added on cost increase over time
37094	20	10	20	15	While this section states that feasibility of nuclear has decreased in electricity market environment and utilities in developed countries stop considering nuclear energy as an option, Several developed countries with liberalized electricity markets are pursuing new construction of nuclear plants (e.g., UK) for the sake of energy security and climate change mitigation. [Jun Arima, Japan]	accepted text modified
51510	20	10	20	20	This paragraph is of paramount importance when deliberating on nuclear energy and power for 1.5 degree pathway. Nuclear safety and waste management and possible risk and hazard impact across borders of countries and has no known restricted impact area. Therefore, it concerns the issue of global nuclear governance where as the immediate safety and protection concerns the management of nuclear plants within the national sovereignty. Can the risks be managed globally? Without any feasible model to demonstrate such risks will be beyond global management and purview of any international body. Moreover, business agreements between country governments and companies may not allow this to develop with suppliers going in for no liability agreements with countries where plants are installed. [Souparna Lahiri, India]	taken into account . Text added regarding national and international institute and reference made to AR5
62168	20	10	20	10	Economic does not apply to existing monopolistic choices of nuclear, where this choice was done in spite of competing and cheaper options. E.G. projects by Florida Light (US) or EDF (UK) where new reactors are build for other reasons that economy. "The feasibility of nuclear remains valid in countries with monopolies..." [Antoine Bonduelle, France]	taken into account text modified to include cobenefits as drivers
52088	20	12	20	15	This is vague, which countries are dropping nuclear power? How much power is being dropped? How much is being taken off line? Quantify these numbers! How many more solar panels and wind farms will have to be built to compensate for this loss? [Jason Donev, Canada]	taken into account, text modified. However list of nations with quantitative information is beyond the scope of this section.
52090	20	12	20	15	What are the relative land requirements for wind, solar, biomass and nuclear? Nuclear power's footprint is quite small. I mean, one mine in northern Saskatchewan (which I've been to), provides enough uranium to power more than all of the wind and all of the solar in the world combined. Please be explicit about land use requirements for nuclear power, and compare it to other emission free sources of electricity. [Jason Donev, Canada]	accepted text added on land requirement
57338	20	12	20	12	Need to explain "speed and scaling up issues" [Hans Poertner, Germany]	accepted text modified
32042	20	13	20	13	Negative learning is a term only used by Grubler, it is not clear whether the literature has adopted it. However, it is clear that there has been cost increases, well documented. e.g. Rangel, 2015 (doi: http://dx.doi.org/10.5547/2160-5890.4.2.lran) , Lovering, 2016 (https://doi.org/10.1016/j.enpol.2016.01.011) [France]	accepted text modified and literature added
12968	20	15	20	17	Some authors indicate that safety... Only one author/ paper is listed. It is more correct to state that one author indicates that safety… In addition, the IPCC has summarised this paper a little different from what Budnitz (2016) had originally written. Budnitz only refers to 'newcomer' countries and that political and social cultural are likely to be key issues. No mention is made that "safety may be a larger issue in jurisdictions with limited institutional capacity and human capabilities". [Jessica Callen, Austria]	taken into account text modified

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12248	20	17	20	20	This is an unfair characterisation of the IAEA - it has more influence and stature than is implied here. It is not simply facilitative [United Kingdom (of Great Britain and Northern Ireland)]	taken into account text modified
12974	20	17	20	20	raising the political feasibility question of a world governance of nuclear risks that goes beyond the facilitative role of the International Atomic Energy Agency - the meaning of this sentence is unclear. Do you want to evaluate the role of the IAEA and engage in a discussion surrounding its Statute and the role of the IAEA in nuclear safety? Perhaps the IPCC wants to evaluate the IAEA's Safety Standards and its Member States' adoption of them? Or perhaps even evaluate the the Convention on Nuclear Safety and the national reports of the Contracting Parties? This seems a little bizarre, and again beyond the scope of an IPCC report. I would strongly recommend deleting this. [Jessica Callen, Austria]	Accepted text modified
12972	20	17	20	20	Some papers indicate that impacts of a nuclear accident would cross borders, but nuclear safety depends upon the sovereignty of nation-states (Budnitz, 2016; Meserve, 2009), raising the political feasibility question of a world governance of nuclear risks that goes beyond the facilitative role of the International Atomic Energy Agency (Finon, 2013). This statement is a little out of the IPCC's expertise and sits uncomfortably in this report. I would suggest deleting this text. It is clumsily written - it is well known that many nuclear power plants sit along national borders and that a severe release of radiocative material could potentially be of concequence for a neighbouring state. This is why the Convention on Early Notification of a Nuclear Accident was adopted by the IAEA's General Conference in September 1986: https://www.iaea.org/sites/default/files/infcirc335.pdf. [Jessica Callen, Austria]	Accepted text deleted
1290	20	18	20	20	I think the author should explain this statement more fully - " nuclear safety depends upon the sovereignty of nation-states." Why does the safety depend on the sovereignty of nation-states? [Elizabeth Aldrich, United States of America]	Accepted text modified
12250	20	23	20	23	This section is about "adaptation and mitigation options…for a 1.5C world" - how is it specific to a 1.5C world? It reads as generic (useful) advice about adaptation to a changing climate. If this is the case thenit needs caveating that we can't say anything specific. [United Kingdom (of Great Britain and Northern Ireland)]	Noted - where literature was available, 1.5-specific studies have been cited Otherwise, we have cited 1.5-relevant findings (As has been done across the report).
17728	20	23	20	28	The adaptation / mitigation options covers in chapter 4.3.3 have a direct impact on the spatial composition of actual land use. In terms of spatial composition, changes in agriculture, forest or in urban also lead to changes in other land uses, and there is a lack of comprehensive consideration of these dynamic relationships. It needs the further review on studies on optimization of land-use allocation. [Republic of Korea]	Accepted. The synergies and trade-offs between different mitigation and adaptation options are detailed in 4.5.4.
30594	20	23			4.3.3 Land and ecosystem transitions This section is quite short and seems to ommit several emissions reduction practices, and doesn't evoke stock practices. We may suggest some additionnal references for this part : 1- Nitrogen pollution: a key building block for addressing climate change, Rang Kanter, 2017 (https://link.springer.com/article/10.1007%2Fs10584-017-2126-6) dans Climatic change. 2- Identifying cost-competitive greenhouse gas mitigation potential of French agriculture - Environmental Science and Policy 2017 Sylvain Pellerin, Laure Bamière, Denis Angers, Fabrice Béline, Marc Benoit, Jean-Pierre Butault, Claire Chenu, Caroline Colnenne-David, Stéphane De Cara, Nathalie Delame, Michel Doreau, Pierre Dupraz, Philippe Faverdin, Florence Garcia-Launay, Melynda Hassouna, Catherine Hénault, Marie-Hélène Jeuffroy, Katja Klumpp, Aurélie Metay, Dominic Moran, Sylvie Recous, Elisabeth Samson, Isabelle Savini, Lénaïc Pardonq, Philippe Chemineau. 3-Most of the references of above-mentioned "Identifying cost-competitive greenhouse gas mitigation potential of French agriculture – Environmental Science And Policy 2017" [France]	Rejected - outside of the scope of the chapter. This is a theme that will be picked up in AR6. Highlights of regional or country analyses cannot fit to the plenary approved length of the chapter, unless they have been chosen as a case study.
33956	20	23	22	21	4.3.3.1 Agriculture and food: Dietary shifts towards more plant based and less animal based foods, have a large potential for reducing GHG emissions, while at the same time provide extensive benefits for public health, environment, water resources, over use of antibiotics etc. This is hardly mentioned in the section "Agriculture and food". Please consider to address this topic more thoroughly in this section, the Executive Summary and the rest of the chapter. [Norway]	Rejected - We highlight the importance of dietary change for climate change. However, there is no space to introduce a new subsection that will discuss it more deeply
39236	20	23	22	21	Many sections of this report relay experiences already under a 1C rise and this would seem important in this agriculture section, when relating to 1.5C v.s 2C, as farmers are already reporting significant challenges with a 1C rise. [Lindsey Cook, Germany]	Noted
45652	20	23			I suggest including in section 4.3.3 a new subpoint about education as one of the basis of agricultural transformation. This eduational programs should be focused on consumers but also on farmers, as knowing the local needs of the ecosystem where crops will be developed will be essential from an agroecological perspective. [Adela M Sánchez-Moreiras, Spain]	Taken into account - education is broadly covered in the item Climate Services. However, considering the length given in the chapter, it is not possible to cover such a wide and deep theme within the little space available.
45654	20	23			I suggest including in section 4.3.3 promoting and expanding research on crops behaviour under warming conditions but also looking for species and management practices that allow long-term sustainability instead of immediate yield. [Adela M Sánchez-Moreiras, Spain]	Rejected . Outside of the scope of the chapter. Because the chapter focuses on options to strengthen 1.5C at global scale, only major crops are considered, constrained by the text space available.
45656	20	23			I suggest including in section 4.3.3 leaving aside vast natural areas, such as old-growth forest, to protect biodiversity and ecosystems. [Adela M Sánchez-Moreiras, Spain]	Taken into account - Covered broadly in section 4.3.3. It has also been covered the cross chapter box 9 where the Amazon forest is discussed
45658	20	23			As explained before, I suggest replacing in section 4.3.3 CA by AE. Agroecology looks for improving the efficiency of farm systems to potentiate biodiversity and sustainability considering local and social conditions. The diverse environmental and social externalities of a specific production site should be internalized in the crop system. Altieri and Nicholls stated in 2009 that "the global south has the agroecological potential to produce enough food on a global per capita basis to sustain the current human population, and potentially an even larger population, without increasing the agricultural land base". [Adela M Sánchez-Moreiras, Spain]	Taken into account - This is covered in section 4.3.2.3. However, there is not text space to elaborate on certain issues.
45660	20	23			I suggest including in section 4.3.3 another sub-point about promoting local agriculture. [Adela M Sánchez-Moreiras, Spain]	Rejected - Local is not included in the chapter, unless in examples or case studies.
55488	20	23	22	21	This section lacks any discussion of the state of play and potential for transformative changes to emissions from novel technologies that are currently being developed, including methane and nitrification inhibitors (some of which are in commercial use and also boost crop yields), methane vaccine, gene editing to not just increase adaptation potential but deliver mitigation outcomes (a missed opportunity on page 22 lines 17-21). The section is very myopic and does not assess the available literature on transitions for agriculture with regard to mitigation. [Andy Reisinger, New Zealand]	Taken into account - gene editing was already in the text and now mitigation was added. Thanks for the suggestion on the vaccine for methanogens. It is now added to the text.
55490	20	23	22	21	While more speculative, I would have thought it entirely appropriate to at least have a reference to the potential for plant-based and synthetic proteins resulting in disruptive changes to agricultural production systems and their emissions profiles. There should be enough literature available to at least have a single sentence on this. [Andy Reisinger, New Zealand]	Noted - we have introduced the idea of the use of techniques such as CRISPR-Cas, which contemplates the use of synthetic biology tools for agriculture.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
55486	20	23	22	21	This section completely misses the literature on improving productivity and efficiency to reduce emissions from agriculture, which would have major SD co-benefits. See e.g. Gerber et al (2013), Tackling climate change through livestock, FAO (Rome), pp139; FAO & New Zealand Agricultural Greenhouse Gas Research Centre. 2017. Low emissions development of the beef cattle sector in Uruguay – reducing enteric methane for food security and livelihoods. Rome. 34 pp.; FAO & New Zealand Agricultural Greenhouse Gas Research Centre. 2017. Supporting low emissions development in the Ethiopian dairy cattle sector – reducing enteric methane for food security and livelihoods. Rome. 34 pp.; Opio et al - mitigation options in ruminant supply chains (FAO); etc etc. I find it difficult to see the rationale for not even treating this literature, given the significant mitigation potential and SD co-benefits. [Andy Reisinger, New Zealand]	Taken into account - text revised. Synergies and trade-offs in the livestock sector are discussion in Section 4.5.4 and Supplementary Materials E1 and E2.
53238	20	25	20	26	relevant to *Role of bioenergy* The section titled “Land and Ecosystem Transitions” discusses bioenergy and other options, stating “This section assesses the feasibility of adaptation and mitigation options related to land-use and ecosystems that could play a role in the transition to a 1.5°C world.” However, the section on bioenergy does not in fact discuss the “feasibility” of bioenergy in any meaningful way. A huge flaw of this report – the central flaw, in our opinion – is that it takes as a given that burning organic material for energy will reduce atmospheric carbon loading. However, a plethora of recent literature – almost none of which the report cites – finds that upscaling burning material for energy does not “reduce” emissions and can actually increase them. The report says it assesses the feasibility” of measures, including bioenergy; this should mean providing a critical assessment of the assumption of bioenergy carbon neutrality that is “baked in” to practically every mitigation model and scenario. [Mary Booth, United States of America]	Taken into account - Even though space constraints keep us from going into details, we have added a qualifying statement saying that the carbon intensity of bioenergy depends on a number of factors, also adding more references to that effect. It is important to point out, however, that also the previous version did not assume that burning biomass does not cause emissions, but it compared the carbon balance to that of fossil fuels. Please note that the bioenergy section has moved to the energy section (4.3.1.2).
60906	20	25	22	26	Every paragraph in section 4.3.3 is a conclusion. No analysis is provided, no basis provided for the conclusions presented. This minimizes the effects of changes in climate and suggests assertion rather than assessment. Additional information to support these conclusions is necessary. [United States of America]	Noted - Details are in the literature cited,.
17730	20	26	20	27	The chapter 4.3.3 mentioned "Land transitions are grouped around agriculture and food, ecosystems and forests, and coastal systems." Then, agriculture and food, Ecosystems and forests are expained, but Coastal systems are not explained and so it should be explained. [Republic of Korea]	Taken into consideration - FGD has a new section on Coastal Transitions under Sec 4.3.2.3.
14068	20	30	22	31	There are a suite of FAO reports on climate-smart and energy-smart food that are not referenced here. The FAO analysis is far more robust than what is presented here. In essence, reducing GHG emissions from the agr-food sector involves 1) improving productivity (eg t/ha) with fewer inputs (irrigation efficiency being but one); 2) displacing fossil fuels along the food supply chain with renewables coupled with improved energy efficiency; 3) changing consumption patterns, particularly away from animal protein; 4) increased urban agriculture including roof tops, tower factories and synthetic "meat" production. [Ralph Sims, New Zealand]	Noted, most of what the reviewer comments is already directly or indirectly mentioned in the text in different forms
30596	20	30			4.3.3.1 Agriculture and food It has to be underlined that changes in cropping practices can also (i) increase carbon in soils (ii) lower GHG emissions (less chemical fertilizers) [France]	Noted
28490	20	30	22	21	The subchapter 4.3.3.1 is very weak. It needs serious editing for language but also a more coherent approach to the available literature and a more conclusive structure. For example, "Conservation agriculture" is being presented as some sort of the silver bullet, but it is not defined well. The definition on p 20 l 51-53 is confusing, in particular with its reference to maize and wheat yields. A more generic framing (e.g. "site-specific" agricultural techniques that conserve water and soil carbon") would be helpful. The three adaptation options listed in l 47/48 are not sufficient to represent the portfolio of options available. The statement on bioenergy potential in l 53 is confusing (high agreement the potential MAY be restricted?) and the number does not seem to be in line with the literature cited. On p 22 l 12 genome editing is singled out on what reasons? Given the importance of agriculture and food production, and the wealth and breadth of evidence available here, we strongly suggest this section to be rewritten in its entirety. [Germany]	Taken into consideration - text revised
60908	20	30	23	55	Not all of these are options and the assessment of feasibility is mostly missing. The section is also not really tied to section 1.5. [United States of America]	Taken into consideration - the feasibility was completely reformulated in the new version of Chapter 4
58652	20	30	22	21	This section would be improved by considering literature that demonstrates options for mitigation in agriculture that are consistent with other sustainable development objectives, such as ending hunger, improved livelihoods, building resilience. For example, FAO proposes the following three ways to substantially reduce emissions from livestock production: productivity improvements that reduce emission intensities; carbon sequestration through improved pasture management;? and better livestock integration in the circular bioeconomy. These solutions can be combined and they also contribute to increase resilience to climate change. http://www.fao.org/3/a-i8098e.pdf. Another example, are the five principles of sustainable food and agriculture that FAO member states have endorsed: Improving efficiency in the use of resources is crucial to sustainable agriculture; Sustainability requires direct action to conserve, protect and enhance natural resources; Agriculture that fails to protect and improve rural livelihoods, equity and social well-being is unsustainable; Enhanced resilience of people, communities and ecosystems is key to sustainable agriculture; Sustainable food and agriculture requires responsible and effective governance mechanisms. http://www.fao.org/3/a-i7994e.pdf The FAO, in its 2016 report on Food Security, Climate Change and Agriculture has also pointed out that the agriculture sectors face a unique challenge: to produce more food while reducing greenhouse gas emissions caused by food production. Agriculture could reduce its emission intensity, but not enough to counterbalance projected increases in its total emissions. Addressing emissions from land use change driven by agricultural expansion is essential, but sustainable agricultural development will determine its success. Although improvements in carbon and nitrogen management also reduce emissions, they are likely to be driven by adaptation and food security objectives, rather than mitigation goals. Reducing emissions from agriculture also hinges on action to minimize food losses and waste and to promote sustainable diets. This is outlined in detail in http://www.fao.org/publications/sofa/2016/en/ Other relevant references include: http://www.fao.org/ag/againfo/resources/en/publications/tackling_climate_change/index.htm http://www.fao.org/docrep/018/i3288e/i3288e.pdf [New Zealand]	Accepted. A livestock section was added to section 4.3.2 on page 23 which discusses GHG emissions and mitigation actions in the livestock sector, adaptation interventions such as feed management, variety changes; as well as a discussion on changing mixed crop-livestock systems. Synergies and trade-offs in the livestock sector are discussion in Section 4.5.4 and Supplementary Materials E1 and E2. The FAO 2016 documents mentioned are also cited now.
60910	20	30	20	55	While this section succinctly discusses the potential impacts of climate change on food productivity, it would benefit from the inclusion of a discussion on the potential mitigation and productivity benefits associated with the adoption of better agricultural practices. Addressing conservation agriculture in the next section implies a distinction between food production and improved agricultural practices. Suggest these sections be combined. [United States of America]	Taken into account - the new version is expanded and takes agricultural practices into account.
62056	20	30	20	55	More quantitative assessment on the effects of droughts would be needed. The paragraphs in the section are not very tied together. [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Noted- Impacts of droughts are discussed in Ch. 3
49638	20	31	20	35	This sections should be made consistent with chapter 2 on yields. The yield projections in ch2 are from 1-3t/ha/yr to 4-5 t/ha/yr, which is in obvious conflict with the statement here. [Karlheinz ERB, Austria]	Taken into account - we will check that comparing to Ch2

Comment No	From Page	From Line	To Page	To Line	Comment	Response
55674	20	31	22	21	section 4.3..3.1-agriculture and food. This section is missing conisderation of nutrient management (avoiding overapplications of N etc) [David Cooper, Canada]	Noted - due to the limited space we had to prioritize some issues over others
55680	20	31	22	21	section 4.3..3.1-agriculture and food. This section is missing consideration of better management of soil organic matter (preventing losses, improving sequestration). Add data from, and include references to Griscom et al 2017. [David Cooper, Canada]	Taken into consideration - reference added
55682	20	31	22	21	section 4.3..3.1-agriculture and food. This section is missing consideration of better management of pastures and livsetock [David Cooper, Canada]	Synergies and trade-offs in the livestock sector are discussion in Section 4.5.4 and Supplementary Materials E1 and E2.
55684	20	31	22	21	section 4.3..3.1-agriculture and food. This section is missing consideration of how increases in crop and pasture productivity, combined with land planning, coud free up land for ecosystem restoration. See for example: Stassburg (2014) When enough should be enough: Improving the use of current agricultural lands could meet production demands and spare natural habitats in Brazil. Global Environemntal Change. 28. 87-94; Stassburg et al (2018) Moment of truth for the Cerrado. Nature Ecology and Evolution. [David Cooper, Canada]	Rejected - there is no space to include more specific discussions
5052	20	32	20	32	Change "reduce" to "decrease" [Michael MacCracken, United States of America]	Taken into account - text revised
36088	20	32	20	32	Add 'South-Asia' after 'South-East Asia'. [India]	Taken into account - text revised
5054	20	33	20	33	Saying "may benefit" is really useless in terms of getting a sense of likelihood--is the chance 1% or 99%? Please use the IPCC likelihood lexicon, adding an explaining phrase if also necessary. [Michael MacCracken, United States of America]	Taken into account - text revised
40440	20	33	20	35	It is also strongly linked to poverty, loss of traditional knowledge and adverse effects on local livelihoods. [Pedro Alfredo Borges Landaez, Venezuela]	Not applicable - this issue is in the scope of Ch5
56054	20	33	20	34	Food access, which is one of the four pillars of food security is not mentioned here. Food production at a level to keep prices from spiking does not, in and of itself, ensure that communities have access to food. Loss of land to climate change impacts or mitigation activities for communities would negatively impact their food security because their loss of access to food, even if global food production remains the same through expanded production or yield increases elsewhere. This should be mentioned in this sentance and discussed in the following section. [Kelly Stone, United States of America]	Not applicable - this issue is in the scope of Ch5
40362	20	34			bioenergy causes pollution, soil loss and lower biodiversity. It is not the best idea [Jonathan Gómez Cantero, Spain]	Noted
5056	20	37	20	38	This sentence does not really give a sense of whether impacts would be positive or negative, unless the word "impacts as taken to always refer to the negative, which is not generally the case. Same with "affect"--does this mean up or down? Say "adversely impact" or something similar to be sure the sign is clear [Michael MacCracken, United States of America]	Noted - This is exactly the idea i.e. that there are effects that could be positive of negative. This will depend on the crop and on the needs of consumers.
10564	20	37	20	49	The impact of 1.5C warmer world on food production is here stated as negative (with medium agreement). But some recent studies also suggested positive impacts in some regions and on some crops. One reference is Deryng, D. et al. 2016. Regional disparities in the beneficial effects of rising CO2 emissions on crop water productivity. Nature Climate Change. http://dx.doi.org/10.1038/nclimate2995. [Hong Yang, Switzerland]	Noted - in this part of the text there is no claim of its being positive of negative. It is just said that there are several effects. In the space available for text, figures and tables it is only possible to give broad directions of what are the effects and indicated general feasibility pathways. The feasibility for local options will have to take into account local conditions that we have no space to assess here.
31520	20	37	20	49	Three paragraphs from Chapter 4-22?L32 to L51 need to be reconsidered adding more detailed information because the title “forest management” does not really fit its contents describing grazing land management, livestock management and benefits of certification. For reference, Decision 16/CMP.1 defines "'Forest management' is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner" [Japan]	Rejected - this may be seen a policy prescriptive. Forest management means different things in different parts of the world. Here we take the widest possible concept, that includes all systems associated to forests, cattle raising, teleconnection with ecosystems, and human systems
37404	20	37	20	49	In this context it might be interesting to discuss the feasilibilty respectively the conditions of feasibility of producing sufficient food for all on existing or even shrinking food-production areas, e.g. in a no-deforestation world, and the behavioral and technology choices associated to do so (e.g. see Erb et al., 2016 Nature Comm.) [Helmut Haberl, Austria]	Rejected - there is not space to discuss further details given the plenary defined length of the chapter
40066	20	37		40	Climate change impact on plant quality and its implications for food and nutrition security is absolutely critical and need a full treatment. Increasing evidence is showing that elevated carbon dioxide alters plant nutrient composition and quality with significant implications for human nutrition, food insecurity and human health. A recent study reported that C3 grains (e.g. wheat, rice) and legumes have lower concentrations of zinc and iron when grown under field conditions with elevated CO2 levels [Myers et al., 2014]. C3 crops other than legumes also have lower concentrations of protein. An extensive meta-analysis, covering 7761 observations and 130 species/cultivars, corroborated these findings (Loladze, 2014). This study found that elevated CO2 reduces the overall mineral concentrations (by 8%) and increases the total non-structural carbohydrates (mainly starch and sugars) in C3 plants. These results offer the first robust documentation of the adverse nutritional impact of climate change, which can exacerbate the prevalence of “hidden hunger” and obesity. Research on the impact of elevated atmospheric CO2 is also expanding beyond field crops and encompassing other vital ecosystem services such as pollinators. A recent study focusing on Canada goldenrod (Solidago canadensis) pollen, found a close correlation between elevated atmospheric CO2 concentration and changes in pollen protein concentration (Ziske et al., 2016). While the implications for honeybee health and population stability and implications for crop production remain to be fully assessed, there is increasing urgency to pay more attention to this emerging threat to the future food supply due to high CO2 concentration and climate change. Cited references: Loladze, I. (2014). Hidden shift of the ionome of plants exposed to elevated CO2 depletes minerals at the base of human nutrition Ecology, Epidemiology and Global Health, Research Article May 7, 2014 Medek, D.E., J. Schwartz, and S.S. Myers (2017). Estimated Effects of Future Atmospheric CO2 Concentrations on Protein Intake and the Risk of Protein Deficiency by Country and Region. Environmental Health Perspectives (2017): 1-8. Myers, S.S., A. Zanobetti, I. Kloog, P. Huybers, A.D. Leakey, A.J. Bloom, E. Carlisle, L.H. Dietterich, G. Fitzgerald, T. Hasegawa, N. M. Holbrook, R.L. Nelson, M.J. Ottman, V. Raboy, H. Sakai, K.A. Sartor, J. Schwartz, S. Seneweera, M. Tausz & Y. Usui (2014). Increasing CO2 threatens human nutrition. Nature Vol 510: 139. Ziska LH, Pettis JS, Edwards J, Hancock JE, Tomecek MB, Clark A, Dukes JS, Loladze I, Polley HW. (2017). Rising atmospheric CO2 is reducing the protein concentration of a floral pollen source essential for North American bees. Proc. R. Soc. B 283: 20160414. [Aziz ELBEHRI, Italy]	Taken into account - thanks for the literature and the explanations. We attempted to use some examples, but focussed on literature associated with meta-analysis, which gives a wide perspective of what may happen with large crops in the future. But we will add some of the references suggested to enrich the evidence available about possible changes in food quality with climate change.
36574	20	42	20	44	This paragraph does not apply to the 1.5 scenario, thus a quantitative statement comparing the two should be made to be able to place the paragrph in the appropriate context. [Snaliah Mahal, Saint Lucia]	Rejected - it is clear that it is not 1.5C, since it is stated that it is for 2C. There is not enough literature yet for 1.5C. In the following paragraph we go back to 1.5 and explain that the options are similar to 2C.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
5058	20	43	20	43	Use of the word "could" is also not helpful--is this 1% chance or 99% chance? Please use the IPCC likelihood [Michael MacCracken, United States of America]	Taken into account - text revised
17732	20	43	20	44	The chapter 4.3.3.1 mentioned "This could be reduced if appropriate adaptation measures are taken (Challinor et al., 2014)." However, we may need explain what appropriate adaptation measures are. [Republic of Korea]	Taken into account - text revised
33538	20	43			For clarity suggest adding two words "…yield could decrease. This yield decrease could be reduced…" [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
57340	20	43	20	44	Need to specify “appropriate adaptation measures” [Hans Poertner, Germany]	Taken into account - text revised
32964	20	46			The paragraph does not address the scientific development bottleneck needed to pave a solid way for resilient agricultural development in the agricultural sector, considering a 1.5ºC degree scenario. It is essential that the text emphasizes the need for robust and immediate investment in the improvement and development of varieties and management systems compatibles with local climatic conditions and alert to the possible effects of climate change. [Brazil]	Not applicable - finance is covered in other sections of the chapter.
36090	20	46	20	49	Add - "Drought, temperature and pest tolerant varieties" in line 47. [India]	Noted - This comment probably meant line 44. Text was changed to explain possible adaptation measures
28492	20	47	20	49	The sentences should be adapted to read: "The following three adaptation options are examples among various that can help assist this: conservation agriculture, irrigation efficiency and climate services. For mitigation options, the examples of reducing food waste, bio-energy and (bio)technology are assessed below." Otherwise, this section seems to imply that these are the only adaptation and mitigation options. [Germany]	Noted, text has been amended.
33540	20	48			reducing food waste should read "food wastage" - on following page line 39 and 41 refer to "food wastage" and define this as "a combination of food loss… and food waste" [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
33542	20	48			be consistent with "bio-energy" or "bioenergy" - on next page "bioenergy" is used (which I prefer). [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
50740	20	50	20	50	In opinion of the reviewer, something should be said about the impact of temperature raise in food conservation, because of the impact in food security, in particular in developing countries. Off-grid food refrigeration, for instance using naturally cold air, locally powered air convection or heat pumps, powered by renewable energy sources, or using waste heat, e.g. from an internal combustion engine, could be mentioned here. Similarly cooking stoves or furnaces using solar heat or biomass are al alternative for autonomous food processing. Also off-grid thermal processing (e.g. sun drying). [Francisco Javier Hurtado Albir, Germany]	Noted - these issues a43 relevant. Relevant literature is too limited to examine them as specific options
16464	20	51	21	9	Section 4.3.3.1 "conservation agriculture" gives about 12 lines to this issue but more detail about the potential for increased carbon sequestration through altered farming practices would be desirable. Although some references are given in the brief discussion, the references of Minasny et al. (2017) and (probably) Lal (2014) (as already given in 3.4.3.4) would be worth adding. Lou et al (2010) would also be suitable (Luo, Z., Wang, E., Sun, O.J., 2010. Soil carbon change and its responses to agricultural practices in Australian agro-ecosystems: a review and synthesis. Geoderma 155, 211–223). [Australia]	Noted - thanks for the suggestion. These references are more about impacts that options for 1.5C worlds.
17734	20	51	21	9	So far conservation agriculture was focused on more yields, less impact on soil and water environment. When the concept of W-E-F Nexus is considered, effects of conservation agriculture on water-energy-food is beyond our conventional expectation. In Korea, it was found that no-till could increase more yields and less soil erosion (possibly more soil carbon sequestration) due to limited soil disturbance. [Republic of Korea]	Noted - the Impact´s chapter is Chapter 2. In Chapter 4 we are focused on options for 1.5
30598	20	51	20	51	Please use a strict definition of "conservation agriculture" like the one done by the FAO: (i) Continuous minimum mechanical soil disturbance.(ii) Permanent organic soil cover. (iii) Diversification of crop species grown in sequences and/or associations. ==> irrigation is not specifically part of conservation agriculture [France]	Noted - We have assessed CA and irrigation efficiency as separate options in Sec 4.3.3.1.
36092	20	51	21	9	In lines 51 to 53, the meaning of conservation requires clarification. Generally conservation agriculture is associated with tillage and not improved crop varieties, irrigation, etc. Further conservation agriculture has very limited potential in Tropical countries. More citations are required to substantiate this. [India]	Taken into account - text revised
16466	20	53	20	55	Please explain this statement and clarify the relevance to conservation agriculture. Are you inferring that conservaiton agriculture is organic agriculture; that grass-fed beef is not conventional? [Australia]	Noted - it is explained in the first paragraph.
19732	20	53	21	1	Without an explanation on what environmental benefits arise from an even stronger intensification (efficiency) in agricultural production this comparison is somewhat misleading. [Jennifer Morgan, Netherlands]	Noted- Synergies and trade-offs of different options are discussed in 4.5.4
30600	20	53	21	1	You could also refer to agroecology which is more diverse: it includes organic agriculture (less chemical inputs and less emissions) & knowledge intensive strategies (Van der Zaag, P., 2010: Water variability, soil nutrient heterogeneity and market volatility – Why sub-Saharan Africa’s Green Revolution will be location-specific and knowledge-intensive.) [France]	Noted
57860	20	53	21	1	This section makes a brief mention of dietary change, which is completely inadequate to cover the rich literature on the mitigation potential of dietary change, particularly away from meat-intensive diets. I realise that this section is on conservation agriculture, but it is the only reference to dietary change – I would suggest that this section 4.3.3.1 needs a stand-alone section on dietary change, summarising the literature that gives quantified mitigation potentials from shifts in eating habits: Bajz?elj, B., Richards, K. S., Allwood, J. M., Smith, P., Dennis, J. S., Curmi, E., et al. (2014). Importance of food-demand management for climate mitigation. Nature Climate Change, 4, 924–929. https://doi.org/10.1038/nclimate2353; Cassidy et al (2013). Redefining agricultural yields: from tonnes to people nourished per hectare, Environ. Res. Lett. 8 034015; Wellesley and Froggatt (2015). Changing Climate, Changing Diets: Pathways to Lower Meat Consumption, Chatham House, https://www.chathamhouse.org/publication/changing-climate-changing-diets. Given the critical dependency of both mitigation and adaptation strategies on land and access to land for rural communities, the potential to free land though less meat-intensive diets needs to be highlighted. [Kate Dooley, Australia]	Rejected - We highlight the importance of dietary change to enable the transition to 1.5C worlds. However, there is no space to introduce a new subsection that will discuss it more deeply, because of space constraints
57342	20	54	20	54	Specify “shift towards low-impact foods” [Hans Poertner, Germany]	Taken into account - text revised
32966	20	55			The conclusion of this paragraph, including the reference for animals managed in natural pasture is inappropriate. We have vast literature indicating the robust benefits of adopting modern, well managed grazing systems. Therefore I recommend excluding the reference [or grass-fed beef] [Brazil]	Rejected - the conclusion is not that grass-fed grazing cattle is inappropriate. Under certain conditions it may be appropriate and technologies are improving. The point here is that there are other systems that are more efficient if we consider the urgency of taking action in a 1.5C scenario.
16468	21	3	21	5	Please clarify, surely no til practices don't reduce yields in all circumstances. This comment would be improved if there were some qualifiers. Eg, No til practices reduce yields in more than half of the studies included in the meta-analysis. [Australia]	Accepted - the sentence has been qualified with a reference to show that no-till does work in rain fed agriculture in dry contexts
18584	21	3	21	9	Within 'Conservation agriculture', reference is made to the climate benefits of low tillage practices, including trade-offs with other agriculture practices and benefits. However, no reference is made here (or elsewhere in the document) on potential trade-offs with pesticide use. The Panel mayn wish to consider additional reference. [Andrea TILCHE, Belgium]	Accepted - have edited text to add references on mitigation co-benefits. This is further showed in Sec 4.5.4 and Supplementary Material E.2 on synergies and trade-offs between adaptation and mitigation options.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
30602	21	3	21	9	What about the co-benefits of conservation agriculture (eg. increased carbon stock, biodiversity etc.) ? [France]	Accepted - have edited text to add references on mitigation co-benefits. This is further showed in Sec 4.5.4 and Supplementary Material E.2 on synergies and trade-offs between adaptation and mitigation options.
49640	21	3	21	9	It would also be intersting to discuss the costs and benefits of organic agriculture for C mitigation, in particular in combination wiht dietary changes. The body of literature is rich, some material is: Mueller et al 2017 doi10.1038/s41467-017-01410-w, but there is much much more which should be included in the assessment of Ch4 [Karlheinz ERB, Austria]	Rejected - there is no space to include more specific discussions
51512	21	3	21	9	In most rain-fed areas, crop rotation means planting a different crop next year since rainfed agriculture is performed once a year. And that means changing the staple crop every year disrupting food security, food stability and in cases of marketable crops, price volatility. Nutritional security, culturally appropriate food systems should also be taken in to consideration. [Souparna Lahiri, India]	Noted
16470	21	7	21	9	Please clarify, how will more information improve the feasibility? [Australia]	Accepted. Text has been removed as this was misleading.
36094	21	7	21	9	May consider adding example from South Asia: The residue incorporation is reported to be one of the important steps to increase soil moisture retention and reduce air pollution due to burning (IARI, 2012; Srinivasa Rao et al. 2016). Further, the agricultural profit of farmers adapting climatic stress adaptation technologies such as heat tolerant varieties, timely sowing, recommended seed rate, improved irrigation management, crop diversification increase crop yield and farm income (Naresh Kumar et al., 2016) [India]	Noted - there is no space to include more specific discussion
40850	21	7	21	9	Example from south Asia:The residue incorporation is reported to be one of the important steps to increase soil moisture retention and reduce air pollution dur to burning (IARI, 2012; Srinivasa Rao et al. 2016). Further, the agricultural profit of farmers adapting climatic stress adaptation technologies such as heat tolerant varieties, timely sowing, recommended seed rate, improved irrigation management, crop diversification increase crop yield and farm income (Naresh Kumar et al., 2016) [NARESH KUMAR SOORA, India]	Noted - there is no space to include more specific discussion
40854	21	7	21	9	References: IARI (2012) Crop residues management with conservation agriculture: Potential, constraints and policy needs. Indian Agricultural Research Institute, New Delhi, vii+32 p. [NARESH KUMAR SOORA, India]	Noted
40856	21	7	21	9	Reference: Srinivasa Rao, C., K.A. Gopinath J.V.N.S. Prasad, Prasannakumar, A.K. Singh 2016. Climate Resilient Villages for Sustainable Food Security in Tropical India: Concept, Process, Technologies, Institutions, and Impacts Advances in Agronomy, http://dx.doi.org/10.1016/bs.agron.2016.06.003. [NARESH KUMAR SOORA, India]	Noted
40858	21	7	21	9	Reference: Naresh Kumar S., Anuja, Md. Rashid, S.K. Bandyopadhyay, Rabindra Padaria and Manoj Khanna 2016 Adaptation of farming community to climatic risk: does adaptation cost for sustaining agricultural profitability? Current Science, 110 (10): 1216-1224. [NARESH KUMAR SOORA, India]	Noted
10566	21	11	21	27	The text under Irrigation Efficiency has little connection with the mitigation and adaptation to a 1.5C warmer world. [Hong Yang, Switzerland]	Noted - there is little evidence on the role of improved irrigation efficiency and 1.5deg but its feasibility as an effective adaptation strategy has been assessed and text amended to reflect this. Also see Sec 4.5.3 for feasibility assessment. Text has been edited substantially in the final draft.
17736	21	11	21	27	In addition to shift in irrigation technology, changes in rice paddy management (such as SRI or Wet-Dry rice processing method) could increase irrigation efficiency, yield more rice compared with conventional rice-paddy, and reduce greenhouse gas emission from paddy fields. [Republic of Korea]	Noted - unfortunately we cannot go into too much detail and discussions due to the lack of space.
33544	21	11	21	27	there is repitition between these two paragraphs - final sentence of 2nd para could be deleted? [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
36096	21	11	21	27	Replace 'Irrigation efficiency' with "Water-use efficiency" [India]	Rejected - the names of the options are taken from AR5 where in Chapter 14, efficient irrigation is an adaptation option (Table 14.1 in Ch 14, WG2). In this case we meant irrigation and not water use.
40068	21	11		16	The issue goes beyond irrigation efficiency. In situations of water scarcity which touch a significant portion of the world population, strategies to cope with water strategies (likely to be aggravated by climate change) goes beyond irrigation efficiency. Investments in irrigated agriculture need to be coupled with water-smart trade policies (i.e., importing more water intensive food) to lessen the pressure on water use for domestic food production under irrigation [De Fraiture and Wichelns, 2010]. Cited reference: De Fraiture, C. & D. Wichelns. 2010. Satisfying future water demands for agriculture. Agricultural Water Management, 97 (4): 502–511. [Aziz ELBEHRI, Italy]	Noted - unfortunately we cannot go into too much detail and discussions due to the lack of space.
50742	21	11	21	11	After "of irrigation efficiency" insert "including energy efficient irrigation (motor controlled pumping or solar water pumping)" [Francisco Javier Hurtado Albir, Germany]	Noted. Mitigation synergies and trade-offs with increasing irrigation efficiency is discussed in Supplementary Material E2.
51514	21	11	21	27	This discusison on irrigation efficiciency and shift in crop pattern and ancilliaries should also focus on agriculture in forest areas. Most of this subsistence agriculture is rain fed and hence mostly once a year due to lack of suitable irrigation facilities on forest land due to existing legislations on forest conservation and lack of irrigation infrastructure. Probably creation of more water bodies or canals, wetlands would help. But, that will mean amending forest conservation legislations to allow community controlled and governed small scale water harvesting systems. [Souparna Lahiri, India]	Noted - the focus of this item is on crops and not forests. Sec 4.3.2.2 is on forests.
57224	21	11	21	27	it has been shown for the case of Pakistan (https://doi.org/10.1016/j.energy.2018.01.027) that a high irrigation efficiency is essential also for an affordable energy system, since in a business-as-usual scenario the energy demand for desalination would exceed the energy demand for the remaining power sector by a factor of two, which is regarded as almost not affordable. Pakistian is one of the most water constraint countries in the world [Christian Breyer, Finland]	Noted - energy efficiency is discussed in other sections in the chapter (4.3.1).
3690	21	12	21	27	The sentences of Line 12-15 are as same as Line 24-27. [Ying Chen, China]	Noted - repetition removed.
18586	21	12	21	15	The sentence "There is high agreement that improvement in irrigation efficiency ... improve soil and moisture conservation (Fader et al., 2016; 15 Hong and Yabe, 2017; Sikka et al., 2017)" is also repeated in the subsequent paragraph (lines 23 to 27) [Andrea TILCHE, Belgium]	Noted - repetition removed.
31522	21	12	21	15	A very similar sentence "There is high ..." appears on line 24, and perhaps one of them could be deleted to avoid redundancy. [Japan]	Noted - repetition removed.
53580	21	12	21	27	Lines 12-15 are repeated in lines 24-27 [Sumetee Pahwa Gajjar, India]	Noted - repetition removed.
47104	21	13	21	13	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Noted, text amended
5062	21	14	21	14	Change "improve" to "improving" [Michael MacCracken, United States of America]	Editorial - text amended.
5064	21	15	21	16	Needs reworking as now ith reads as if "crop shifts" will have to be shifted instead of that "crop ranges will need to be shifted in responses to shifts in the climate. [Michael MacCracken, United States of America]	Editorial - text amended.
5066	21	16	21	16	Not clear who "They" is--needs to change as "They" is not same as "them" on this line [Michael MacCracken, United States of America]	Noted, text amended.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16472	21	21	21	22	Suggest acknowledge the high costs, and GHG-intensity, of improving irrigation efficiency ie implementing and operating high water-use efficiency technologies [Australia]	Noted. Mitigation synergies and trade-offs with increasing irrigation efficiency is discussed in Supplementary Material E2.
31524	21	24	21	27	A very similar sentence "There is high …" appears on line 12, and perhaps one of them could be deleted to avoid redundancy. [Japan]	Noted - text was revised
32258	21	24	21	27	repeated sentence (same page lines 12-15) [Jamaica]	Noted - text was revised
55074	21	24	21	27	Delete the last sentence of the para, since redundant to the sentence in line 2 to 5. [Yamide Dagnet, United States of America]	Noted - text was revised
47106	21	25	21	25	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Noted - text was revised
16474	21	29	21	37	Is the low uptake of longer term forecasts linked to a low level of trust in the reliability of new technologies delivering correct long term forecasts, and the economic implicaitons of undertaking inappropriate activities related to incorrect forecasting? Does this require some dedication to education to improve uptake? [Australia]	Noted - Lower uptake of longer-term forecasts is linked to several factors, one of which is mistrust of new technologies but also mismatches in forecast and decision-making time horizons or clarity in projected impacts of these forecasts. We are not discussing these aspects in detail in the chapter due to space constraints. Climate services are now discussed in detail in Sec 4.3.5.7. Table 4.4 and Supplementary Material 4.B.
30604	21	29	21	30	Many studies suggest that their impact is beneficial for farmers -Roudier et al, 2016 http://dx.doi.org/10.1016/j.agrformet.2016.04.010 , which finds that climate services has led to Up +15% income for millet growers in Niger Rodrigues et al 2016 (http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130497) show that climate services have been adopted by all farmers, seasonal forecasts generates avg regional income gains of US$113 million/year ($317 million/yr perfect info) (Kenya, Malawi, Mozambique, Tanzania, Zambia) [France]	Accepted -Thank you for the very useful references which we have included in the feasibility assessment of climate services (especially on cost effectiveness of climate services). Climate services are now discussed in detail in Sec 4.3.5.7. Table 4.4 and Supplementary Material 4.B
61968	21	29	21	37	There should be a cross-chapter discussion at LAM4 on how to address climate services, which is much broader than implied by their placement in a subsection on land and ecosystem transitions and refers to climate information at different timescales relevant for various sectors (coastal areas, disaster risk reduction, infrastructure, health, transport, insurance, energy, tourism, agriculture and forestry or water management), both for mitigation and adaptation. A box may be relevant. [Valérie Masson-Delmotte, France]	Noted - climate services were transferred to Section 4.3.5.7
50744	21	30	21	30	Insert after the brackets. "In addition climate services can support mitigation by providing services to the energy industry". Literature reference: Diverse authors (editor Alberto Troccoli) "Weather & Climate Services for the Energy Industry, Palgrave Macmillan", ISBN 978-3-319-68417-8. [Francisco Javier Hurtado Albir, Germany]	Noted - Climate services are now discussed in detail in Sec 4.3.5.7. Table 4.4 and Supplementary Material 4.B
16602	21	32	21	32	EBA has certainly not been mainstreamed in Australia - indeed the environment is grossly neglected. [Janet Stanley, Australia]	Taken into account but not applicable - due to major restriction of chapter length, mainstreaming of EBA is no longer discussed.
30606	21	35	21	37	However, many countries are building their national framework for climate services: the aim is to scale-up local initiatives. So, there is a political will. [France]	Noted - We agree with the reviewer that political will is there but other barriers to scaling up exist (as discussed in the text). This aspect is covered in Section 4.5.3 where climate services ranks 'medium' in institutional feasibility (composed of political acceptance among other indicators).
1292	21	39	21	39	I think the term "food wastage" is awkward and not conventional. Usually (in the US at least), "food waste" is used. [Elizabeth Aldrich, United States of America]	Rejected - the meaning of food wastage is clearly explained in the text as per the FAO definition that was proposed
16476	21	39	21	51	Have there been any studies on the success of strategies to reduce the quantity of food waste - compared to reducing emissiosn from the waste - which is discussed? [Australia]	Noted. There is general information about food wastage in the cited report of FAO
16478	21	39	21	51	Please reword this section, it is poorly expressed and inaccurate. [Australia]	Noted
49766	21	39	21	51	Food wastage is also wastage of the energy embedded in food. It has to be reminded that food production and consumption is a major energy use driver. E.g., the overall amount of energy embedded in the food consumed in EU-27 in 2013 is estimated to 11 836 PJ (283 Mtoe), equivalent to 17 % of the EU-27's gross energy consumption and 25.7 % of its final energy consumption in 2013. (data from Monforti and Pinedo - eds -Energy use in the EU food sector: State of play and opportunities for improvement, EUR 27247 EN) [Fabio Monforti-Ferrario, Italy]	Noted
60912	21	39	21	51	It would be helpful to provide some more quantitative analysis of the cost-effectiveness of reducing food waste (e.g., in relation to other modes of reducing emissions). On lines 44-45, the text states that "it is likely that food wastage will lead to increase in emissions estimated to 1.9-2.5 GtCO2-eq yr." The text should indicate the assumptions that underlie this assessment. Food waste would seem to be amenable to large-scale institutional and behavioral change, if it is addressed with sufficient attention from the relevant institutions. [United States of America]	Taken into account - we have now feasibility tables that take this into account and provide literature with the quantifications
7922	21	40	21	40	on the planet, not "in the planet" [Christopher Bataille, Canada]	Noted
5068	21	41	21	43	I thought there was also a lot of loss when going from harvesting to the initial storage before processing and sale--that is, a lot of the food in the field does not make it to market. Perhaps it would be clearer here if it said there is loss of harvest/crops in going from field to market--during this transition, only some of this might be called "food", so perhaps add in other words as well. [Michael MacCracken, United States of America]	Noted - unfortunately we cannot go into too much detail and discussions due to the lack of space.
60914	21	41	21	43	Provide illustrative examples of "poor infrastructure" and "lack of technologies." [United States of America]	Noted - instead of adding more details to the text we have not tables with the line of sight giving references, where some examples could be found
46914	21	44	21	46	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Taken into account - text revised
28494	21	47	21	50	Besides transforming "food waste into products with marketable value", reduction of food loss and food waste is required. Consider to add this point to the sentence. [Germany]	Noted - instead of adding more details to the text we have not tables with the line of sight giving references, where some examples could be found
55676	21	51	22	8	bioenergy dicussion needs to consider challenges of indirect land use change and implications for real C emission avoidance (see chapter 3, p 167 l37-45. AR5 (WG3, Ch 11, annex) concluded that difficult to accout for iLUC; unless this has changed, need to reflect here. [David Cooper, Canada]	Taken into account - within space constraints the discussion of the carbon intensity of bioenergy in general and iluc in particular has been expanded. (Section has been moved to section 4.3.1.2)
12252	21	53	21	53	Well, someone had better tell the modellers then as, in chapter 2, they are assuming a lot more bioenergy than this….(and even more in 2100). Again, no joined up or coherent approach between chapter 2 and chapter 4. This is a particular problem given we are dealing with such a controversial subject as bioenergy, for which the IAMs have recieved so much criticism. It's crucial that the actual scenarios outlined in Chapter 2 are scrutinised in this chapter. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the discrepancy between scenarios and bottom up assessment of bioenergy potentials has been highlighted. (Section has been moved to section 4.3.1.2)

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12254	21	53	21	53	I think this incorrectly reports the conclusions from the Creutzig et al. 2014 study, which concluded "We estimate the sustainable technical potential as up to 100 EJ: high agreement; 100–300 EJ: medium agreement; above 300 EJ: low agreement." The text woudl be better if it stated something like "there is high agreement that there is at least 100EJ/yr potential in 2050 and low agreement in more than 300EJ/yr." [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - although there are studies that provide higher estimates there are also several studies that consider deployment to be less than 100 EJ. The consensus seems to be around 100 EJ for estimates that do not assume very large increases in yields or radical changes in diets that free up land. The bioenergy potentials are further discussed in section 4.3.7.1 (BECCS) on the basis of a systematic review. Combined with 16480 (Section has been moved to section 4.3.1.2)
12256	21	53	22	8	This is a partial and very limited discussion of a key issue for land and agriculture. Almost all IAM pathways, with or without BECCS, indicate a need to scale up bioenergy production significantly to 2050 to meet 1.5C and 2C pathways. Bio-based feedstocks are also important non-energy options in production and construction, as mentioned on page 29 lines 49-51. I suggest it is important to state this explicitly in the paragraph. I agree with the text that there are important uncertainties/risks, but at the moment it gives the impression that this is very uncecrtain and something of an optional extra in meeting 1.5C, which I think underplays the availability of literature and the importance of bioenergy in pathways. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the role of bioenergy in IAMs has been made explicit and compared with the bottom-up literature. This section is now discussed under energy system transitions and due to space constraints we limit the discussion to bioenergy and not bio-based feedstocks in production or construction. The discussion of bioenergy is also taken up in section 4.3.7.1 (BECCS) (Section has been moved to section 4.3.1.2)
14064	21	53	22	8	Why is bioenergy included in the agriculture section? This shows limited understanding of the technologies that include conversion of wood and food processing residues and forest residues, sewage and landfill gas plants, biogas from various organic sources etc. Suggest Bioenergy is more important than as presented and needs a separate section. Two references don't lead to "high agreement" the biomass potential is 100 EJ/yr. IPCC's role is to carefully assess the literature. The Creutzig paper states: "the sustainable technical potential is up to 100 EJ: high agreement; 100–300 EJ: medium agreement; above 300 EJ: low agreement" which implies there is low agreement that more than 300 EJ/yr can be supplied sustainably. This should replace existing text. [Ralph Sims, New Zealand]	Noted - Bioenergy is now discussed under energy system transitions and more space has been allocated to a proper discussion of its potential and risks. Although there are studies that provide higher estimates there are also several studies that consider deployment to be less than 100 EJ. The consensus seems to be around 100 EJ for estimates that do not assume very large increases in yields or radical changes in diets that free up land. The bioenergy potentials are further discussed in section 4.3.7.1 (BECCS) on the basis of a systematic review. Combined with 16480 (Section has been moved to section 4.3.1.2)
16480	21	53	21	54	This sentence misquotes these papers and is misleading. It would be correct to say that Creutzig et al estimate the sustainable technical potential as up to 100 EJ: high agreement; 100–300 EJ: medium agreement; above 300 EJ: low agreement. Note also that this should NOT be interpreted as that there is high agreement that sustainable technical potential is <300 EJ/yr; rather it should be interpreted as that there is low agreement that more than 300 EJ/yr can be supplied sustainably. And low agreement means that 50% may say yes and 50% may say no. Also, note that "above 300 EJ" covers 301 to > 1000 EJ/yr. [Australia]	Taken into account - although there are studies that provide higher estimates there are also several studies that consider deployment to be less than 100 EJ. The consensus seems to be around 100 EJ for estimates that do not assume very large increases in yields or radical changes in diets that free up land. The bioenergy potentials are further discussed in section 4.3.7.1 (BECCS) on the basis of a systematic review. Combined with 12254 (Section has been moved to section 4.3.1.2)
19736	21	53	22	8	The bioenergy paragraph gives the impression of a large consent that 100 EJ. Yr-1 can be sustainably produced. However, as the paragraph also indicates, the potential depends on a variety of uncertain factors and bioenergy competes with essential ecosystem services like food production. Hence, it should be questioned more strongly, if bioenergy production on this scales is "sustainable" and "feasable and aligned" with the SDGs. In particular, the sentence in the end, "it has been proposed that large-scale bioenergy production is feasible and aligned with the global SDG agenda", is not a fair representation of the study quoted as a reference for the claim (Humpenöder et al., 2017). [Jennifer Morgan, Netherlands]	Accepted - the section has been reframed to more adequately discuss both potentials and associated risks (Section has been moved to section 4.3.1.2)
37406	21	53	22	8	These concerns also include potentially high GHG emissions of sourcing the biomass, in particular in scenarios with very high biomass/bioenergy deployment. Many of the pathways analysed in chapter 2 assume that in 2100 substantially more biomass will be used for bioenergy/BECCS than the entire amount of biomass harvested today for human purposes, including grazing, crops, timber, etc. The feasibility, sustainability implications, and GHG emissions involved in sourcing such enormous amounts of biomass become not really visible in this paragraph. At the very least it should be mentioned that effects of producing biomass for energy and BECCS may not be linear with increasing volume of biomass production, given the inherent limitations of fertile land, available water, etc. but may well grow far overproportionally if certain thresholds are exceeded. See for example, Plevin et al. Journal of Industrial Ecology on the limitations of attributional LCA when used to evaluate large-scale programs (Plevin, et al. 2014. Journal of Industrial Ecology 18, 73–83.) [Helmut Haberl, Austria]	Noted - We appreciate the suggestion for this very well-made point, however due to space constraints we could not go into detail here and focused our assessment on 2050. In the revision we have devoted more space to the discussion of side-effects and risks, including the carbon intensity of biomass. In addition, we start the section now by contrasting the deployment levels of chapter 2 pathways with what is generally agreed to be sustainably available in terms of biomass for bioenergy, demonstrating the massive discrepancy between some pathways and the bottom-up literature. Also, more references have been added. (Section has been moved to section 4.3.1.2)
45498	21	53	21	54	This is a crtiical observation. Many conclusions reached earlier about feasibility rest on scenarios that exceed these sustainable potentials by a factor 2-3 [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the discrepancy between scenarios and bottom up assessment of bioenergy potentials has been highlighted. (Section has been moved to section 4.3.1.2)
57862	21	53	21	54	There is some very recent literature assessing sustainable supply of bioenergy through to 2100, which concludes similar numbers to the 2050 estimates – that only low levels of bioenergy could be produced (less than 100 Ej/yr) without significant impacts on food production, water availability and biodiversity. See: Boysen, L.R., Lucht, W. & Gerten, D., 2017. Trade-offs for food production, nature conservation and climate limit the terrestrial carbon dioxide removal potential. Global Change Biology, 23(10), pp.4303–4317. [Kate Dooley, Australia]	Taken into account - the discussion on the sustainability and possible trade-offs of bioenergy has been expanded. The reference has also been incorporated in the discussion of BECCS in Section 4.3.7.1 (Section has been moved to section 4.3.1.2)
60916	21	53	21	55	Is "sustainable" a requirement? "May be" is uncertain. What are the sources of uncertainty? Is 100 EJ more or less than needed for 1.5°C? What assumptions are included in the assessment that sustainable bioenergy is limited to 100 EJ/year by 2050? Does this assume first-generation biofuels using dedicated feedstocks? Or does it also contemplate advanced biofuels and waste feedstocks? [United States of America]	Taken into account - the relevance to a 1.5C consistent pathway has been expanded and the discrepancy between scenarios and assessed sustainable potential has been expanded. There is a wide variety of technologies and assumptions that feed into these assessments. Please see also Section 4.3.7.1 on BECCS. The possible side effects and pressures that wide-scale deployment of bioenergy can create are expanded upon to highlight the importance of considering sustainability constraints. (Section has been moved to section 4.3.1.2)
60918	21	53	22	8	The discussion of bioenergy should be aligned with the discussion on page 2-49. [United States of America]	Accepted - we have linked the discussion more explicitly with findings from Chapter 2. Due to space constraints not all elements of the analysis have been included here. There is further discussion of bioenergy with regards to BECCS in Section 4.3.7.1. (Section has been moved to section 4.3.1.2)
29562	21	54	21	55	Suggest adding in the benginning of second sentence: "If biomass is grown/cultivated for bioenergy productions, bioenergy potential typcially … " (see also comment on term "bioenergy" for Ch 4) [Finland]	Noted - however, we have had to cut this sentence. (Section has been moved to section 4.3.1.2)
33546	21	54			EJ has redundant "." after it (make consistent throughout document) [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
49642	21	55	212	55	insert the role of feed conversion ratios of livestock and livestock systems (Erb et al. 2016, doi10.1038/ncomms11382) [Karlheinz ERB, Austria]	Noted - text was revised
5070	22	2	22	2	Regarding this question of "nutrient constraints", I would think a bit more discussion of this is needed. So, one problem is whether there are enough nutrients to grow one or any other crop (is the land fertile enough), and another issue would be the steady removal of nutrients from a field and dispersal somewhere else (e.g., into waterways and the oceans, etc.). So, is it really not just about nutrient constraints, but about long-term soil fertility (and perhaps the need for ongoig fertilization? I think the long-term problem also merits mention. [Michael MacCracken, United States of America]	Noted - the point is well made and we agree that more discussion would have been helpful, but due to extremely limited space we were unable to go into further detail. (Section has been moved to section 4.3.1.2)
94	22	3	22	6	Hammar, T., Ortiz, C., Stendahl, J., Ahlgren, S. & Hansson, P.-A. (2015). Time-Dynamic Effects on the Global Temperature When Harvesting Logging Residues for Bioenergy. BioEnergy Research 8(4), 1912-1924. [Levihn Fabian, Sweden]	Noted - see comment 93

Comment No	From Page	From Line	To Page	To Line	Comment	Response
95	22	3	22	6	Hammar, T. (2017). Climate Impacts of Woody Biomass Use for Heat and Power Production in Sweden. Diss. [Levihn Fabian, Sweden]	Noted - see comment 93
96	22	3	22	6	Suggested reformulation: "In some regions of the world (for example the case of Brazilian ethanol and Swedish forest industries) where the use of bioenergy is mature and industry is well developed, land transitions can potentially be balanced with food production and biodiversity to enable a global impact on CO2 emissions (Jaiswal et al., 2017; Hammar, 2017)." [Levihn Fabian, Sweden]	Noted - see comment 93
93	22	3	22	6	Nordic forest based bio sector should be added, or "e.g. the case of Brazilian Ethanol" removed. Sweden has a long tradition of sustainable forest management where the present outtake could be substantially increased while still having larger regrowth than outtake. The role of biomass in limiting climate change is found in the following two references: [Levihn Fabian, Sweden]	Rejected - Even though we agree that a regional assessment of biomass sources is important, space constraints have kept us from adding more regional examples. Brazil was kept to make the link to Box 4.7. A further reason is to avoid overlap with the parallel special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (SRCCL), which goes into much more detail with respect to biomass sources. (Section has been moved to section 4.3.1.2)
18588	22	3	22	6	The sentence "In some regions of the world (e.g. the case of Brazilian ethanol) where the use of bioenergy is mature and industry is well developed, land transitions can potentially be balanced with food production and biodiversity to enable a global impact on CO2 emissions" is very arguable. It quotes one source, (Jaiswal et al., 2017), but there is a lot of evidence that challenges the bio-ethanol production in Brazil, considering its trade-offs with biodiversity, deforestation and social impacts (on local communities). The Brazilian example, further developed in Box 4.7 (p.68), should be further developed, presenting also findings from literature much more critical with the Brazilian policy on bio-fuels. Note that this example, presented in very positive terms, could have very negative consequences in terms of policy decision-making. A thesis is presented, but neither the antithesis, nor the synthesis. [Andrea TILCHE, Belgium]	Taken into account. More critical literature on the Brazilian ethanol case is included in Box 4.7 in section 4.4.4.
16482	22	4	22	5	Please re-word, "land transitions can potentially be balanced with food production and biodiversity to enable a global impact on CO2 emissions" makes no sense. [Australia]	Noted. The sentence is marginally reworded but it is not fully clear why the sentence does not make sense. We are trying to convey that there is often a tension between food production, biodiversity and bioenergy, especially when the scale of bioenergy use is such that it exerts a global impact on CO2 emissions.
5072	22	6	22	8	The phrasing here is a bit strange. It seems as if this other reference just had to be added. If the general view is that large-scale bioenergy production is not feasible, make that at least as clear as the apparent objection to that position. [Michael MacCracken, United States of America]	Taken into account - the bioenergy section has been significantly expanded to and more space has been devoted to the issues that affect the feasibility of large scale deployment
10078	22	6	22	8	Large scale bioenergy production could be in alignment with SDG of energy access but not other SDGs related to food, nutrition, and poverty. So trade-offs can't be ignored. These trade-offs limit feasibility of large scale bioenergy in a 1.5c world. [Saudi Arabia]	Accepted - this sentence was removed and instead the trade-offs and possible benefits are explicitly discussed.
51516	22	6	22	8	The assumption and summarisation that large scale bioenergy is aligned with sustainable development agenda with known irreversible and large impacts on food security, forest and biodiversity and emission of black carbon is unfortunate and cannot be argued emaphatically. IPCC should reconsider the consequences and impacts in the long term and short term before advocating for CCS and bioenergy. Social tensions and arising inequity cannot be overlooked. Please refer to "Negative emission technologies: What role in meeting Paris Agreement targets?", European Academies Science Advisory Council, German National Academy of Sciences Leopoldina 2018, where it is argued that advocating blindly for CCS and such technologies would mena that climate change can be fixed with technology and will greatly hamper the will of the countries and companies to go for deeper emission cut. Technology fixes can lead to business as usual since tehcnology is there to fix the rising emission; can be more attractive to developing economcies which aspire growth and development and can lead to serious social strife. [Souparna Lahiri, India]	Taken into account - the discussion of trade-offs was made more explicit and the claim regarding alignment with SDGs was removed. We present a clear statement of benefits and possible synergies as well as risks and negative side-effects based on peer-reviewed literature rather than advocate for any one approach or technology. (Section has been moved to section 4.3.1.2)
57864	22	6	22	8	This is a very unbalanced statement - it has also been proposed that terrestrial carbon dioxide removal is not a viable option for countering unabated GHG emissions (Boysen et al (2017). The limits to global-warming mitigation by terrestrial carbon removal. Earth's Future, 5, doi:10.1002/2016EF000469), and that large-scale BECCs is not aligned with meeting SDGs (Dooley K and Kartha S (2017) Land-based negative emissions: risks for climate mitigation and impacts on sustainable development. Inter. Environ. Agreements, 18(1):79-98. doi.org/10.1007/s10784-017-9382-9). A recently published paper looking at the impact of BECCS on planetary boundaries suggests that "the potential for NEs from dedicated bioenergy plantation is marginal (<0.1 GtC yr?1), and hence relying on BECCS as a key decarbonization strategy should be considered highly risky" Heck, V. et al., 2018. Biomass-based negative emissions difficult to reconcile with planetary boundaries. Nature Climate Change, 10, p.105007. The reference to Humpenoder should be balanced with these other references. [Kate Dooley, Australia]	Taken into account - the claim regarding alignment with the SDGs was removed, as mentioned by the reviewer it is very much contested. Instead discussion was expanded regarding specific trade-offs. Much of the literature suggested was taken up in the discussion of BECCS (section 4.3.7.1). (Section has been moved to section 4.3.1.2)
63236	22	8	22	8	Add: Biomass energy competition for land and freshwater uses and services can be aleviated by considering marine sources of biomass, e.g., as a fuel for BECCS (Hughes et al. 2012), as well as for food and fiber production (Greene et al. 2017). see my additions to chpter 4. Refs: C.H. Greene et al. 2017. Geoengineering, marine microalgae, and climate stabilization in the 21st century Earth's Future 5, doi:10.1002/2016EF000486 . Hughes, A. D., Black, K. D., Campbell, I., Davidson, K., Kelly, M. S., & Stanley, M. S. (2012). Does seaweed offer a solution for bioenergy with biological carbon capture and storage?. Greenhouse Gases: Science and Technology, 2(6), 402-407. [Greg Rau, United States of America]	Noted - This section is now discussed under energy system transitions and due to space constraints we limit the discussion to bioenergy and not bio-based feedstocks in food or fibre. The discussion of bioenergy is also taken up in section 4.3.7.1 (BECCS) and the emergence of marine sources of biomass is noted in table 4.6 in Section 4.3.7. (Section has been moved to section 4.3.1.2)
4540	22	10	22	21	These two paras should possibly include some references to the risks and socio-economic impacts of agricultural biotechnology, and how those may lead to trade-offs between adaptation and other policy objectives. [Florian Rabitz, Lithuania]	Taken into consideration - text revised
28496	22	10	22	10	Please correct: molecular "biological" tools not "biology". [Germany]	Noted. Both Molecular Biology Tools and Molecular Biological Tools are used in the literature
28498	22	10	22	15	The following sentence could help to further substantiate the point: "Potential adaptation benefits of genome editing need to be carefully assessed against other (value-related) aspects and viewpoints, e.g. with regard to access to seeds and potential ecosystem imbalances." This suggestion is based on the statement „Since governance and regulatory decision making involves robust standards of evidence extending from the laboratory to the postcommercial marketplace, developers of genome-edited crops must anticipate significant engagement and investment to address questions of regulators and civil society." in Jeffrey D. Wolt 2017: Chapter Twelve - Safety, Security, and Policy Considerations for Plant Genome Editing. In: Progress in Molecular Biology and Translational Science. Volume 149, 2017, Pages 215-241. https://www.sciencedirect.com/science/article/pii/S1877117317300376. [Germany]	Taken into consideration - these issues were approached in the first draft and taken out due to lack of space. It is now reintroduced
36098	22	10	22	21	Different rules and regulations are in place in different countries for such technologies. The public acceptability of these technologies is an issue. The authors may therefore mention about the regulatory requirements and acceptability for such technologies. [India]	Taken into consideration - text revised

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40442	22	10	22	10	"Such genome editing tools can assist in the adaptation of agriculture to climate change, due to CO2 elevation, drought and flooding" This sentence ignores the many concerns about the health, ecosystemic, cultural and socioeconomic risks of genetic manipulation in agriculture. Confronting views and the precautionary principle must be considered. Uncertainty levels should be stated. See for example Wolfenbarger andPhifer Science 2000 The Ecological Risks and Benefits of Genetically Engineered Plants, 290 (5499): . 2088-2093; and Williamson (1992), Environmental risks from the release of genetically modified organisms (GMOs)–the need for molecular ecology. Molecular Ecology, 1: 3–8. [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account - text revised
54022	22	10	22	14	The whole paragraph should be deleted, as well any ohter similar statement inside the text. New biotechnologies are not as precise as stated. See eg Latham, J, 201, 6https://www.independentsciencenews.org/science-media/gods-red-pencil-crispr-and-the-three-myths-of-precise-genome-editing/ Furthermore, all the other examples are just wishful thinking since those do not exist or have not by any means demostrated that they actually would function as claimed. Biotech agriculture and its high input model is one of the main single factors for the increase of GHG, and there is no reason to believe that this will change in the future. [Elenita Daño, Philippines]	Rejected. A balanced review of the literature does not indicate this.
54494	22	10	22	21	This rhetoric is a lot like that of the Green Revolution. To avoid the technofix blindness, the local context needs to be considered, just as in socio-technical transitions, discussed in previous chapters. [Thomas Thornton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into consideration - text revised
55678	22	10	22	21	section on (new) biotechnologies should be complemented by disucssion on better use of agro-ecological other aprpoaches, ie. nurturing diversity of polliantors and natural enemies of pests and imporving soil fertility to increase agricultural productivity. eg Garibaldi et al (12016) Mutually beneficial pollinator diversity and crop yield outcomes in small and large farms. Science. [David Cooper, Canada]	Noted - unfortunately we cannot go into too much detail and discussions due to the lack of space.
5074	22	12	22	12	Might "can assist" be too strong, especially as "assist" could be small etc. I would think one would say "likely has the potential to moderately assist" or something a bit more qualified than in the text [Michael MacCracken, United States of America]	Taken into account - text revised
54024	22	17		21	delete the whole paragraph as it has no link to reality. As mentioned, high tech, corporate driven agriculture has until now been one of the key threats to the environment, climate, food security and nutrition of the world, taking 75-80 percent of resources while only feeding 30 percent of the global populations. Ref: IPES-Food report Too Big to feed, 2017, http://www.ipes-food.org/images/Reports/Concentration_FullReport.pdf and ETC Group, Who will feed us, 2017, http://www.etcgroup.org/whowillfeedus [Elenita Daño, Philippines]	Noted - however, we have carefully balanced our assessment based on peer-reviewed literature, also highlighting concerns, so we see no need to cut the assessment here.
57344	22	17	22	21	Add confidence statements to this summary. [Hans Poertner, Germany]	Taken into consideration - text revised
28500	22	21	22	21	Please add "and biodiversity" after "natural ecosystems". [Germany]	Taken into consideration, text modified
63238	22	21	22	21	Add: Technlogical innovation in culturing marine and freshwater micro and macro flora has significant potential to expand food, fuel and fiber resources, and could significantly reduce impacts on land and conventional agriculuture refs: C.H. Greene et al. 2017. Geoengineering, marine microalgae, and climate stabilization in the 21st centuryEarth's Future 5, doi:10.1002/2016EF000486 . P. Hawken. 2017. Drawdown. Penguin, New York, pp. 176-180. [Greg Rau, United States of America]	Taken into consideration - text revised
9634	22	24	24	4	In the Chapter 4.3.3.2 Ecosystems and forests, there are some mistmatches between subheadings and their texts. With regard to the section of "Forest management (bold)", there is limited descrption on forest management, and the text focuses on land management, bioenergy, and livestock managment. On the other hand, section "Ecosystem restoration (bold)" disucsses forest management through REDD+. Further, section "Indigenrous knowledge systems (bold)" needs to discuss the relationship between indigineous knowledge systems and ecosystems/forests. [Morita Kanako, Japan]	Noted - text was revised
19738	22	24	22	30	Although the importance of tropical forest regions should be highlighted in the introduction for this sub-chapter, subtropical and boreal forests zones do deliver a significant extend of the climatic services of forest ecosystems in terms of sequestration and storage. [Jennifer Morgan, Netherlands]	Noted
28502	22	24	24	4	Section 4.3.3.2 on Forest and Ecosystems should be restructured and substantially revised. The current subsection headings and their content do not match, and the selection of topics is not comprehensive and the space allocated seems arbitrary. For example, the important work by Griscom et al. is cited for ecosystem restauration (which then spends most of its space on describing REDD+ regimes, which are mostly forestry related), but not under forest management, even though a large part of their database refers to forest restoration. There is a paragraph on livestock management and rangeland ecology in the forestry section, while actual forest management is not treated at all apart from a cursory reflection on certification schemes. Forest and ecosystem based solutions have a high potential for mitigation and adaptation action with substantial co-benefits, and there is a broad literature base. Please revise this section in order to reflect the scientific knowledge more appropriately. [Germany]	Noted - text was revised. Synergies and trade-offs are discussed in detail in Sec 4.5.4 and Supplementary Materials E1 and E2.
37408	22	24	22	51	This part is in principle valid and well-referenced, but I think it should also address possible trade-offs resulting from the well-corroborated fact that raising harvests (shortening harvest cycles) accelerate the C turnover of forest ecosystems and reduce their C stocks per unit area. See e.g. Holtsmark, 2012, Climatic Change, Schulze et al., 2012, GCB Bioenergy, Haberl, 2013, GCB Bioenergy, Pingoud et al., 2018, J Env Manage, vol 210, as well as Erb et al., 2016, Nature GeoScience and Erb et al, 2018, nature [Helmut Haberl, Austria]	Noted
55686	22	24	24	4	section 4.3.3.2-ecosystems and forests. Change title to forests and other ecosystems [David Cooper, Canada]	Accepted
55688	22	24	24	4	section 4.3.3.2-ecosystems and forests. Note large carbon sequestration potential for ecosystem restoration through natural regeneration (Poorter et al, 2016. Biomass resilience of neotropical secondary forests, Nature. Chazdon et al 2016. Carbon sequestration potential of second-growth forest regeneration in the latine American tropics. Science advances e1501639. [David Cooper, Canada]	Noted - text was revised
57346	22	24			Confusing subheading. Are forests not ecosystems? [Hans Poertner, Germany]	Taken into account - text revised
56424	22	24	25	9	As commented on the FOD, it is important that this section should make due reference to published climate change adaptation principles for biodiversity conservation, most notably: Hopkins, J.J., Allison, H.M., Walmsley, C.A., Gaywood, M., Thurgate, G., 2007. Conserving biodiversity in a changing climate: guidance on building capacity to adapt. Defra, London. Huntley, B., 2007. Climatic change and the conservation of European biodiversity: towards the development of adaptation strategies. Convention on the Conservation of European Wildlife and Natural Habitats, Standing Committee 27th meeting, Strasbourg, 26–29 November 2007. Council of Europe, Strasbourg. Mitchell, R.J., Morecroft, M.D., Acreman, M., Crick, H.P.Q., Frost, M., Harley, M., Maclean, I.M.D., Mountford, O., Piper, J., Pontier, H., Rehfisch, M.M., Ross, L.C., Smithers, R.J., Stott, A., Walmsley, C.A., Watts, K., Wilson, E., 2007. England biodiversity strategy — towards adaptation to climate change. Defra. et al., 2007. Smithers, R.J.; Cowan C.; Harley, M.; Hopkins, J.J.; Pontier, H. and Watts, O. (2008) England Biodiversity Strategy: Climate Change Adaptation Principles. Conserving biodiversity in a changing climate. Defra, London. 16pp. https://www.gov.uk/government/publications/england-biodiversity-strategy-climate-change-adaptation-principles ; Heller and Zavaleta, 2009; Mawdsley, J.R., O'Malley, R., Ojima, D., 2009. A review of climate-change adaptation strategies for wildlife management and conservation. Conserv. Biol. 23, 1080–1089. Pettorelli, N., 2012. Climate change as a main driver of ecological research. J. Appl. Ecol. 49, 542–545. [Richard J. Smithers, United Kingdom (of Great Britain and Northern Ireland)]	Noted - no all literature is cited in the chapter, but the most relevant 1.5C options and their feasibility so that readers can find other relevant references. This is due to the limited space

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56426	22	24	25	9	As commented on the FOD, it is important that this section should make due reference to evidence-based decision frameworks that aim to promote integration of climate change adaptation principles into conservation planning by prioritising and targeting relevant actions to increase the adaptive capacity of species, including: Tanner-McAllister et al. 2017. Managing for climate change on protected areas: An adaptive management decision making framework. 204:1, 510–518, https://doi.org/10.1016/j.jenvman.2017.09.038 . Bonebrake et al. 2017, Managing consequences of climate-driven species redistribution requires integration of ecology, conservation and social science. Biological Reviews. DOI: 10.1111/brv.12344. Oliver, T.H.; Smithers, R.J.; Beale, C.M. and Watts, K. 2016, Are existing biodiversity conservation strategies appropriate in a changing climate? Biological Conservation 193, 17-26. Runting et al. 2016, Incorporating climate change into ecosystem service assessments and decisions: a review. Global Change Biology, DOI: 10.1111/gcb.13457. Oliver, T.; Smithers, R.J.; Bailey, S.; Walmsley, C. and Watts, K. (2012) A decision framework for considering climate change adaptation in biodiversity conservation planning. Journal of Applied Ecology 49:6, 1247–1255. CORRIGENDUM: (2015) 52, 538–538. [Richard J. Smithers, United Kingdom (of Great Britain and Northern Ireland)]	Noted - no all literature is cited in the chapter, but the most relevant 1.5C options and their feasibility so that readers can find other relevant references. This is due to the limited space
60920	22	24	22	30	Amazonian forests are not the only forests that play key roles in climate regulation, and not the only tropical forests experiencing high levels of deforestation. Suggest broadening this introductory paragraph. [United States of America]	Not applicable - There is a box (4.3) just on the Amazon
62810	22	24	30		To get a comprehensive picture, what's happenning in the Congo Basin should be considered. This is the second largest sink carbon after the Amazon [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	Noted - text was revised
5076	22	25	22	25	Please clarify if these numbers apply to the land fraction of are global nubers. [Michael MacCracken, United States of America]	Noted, it is presented as terrestrial (land) carbon
18590	22	25	22	25	45% of C should be clarified. Is it C stock? Including soil? [Andrea TILCHE, Belgium]	Noted - text was revised
54730	22	25	22	37	rehabilitating degraded land is appropriately described as a "transformative climate change intervention" and the potential synergies with bioenergy production are also noted. This discussion is limited to forest management but could be expanded to consider agricultural land more broady. The omission here concerns the similar synergies available on the agricultural landscape, inlcuding the potential to restore and optimize degraded wetlands for hydrological (adaptation) and bioenergy, nutrient management and ecosystems services- and moreover the potential to finance such systems as natural infrastructure. key references for this concept are as follows: (1) Berry, Pamela, et al. "An economic assessment of local farm multi-purpose surface water retention systems under future climate uncertainty." Sustainability 9.3 (2017): 456. (2) Berry, Pamela, et al. "An economic assessment of local farm multi-purpose surface water retention systems in a Canadian Prairie setting." Applied Water Science 7.8 (2017): 4461-4478. (3) Berry, P., Yassin, F., Grosshans, R., & Lindenschmidt, K. E. (2017). Surface water retention systems for cattail production as a biofuel. Journal of environmental management, 203, 500-509. (4) Lazurko, Anita, and Henry David Venema. "Financing High Performance Climate Adaptation in Agriculture: Climate Bonds for Multi-Functional Water Harvesting Infrastructure on the Canadian Prairies." Sustainability 9.7 (2017): 1237. [Henry David Venema, Canada]	Noted - text was revised
62170	22	25	22	25	the sentence should precise here if it describes stocks or flux in formation… [Antoine Bonduelle, France]	Noted - text was revised
12258	22	26	22	28	What's the reference for this claim? [United Kingdom (of Great Britain and Northern Ireland)]	Noted - text was revised
36100	22	26	22	30	Examples from other parts of the world are required to substantiate this point on tropical forests. [India]	Noted - unfortunately there is no space to go into details. We use the Amazon because it is the larges tropical forest in the planet.
10568	22	27	22	30	However, the carbon sink of the Amazon appears to be decreasing slowly due to the combined effect of increasing tree mortality and a reduction in net primary productivity. …..'. The example about Amazon does not fit the context well here. [Hong Yang, Switzerland]	Noted. In fact it fits the context due to the size of the Amazon and also to the fact that the mentioned decrease will not modify the share of the Amazon as the higher carbon sink among forests until the middle of the century.
18592	22	27	22	27	Why only the Amazon is mentioned? Tropical forests are disappearing across the globe. [Andrea TILCHE, Belgium]	Noted - unfortunately there is no space to go into details. We use the Amazon because it is the larges tropical forest in the planet.
51518	22	28	22	30	what about large hydros and oil and gas exploration and their impact on Amazonian ecosystem? Main drivers of forest loss is not agriculture as contented by some in Brazil but ladn use change for plantations for pulp and paper industry and soya for beef industry. [Souparna Lahiri, India]	Noted this is discussed on the section about the use of REDD+
4392	22	32	22	51	It seems relevant to highlight the positive benefits of sustainable tropical forest management in avoiding forest degradation and promoting forest regeneration through the use of reduced-impact logging techniques, as reported in the article: "West TAP, Vidal E, Putz, FE. 2014. Forest biomass recovery after conventional and reduced-impact logging in Amazonian Brazil. Forest Ecology and Management 314, 59-63." Reduced-impact logging techniques can also generate co-benefits in terms of biodiversity and avoided carbon emissions as reported in the following meta-analysis: "Putz FE et al. 2012. Sustaining conservation values in selectively logged tropical forests: the attained and the attainable. Conservation Letters 5(4) 296–303. [Thales A. P. West, Brazil]	Noted - Thank you for the suggestions
10570	22	32	22	42	The heading is Forest management, but much of the content under this heading is not directly relevant, for example, overgrazing. [Hong Yang, Switzerland]	Taken into account - text revised
12260	22	32	22	32	Unclear why "Forest management" is stated in bold at the start of this parargaph (and the bolding of terms in section 4.3.3.2 generally is unclear) [United Kingdom (of Great Britain and Northern Ireland)]	Noted - it is a subtitle. This is why it is written in bold face
16484	22	32	22	36	Has there been any consideration as to the impact of the interaction of increased forestation and the anticipated increase in fire frequency and intensity with climate change in many of these ecosystems? Will the anticipated increases in carbon stored in biomass as a result of the indicated activities be negatively countered by the anticipated increase in fire frequency and intensity? [Australia]	Taken into account - a new comment and reference were added.
16486	22	32	22	51	Please re-word and provide evidence to support the claim. Refer to broader range of relevant literature on potential and challenges for forest management (plus afforesation and reforestation) to deliver mitigation. Move discussion on grazing land management to a new section on that topic. The text on certification is important to the chapter but doesn't belong in this section. The last sentence is unclear: does it refer to certification or bioenergy? [Australia]	Noted - this section will be revised on the basis of this and other suggestions.
18594	22	32			The section on Forest management is substandard. The impact on C stocks vs on flows should be distinguished. The management impact on C stocks has been substantial (Erb et al. 2017 Nature volume 553, pages 73–76 (04 January 2018)) and reversing it is a challenge. Certification is too insignificant to be noted, in particular when much more important factors, such as the rush towards bioenergy, are not. [Andrea TILCHE, Belgium]	Noted, unfortunately there is no space for further discussion. The new version of Ch4 has tables with the line of sight in which more references are added so that the reader can access details.
19742	22	32	22	33	It would be good to mention the potential of increasing natural carbon stocks in vegetation and soils globally as a transformative climate change mitigation intervention. Degraded secondary forest add more restoration potential, if the carbon stock is increased through natural forest management (Griscom et al. 2017). [Jennifer Morgan, Netherlands]	Noted - text was revised

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19746	22	32	22	51	For the Forest Management sub-section it must be noted that most of the examples given are linked to agroforestry or restoration of degraded and deforested landscapes. If this chapter wants to address the potential of improved forest management, it should provide positive examples of ecological forest management practices that lead to an increase of natural carbon storage through an increase in standing stock and soil carbon and therefore also to a whole range of improvements in ecosystem services for biodiversity and the socio-ecological context. On secondary forests management the SDG 15.2 also states: "...to assure sustainable forest management of all types of forests" by 2020. [Jennifer Morgan, Netherlands]	Noted - text was revised
28504	22	32	22	36	This paragraph is about landuse change, but not about forest management. Forest management entails regeneration, thinning, harvesting, planning, eventually fertilizing, disturbance prevention, … see also our general comment on section 4.3.3.2 [Germany]	Noted - text was revised
33958	22	32	22	42	We would like to ask whether this paragraph really belongs under the subtitle "forest management". Under such a title we would expect to read about topics such as forest harvesting, replanting and sivilculture and the sustainability concerning these issues. [Norway]	Taken in into consideration - instead of Forest Management, the subtitle became Land Management, so that it can accommodate other issues.
36102	22	32			May consider adding reference to REDD+ in forest management section also. [India]	Accepted: REDD+ is now mentioned as one of the main institutional mechanisms for reduced rates of deforestation , reforestation and forest management.
40444	22	32	22	32	Indigenous and local knowledge and practice for forest management, particularly for tropical forests, can greatly contribute to adaptation-mitigation in forests, nevertheless, it is completely ignore in this section. (See Posey .1985. Indigenous management of tropical forest ecosystems: the case of the Kayapó indians of the Brazilian Amazon Agroforest Syst: 3(2): 139–158, Gadgil, Berkes and Folke .1993. Indigenous Knowledge for Biodiversity Conservation , Vol. 22, No. 2/3, Biodiversity: Ecology, Economics, Policy pp. 151-156; and references therein) [Pedro Alfredo Borges Landaez, Venezuela]	Accepted - text revised (explicit note and references to forestry made, along with recognition of mitigation co-benefits)
49644	22	32	22	36	In a section on "forest management", I miss a discussion of the systemic link between harvest and carbon stocks in forests (or other perennial ecosystems), which is key for the net carbon effects of managment. The body of literature is old and vast, reaching back to Schlamadinger and Marland, sometimes discussed as "carbon dept" or "payback time". In fact, increaseed harvest pressure (even if below increment) accelerate the C turnover of forest ecosystems and reduces C stocks per unit area (Holtsmark, 2012, Climatic Change, Pingoud et al., 2018, J Env Manage, vol 210, Haberl, 2013, GCB Bioenergy, Schulze et al., 2012, GCB Bioenergy, as well as Naudts et al. 2016 science, Erb et al., 2016, Nature GeoScience and Erb et al, 2018, nature The "restoring" discourse is interesting, of course, but does not really relate to forest management at first hand. [Karlheinz ERB, Austria]	Noted - such discussions are not possible due to the lack of space. We have to keep focus on feasibility of options at 1.5C.
57866	22	32	22	36	The potential of agroforestry, which has significant mitigation and adaptation potential should also be highlighted here: Zomer, R. J., Neufeldt, H., Xu, J., Ahrends, A., Bossio, D., Trabucco, A., et al. (2016). Global Tree Cover and Biomass Carbon on Agricultural Land: The contribution of agroforestry to global and national carbon budgets. Scientific Reports, 6, 1–12. http://doi.org/10.1038/srep29987 [Kate Dooley, Australia]	Taken into account - a new section on agroforestry was introduced in the section
60922	22	32	22	33	Consider qualifying statement to include restoration lands not vulnerable to disturbance (see: Anderegg et al., 2015-New 25 Phytologist, 208(3), 674-683, doi:10.1111/nph.13477; Gough et al., 2016- Ecosphere, 7(6), doi:10.1002/ecs2.1375.; Harmon et al., 2011- Journal of Geophysical Research-19 Biogeosciences, 116, doi:10.1029/2010jg001495) [United States of America]	Noted - text was revised
60924	22	32	22	32	As the paragraphs below this subheading include lands other than forests, a more appropriate subheading might be "land management." [United States of America]	Taken into account - text revised
60926	22	32	22	36	This section might benefit from a greater discussion of the mitigation potential of well-managed forests. Several studies have estimated forests to provide around 1/3 of global mitigation potential pre-2030. [United States of America]	Noted - will check
12262	22	35	22	36	So sustainable bioenergy is possible, what lessons can be drawn from this example and how could they be applied elsewhere? An important point and needs the implications drawing out. Also, possibly worth mentioning the work of the Global Partnership on Forest Landscape restoration? [United Kingdom (of Great Britain and Northern Ireland)]	Noted - Thank you for the suggestions
55076	22	35	22	36	Can the author describe this methodol for Atlantic Fores restoration? [Yamide Dagnet, United States of America]	Rejected - unfortunately there is no space for such a detailed, but a reference is provided so that the reader will be able to follow the literature and find out about the methodology used.
924	22	38	22	38	use of fire regimes in savannah' does the use of fire regimes reduce greenhouse gases, and if so, how? [Robert Shapiro, United States of America]	Noted - text was revised
12264	22	38	22	42	What does this have to do with forest management? In addition how does this all relate to the fundamental need to reduce animal protein consumption? What's the balance for GHG reduction? [United Kingdom (of Great Britain and Northern Ireland)]	Noted - text was revised
16488	22	38	22	39	We do no understand what this sentence is trying to say. [Australia]	Noted - text was revised
28506	22	38	22	42	This paragraph does not concern FOREST management, please delete here. See also our general comment on section 4.3.3.2 [Germany]	Noted - text was revised
51520	22	41	23	4	Several citations on REDD+ have been referred to in the review of chapter 5. To this date, REDD+ has not been able to demonstrate what it preaches; on the contrary there are enough reports to point out serious human rights violations in Africa and South America. For REDD+ to succeed, decentralised forest governance down to the community level is needed with secured tenurial rights and rights over community resources. But, if the IPs and local forest communities secure community rights, tenurail rights and rights to community forest/resource governance, then REDD+ will not be neede for sustainabe forest management and conservation and sequetration of CO2. The communities themselves will able to reduce deforestation and degradation. But, this co-benefit scenario will not involve fund and finance and therefore, is not being agressively campaigned by all concerned including country governments. In short, sustainable forest management and reducing deforestation and degradation needs decentralised forest management [Souparna Lahiri, India]	Noted - text was revised
12266	22	44	22	51	What does this have to do with forest management specifically? Are all these studies of forestry certification? [United Kingdom (of Great Britain and Northern Ireland)]	Noted - text was revised
28508	22	44	22	44	It is not fully clear what is meant by "certification" in this context and how it contributes to increasing yields, income and capital. Please specify. [Germany]	Noted - text was revised
28510	22	44	22	51	We assume that "Certificates" in this context refer to external audits to show the currently applied management is in accordance with a set sustainability targets. Lands not under such a certificate must not be managed in a poorer way, so "certificates" are only a weak proxy for a specific quality in management, but not necessarily for mitigation. Please revise. [Germany]	Noted - text was revised
60928	22	44	22	51	The discussion of certification seems misplaced here, as it is not connected to any specific crop nor any specific management practice. The second half of the paragraph seems to be focused on bioenergy, but this is not fully clear. Suggest redrafting the paragraph for focus and clarity, or deleting. [United States of America]	Noted - text was revised

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17738	22	53	22	55	The chapter 4.3.3.1 mentioned. "In wetland ecosystems, temperature rise has direct and irreversible first order impacts on species functioning and distribution, ecosystem equilibrium and services, and second order impacts on local livelihoods (see Chapter 3)." However, we may need add something more like "Also, the structure and function of wetland system itself is changing due to the climate change. [Republic of Korea]	Taken into account - text revised
33960	22	53	22	55	Ecosystem equilibrium can be interpreted as a vague term. Does it mean "ecosystem condition", "ecosystem integrity" or "ecosystem function" in this case? Please consider to use more clear terms. [Norway]	Noted - text was revised
32260	23				what do the authors mean by "colonisation" here? [Jamaica]	Noted - indigenous knowledge has been transferred to Section 4.3.5
53582	23		23		Links between indegenous knowledge systems and ecosystem restoration would be useful. [Sumetee Pahwa Gajjar, India]	Accepted - text revision made
60930	23	8	23	9	Where a claim is made that policies are not effective, it would be helpful to expand on this so that the larger lesson can be evaluated and conveyed. [United States of America]	Noted
63240	23	12	23	12	I can't believe your guys completely ignored 70% of the Earth's surface! Are there any marine scientists on this report?? Please add a section here like this: Oceans. Ocean biota and non-living organic matter comprise about 700GT C and marine photsynthesis consumes assilimates 180 GT of CO2/yr (IPCC AR5 WG1 capter 6. Under aquaculuture the areal productivity can be dramaticlly increased to densities that can be 10X greater than that of conventional agriculture and without the need for freshwater. It therefore follows that policies that seek to attain both climate and sustainable developement goals as described in this report should not ignore the vast (70% of the Earth surface) and largely untapped potential contribution the marine-based methods could make in achieving climate and sustainable development goals (Rau 2014, Keller 2018). refs: Keller, D. 2018. Marine Climate Engineering. in: M. Salomon, T. Markus (eds.), Handbook on Marine Environment Protection, Chapter 13. Springer International, Cham, Switzerland. https://doi.org/10.1007/978-3-319-60156-4_13 . Rau, G.H. 2014. Enhancing the Ocean's Role in CO2 Mitigation, in B Freedman (ed.), Global Environmental Change Handbook of Global Environmental Pollution, Volume 1, Springer, Dordrecht, pp 817-824. [Greg Rau, United States of America]	Taken into account - Oceans became a placeholder due to pressure of time to finish SOD. There is a new a section on Coastal transitions in the new version.
1294	23	13	23	13	If a particular indigenous group is not referenced, I don't think that "indigenous" should be capitalized in this section. [Elizabeth Aldrich, United States of America]	Accepted - the word is not capitalised throughout the chapter and report
3770	23	13	23	29	Indigenous knowledge systems are valuable for the hypotheses they can help generate on (the effects of) climate change in a given ecosystem given the local indigenous land use– but are these traditional ways of life not inherently inefficient (e.g. in their use of local resources, the level of welfare & the number of people sustained by the local land use system) as compared to modern life, and therefore an obstacle rather than helpful for global sustainability and climate control? What is their contribution to mitigating climate change for context other than the simple indigenous life? [Marcel Wissenburg, Netherlands]	Rejected - not supported by the scientific literature
5078	23	13	23	29	Very nicely written section with good use of phrases from the confidence lexicon. It would be nice if the other parts of chapter could be doing this. [Michael MacCracken, United States of America]	Noted
5644	23	13	23	29	As before, I think the contribution of indigenous people is far larger. And indigenous peoples are not just knowledge providers but also need to be able to be part of the decisionmaking for their futures and for the territories they are traditionally guarding. [Marion Grau, Norway]	Accepted - text revision (added in a sentence to note these points, and emphasize the importance of Indigenous leadership in decision making)
33548	23	13			indigenous should not be capitalised when not at the start of a sentence. Here and some other places in this chapter (e.g. first para on next page). [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the word is not capitalised throughout the chapter and report
33962	23	13	23	29	We think the contribution of indigenous people is larger. Indigenous peoples are not just knowledge providers but also need to be able to be part of the decision-making for their futures and for the territories they are traditionally guarding. [Norway]	Accepted - text revision (added in a sentence to note these points, and emphasize the importance of Indigenous leadership in decision making)
40446	23	13	23	13	Indigenous knowledge is mostly treated a as an isolated issue among others, but it is a cross-cutting issue whose role and relevance need to be addressed as a dimension of many other issues. There is abundant literature on the issue. (See Ford et al (2016) "Including indigenous knowledge and experience in IPCC assessment reports", Nature Climate Change volume 6, pages 349–353; an references therein.) [Pedro Alfredo Borges Landaez, Venezuela]	Accepted - text revision (this section has not been moved to section 4.3.5 on cross-cutting adaptations)
45500	23	13	23	20	Nothing wrong, but as with other subsections how much is 1.5 relevant? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted - indigenous knowledge has been transferred to Section 4.3.5
52092	23	13	23	20	This paragraph is not clear. What are you trying to say here? Is this mitigation or adaptation? [Jason Donev, Canada]	Noted - indigenous knowledge has been transferred to Section 4.3.5
40392	23	13	23	29	This part of the chapter should emphasize that Traditional knowledge systems of indigenous peoples are strongly based on an inter-generational ethics –and their ecological ethics (deep ecology)– under the ancestral principle of «guardianship of Earth». In addition, the ancestral systems of astronomical observation (cultural astronomy) are fundamental to achieve preventive readings of time and climate, which allow a more sophisticated management of traditional agricultural landscapes in scenarios of high climatic variability. To deepen in this regard, see: Pajares G., Erick et al. «Relational knowledge systems and their impact on management of mountain ecosystems: Approaches to understanding the motivations and expectations of traditional farmers in the maintenance of biodiversity zones in the Andes». Management of Environmental Quality: An International Journal, Vol. 22 Iss: 2. London (UK): Emerald Group Publishing Limited, 2011, pp. 213-232. Available on: http://www.academia.edu/3368382/Relational_knowledge_systems_and_their_impact_on_management_of_mountain_ecosystems_Approaches_to_understanding_the_motivations_and_expectations_of_traditional_farmers_in_the_maintenance_of_biodiversity_zones_in_the_Andes [Erick Pajares, Peru]	Noted - we have added more text on Indigenous knowledge
57348	23	13	23	29	What about the relevance of ILK for mitigation and transformation in the 1.5 context? [Hans Poertner, Germany]	Accepted - reference to mitigation also added to text
54496	23	13	23	29	It is important to stress that Indigenous knowledge is not only critical for future adaptation but has been vital to past adaptation, and that local and Indignous knowledge and practices are often illegible (J. Scott, Seeing Like a State) to States and and thus undermined by 'modernist projects.' There is a danger of doing this too in the context of adaptation. It is not just a question of assembling knowledge but finding ways to understand it in both a local and cross-cultural context as well as in supporting practices (often livelihood activities such as hunting and gathering) that contribute to the build up of cummulative knowledge about present environment changes that can be interpreted (co-interpreted) in the context of other knowledge (including Science). In the contex of adaptation Thornton and Manasfi (2010; see also Phyala, et al 2017) have suggested a basic framework for how to do this, including arctic examples. Without a clear framework for engagement it is easy for knowledge 'assembling' to become just another 'colonial' enterprise of knowledge extraction (on narrow terms). [Thomas Thornton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: text and reference added

Comment No	From Page	From Line	To Page	To Line	Comment	Response
55078	23	13	23	20	The issue of Indigenous Knowledge is not just inherent to Ecosystems and Forests. It is a cross-cutting issue. It would be best to create a section: "overarching consderations" that would include "Indigenous knowledge", governance issues, lans use rights/addressing land grabbing issue. The issue of land use rights and land grabbing are not mentioned at all in this report, and should be. A WRI report, Climate Benefits, Tenure Costs The Economic Case For Securing Indigenous Land Rights in the Amazon, offers evidence that the modest investments needed to secure land rights for indigenous communities will generate billions in returns—economically, socially and environmentally—for local communities and the world's changing climate. The report, Climate Benefits, Tenure Costs: The Economic Case for Securing Indigenous Land Rights, quantifies for the first time the economic value of securing land rights for the communities who live in and protect forests, with a focus on Colombia, Brazil, and Bolivia. See https://www.wri.org/sites/default/files/Climate_Benefits_Tenure_Costs.pdf [Yamide Dagnet, United States of America]	Accepted - text revision (this section has not been moved to section 4.3.5 on cross-cutting adaptations. Reference is also made to land grabbing and land rights)
29756	23	31	23	34	A recent study by Dooley and Kartha (https://doi.org/10.1007/s10784-017-9382-9) assess the potential of differend CDR options against potential trade-offs with the SDGs. They suggest that, if constrained by such considerations, ecosystem restoration may be among the most important options for CDR over the 21th century. It is thus perhaps worth bringing attention to the fact that this option yilds an especially high potential for positive co-benefits and lower risk of negative trade-offs than do some other CDR options. [Bård Lahn, Norway]	Noted - CDR is in another section
17740	23	31	24	4	The concept of adaptive management is being applied as a long-term management plan of ecosystem over the world. For example, Comprehensive Everglades Restoration Plan(CERP)(Florida, US) is describing the adaptive management. Therefore, we may need explain for the adaptive management for ecosystem restoration and so we can cite the work of Mori et. al, like As a strategy for climate change adaptation in ecosystem management, it suggest the encouraging species migration, expanding genetic diversity, protecting refugia, envisioning the emergence of novel ecosystems, and implementation of adatative management(Mori et al. 2013).' [Mori, A. S., T. A. Spies, K. Sudmeier-Rieux, and A. Andrade. 2013. "Reframing Ecosystem Management in the era of Climate Change: Issues and Knowledge from Forests." Biological Conservation. 165: 115-127.] [Republic of Korea]	Taken into account - due to space constraints, we focused only on post-AR5 and 1.5°C-specific literature.
33964	23	31	24	4	There is much focus on REDD+ in this section. Please consider if the content is properly balanced. [Norway]	Accepted - text has been rebalanced.
39238	23	31	23	39	Please ensure this is highlighted in your summary. [Lindsey Cook, Germany]	Noted
57872	23	31	23	39	Griscom et al (2017) do not include forest ecosystem restoration in their analysis, which has significant mitigation and adaptation potential, through the sequestration potential of allowing degraded forests to recover and the increase in forest resilience and biodiversity providing significant adaptive benefits. The following reference should be included to highlight forest restoration, which is left out of the Griscom analysis: Houghton et al (2015) A role for tropical forests in stabilizing atmospheric CO2, Nature Climate Change, 5:1022-1023. [Kate Dooley, Australia]	Noted - text was revised
60932	23	31	23	55	This section is directly related to the substance included under "forest management (page 22, lines 32-26); these subsections might be combined for better reading and ease of analysis. [United States of America]	Noted - text was revised
63242	23	31	24	4	Ecosystem restoration - not one mention of restoring marine ecosystems?! Corals? Fisheries? e.g., Bayraktarov, E., Saunders, M. I., Abdullah, S., Mills, M., Beher, J., Possingham, H. P., Mumby, P. J. and Lovelock, C. E. (2016), The cost and feasibility of marine coastal restoration. Ecol Appl, 26: 1055–1074. doi:10.1890/15-1077. Goreau, Thomas J. and Robert Kent Trench. 2013. Innovative Methods of Marine Ecosystem Restoration.CRC Press, Boca Raton, FL. [Greg Rau, United States of America]	Accepted - a subsection on restoration of coastal ecosystems and fisheries has been added and the reference has been incorporated in the new text.
56056	23	34	23	34	Additional citation for considering ecosystem restoration: Kartha Sivan & Dooley Kate (2016) The risks of relying on tomorrow's 'negative emissions' to guide today's mitigation action. Stockholm Environment Institute WORKING PAPER NO. 2016-08. https://www.sei-international.org/mediamanager/documents/Publications/Climate/SEI-WP-2016-08-Negativeemissions.pdf [Kelly Stone, United States of America]	Noted
12268	23	36	23	36	What's the reference for this claim? Griscom et al? Additionally, are the mitigation measures within Griscom et al represented in IAMs? If not, then it would be helpful to highlight this point (here and in the IAM discussion in chapter 2 (2.6.1) [United Kingdom (of Great Britain and Northern Ireland)]	Noted - text was revised
54444	23	36	23	39	Suggest changing wording regarding cost-effectiveness of restoration appraoches to reflect the large uncertainty expressed in Griscom et al (2017). In particular, wording such as "more than a third of cost-effective CO2 mitigation needed through 2030" needs to be modified to ensure the limitations of the economic modelling pursued in this study are clear (e.g. starting at $100/ton CO2 immediately in a world with substantially lower carbon prices, the lack of available marginal abatement curves, preferentially scaling up such options while delaying energy-based mitigation). In addition it should be clarified that saturation effects limit the potential of such approaches to much lower than 1/3 in the longer term (Griscom estimates 12% by 2050 at a similar $100/ton cost-effectiveness cut-off). Finally, a reference to the problem of potential impermanence of sequestration options shoudl be added to this section, with reference to Cross-chapter Box 3.1. [Christopher Weber, United States of America]	Noted - text was revised
60934	23	36	23	36	More than a third of the cost-effective CO2 mitigation needed through 2030 can be met with these activities. This is a strong claim that should be more clearly sourced and elaborated (e.g., what is the threshold used to define cost-effective mitigation)? If defensible, it should be featured more prominently in the chapter summary and the SPM. [United States of America]	Noted - text was revised
33550	23	37			The way this is worded is confusing. It makes it seems like cross-biome leakage would reduce the cost. I understand how it could reduce the potential and the co-benefits, but I'm not sure how it would reduce the cost. [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Noted - indigenous knowledge has been transferred to Section 4.3.5
33966	23	37	23	39	This sentence is somewhat difficult to understand. Please consider to rephrase for readability and clarity. [Norway]	Noted - text was revised
5080	23	39	23	39	Need a comma before "depending" [Michael MacCracken, United States of America]	Taken into account - text revised
9638	23	41	23	42	Explanation of REDD+ in Chapter 4 and Chapter 5 is different. They need consistency. Chapter 4 "Reducing Emissions from Deforestation, forest Degradation, and other forest-related activities (REDD+)" Chapter 5 "REDD+ (Reducing Emissions from Deforestation and Forest Degradation)" [Morita Kanako, Japan]	Accepted - we have adopted the definition used in Chapter 5.
33552	23	41	23	42	Probably best to stick to the formal UNFCCC language: Reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - we have adopted the definition used in Chapter 5.
40448	23	41	23	41	As there are positive views on REDD+ there are also a great deal of well supported concerns. Both views should be mentioned in this section. (See Bastakoti and Davidsen (2017) "Optimism, Hopes and Fears: Local Perceptions of REDD+ in Nepalese Community Forests", International Forestry Review, Vol. 19(1) 1- 16; and reference therein.) [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account - even though we didn't have the space to go into sub-regional assessments, we have balanced the section better and give due consideration to the concerns mentioned in the peer-reviewed literature

Comment No	From Page	From Line	To Page	To Line	Comment	Response
49706	23	41	24	4	the focus on REDD+ for restoration is very limited and may not reflect poltiical reality, where the issues is pursued in multiple governance venues, from private deforestation-free supply chain commitments to regional initiatives, like AFR100 (Pistorius&Freiberg 2014, Brancalion et al, 2016). Many of the countries engaged already in restoration are far from "ready" for REDD or are not even eligible (e.g. USA). Still restoration activities may an important activity in NDCs not only for developing countries but also to achieve other committments under the CBD Aichi Targets , the SDGs or voluntary declarations (e.g. New York Declaration on Forests). Particularly since REDD+ is so complicated and expensive it is much more likely that restoration is pursued beyond REDD+.This may be politically more feasible and easier to implement, e.g. on the basis of traditional multi-or bilateral ODA (without burdensome MRV). Although this too may bring problems (e.g. coherence, safeguards for biodiversity or human rights) it also discursively dissect FLR from the prior reputational flaws of afforestation (A/R) or REDD+ (see on A/R: Razak et al. 2009; Bäckstrand & Lövbrand 2006; on REDD+: Bastakoti et al. 2017; DiGregorio et al 2013). References: Pistorius, T.; Kiff, L. (2017). From a biodiversity perspective: risks, trade-offs, and international guidance for Forest Landscape Restoration. Freiburg, Unique; Pistorius, T. and Freiberg, H., 2014. From Target to Implementation: Perspectives for the International Governance of Forest Landscape Restoration. Forests, 5 (3), 482–497; or: Brancalion, P. H. S., Pinto, S. R., Pugliese, L., Padovezi, A., Rodrigues, R. R., Calmon, M., Mesquita, B. (2016). Governance innovations from a multi-stakeholder coalition to implement large-scale Forest Restoration in Brazil. World Development Perspectives, 3, 15–17; Razak, S. A., Son, Y., Lee, W.-K., Cho, Y., and Noh, N. J. Afforestation and reforestation with the clean development mechanism: Potentials, problems, and future directions. Forest Science and Technology, 2009, 5 (2), 45–56; Bäckstrand, K., & Lövbrand, E. Planting Trees to Mitigate Climate Change: Contested Discourses of Ecological Modernization, Green Governmentality and Civic Environmentalism. Global Environmental Politics, 2006 (1: February), 50–75; Bastakoti, Rishi R., Davidsen, Conny: Framing REDD+ at National Level: Actors and Discourse around Nepal's Policy Debate. Forests 2017, 8(3), 57; Di Gregorio, M., M. Brockhaus, T. Cronin, E. Muharrom, L. Santoso, S. Mardiah, and M. Büdenbender. 2013. Equity and REDD+ in the media: a comparative analysis of policy discourses. Ecology and Society 18(2): 39. [Sabine Reinecke, Germany]	Taken into account - we only refer to REDD+ now as a potential institutional mechanism for reducing rates of deforestation and explicitly also mention forest management and restoration as well. More space has been allocated to the assessment of restoration in this section, while the potentials, costs an side effects of afforestation and reforestation are assessed in 4.3.7.
60936	23	41	23	48	The discussion of REDD+ is very sparse given its potential importance for reducing AFOLU emissions and the significant reductions in AFOLU emissions (essentially to net zero by ~2030) in the Chapter 2 pathways. This should be significantly expanded and more quantitative analysis should be provided. No basis is provided for the claim that "REDD+ has a relatively high cost," and indeed the cost of REDD+ is likely lower than many alternatives. See, e.g., the comment on p. 4-38, line 43, that unit costs for afforestation and reforestation (part of the + in REDD+) "are estimated to be low compared to other CDR options" at 18-29 USD/ton CO2eq." In short, this discussion is very weak relative to the importance of the issue for the 1.5°C pathways. [United States of America]	Noted - text was revised
33554	23	44	23	45	Suggest moving the sentence "There is low agreement on whether climate impacts will reverse mitigation benefits of REDD+ (Le Page et al., 2013) or reinforce them through carbon fertilisation (Smith et al., 2014b)." to the end of the paragraph (after "…slow.") [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Noted - text was revised
55690	23	44	23	45	low agremeemt… wther cliamte imopacts wil reverse benefits … or reinforce them. This statement is not clear. Perhaps it is referrig to separate phenomena that affect net C sequestration: C fertilization; deforestation; forest degradation; cliamte-induced forest dieback ..... May need to unpack these. Note that thresholds for these phenomena may vary. Note also potential for virtuous circle: rapid net GHG reductions, with Ecosystem-based approaches (mature CDR measure) playing a significant role, especially in early stages, limiting temperature increase, thereby increasing ecosystem resilience and permanence. (Contrast with viscous circle of weak mitigation, temp exceeding threhsolds, ecosystem breakdown contriuting to further (possibly runaway) climate change). [David Cooper, Canada]	Noted - text was revised
13166	23	46	23	46	Delete the text ", beyond carbon pricing". [Eleni Kaditi, Austria]	Not applicable - that part of the text has been removed due to shortening.
33556	23	46			"projects" is not clear enough - better is "REDD+ pilot projects and REDD+ programmes." [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - We no longer refer to REDD+ projects in the main text, but the reference is still used in the table.
4384	23	47	23	48	While REDD+ implementation is slow, multiple countries are quite advanced in the development of their national REDD+ programs, which could boost on-the-ground implementation of REDD+ in the near future. [Thales A. P. West, Brazil]	Accepted - text was modified to reflect this.
7742	23	47	23	48	No doubt some REDD+ "has a relatively high cost," but some proven kinds are instead highly profitable and hence rapidly expanding, already through the millions-of-ha scale: please see my FOD comments on 4–35:33–42. [Amory Lovins, United States of America]	Accepted - this has been removed
9636	23	47	23	48	REDD+ has a relatively high cost and its implementation is slow needs references. [Morita Kanako, Japan]	Accepted - this has been removed
17742	23	47	23	48	It seems to be necessary adding the sentence "It is also insufficient to design a scheme that allows capital input by the private sector"(Morita and Matsumoto, 2018). It is important to mention the role of the private sector in becoming a 1.5 ? world. [Republic of Korea]	Taken into account
31526	23	47	23	47	We suggest the inclusion of reference to existing research(es) for the "REDD+ has relatively high cost," as has been done in earlier parts of the sentence. [Japan]	Accepted - this has been removed
33558	23	47			what is the evidence to support "REDD+ has a relatively high cost". Unless this can be cited or qualified, I think this is generally incorrect. Relative to many interventions, reducing emissions from deforestation is considered to be a cheaper option by many. Interventions like reforestation/restoration would incur a higher cost (though Panel A of Fig 4.3 suggests it won't be too high). [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - this was a mistake that has been removed in the new version.
55692	23	47	23	48	REDD+ has a relatively high costs and its implementation is slow. This is an unreferenced statement. Relative to what? Griscom et al 2017 note that avoided deforestation is low cost and rapid. [David Cooper, Canada]	Accepted - this has been removed
60938	23	47	23	48	Yet, REDD+ has a relatively high cost and its implementation is slow. What is this assessment based on, and how was it assessed? The cost is considered high relative to what? And do results assessed include the improvements in governance, development of monitoring systems, establishment of policies, etc., that have occurred? Suggest including citations and definitions, or deleting. [United States of America]	Accepted - this has been removed
16490	23	51	23	52	There is no evidence to suggest that changes to the current global REDD+ institutional structure is a pre-condition to successful achievement of the commitments of the Paris Agreement, including in the paper referenced (Well and Carrapatoso, 2016) which makes a case for improved institutional coordination but does not suggest that Paris Agreement goals will not be reached if this does not occur. The assessment that current international institutional arrangements for REDD+ are a chief constraint to feasibility is contested. The first sentence of this paragraph should be revised to avoid the suggestion that this is a consensus. Suggested revision: Implementation of REDD+ can be complex, with various domestic and international factors constraining countries' efforts. [Australia]	Accepted - has been rephrased to "Strengthening coordination, additional funding sources, and access and disbursement points increase the potential of REDD+ in working towards 2°C and 1.5°C targets (Well and Carrapatoso, 2016)." We also add more literature on concerns around implementation.

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60940	23	51	23	55	This text assumes a prescriptive-policy direction which is not agreed, and should be deleted. There is no widespread agreement on any need for changes or additions to institutional architecture or governance regimes related to REDD+. "To meet the commitments of the Paris Agreement, the institutional financial architecture of REDD+ will require strengthened coordination, additional funding sources, and access and disbursement points (Well and Carrapatoso, 2016). Emerging regional models offer new perspectives for upscaling, but it remains to be determined which governance regimes need to be fostered for REDD+ to be effective." [United States of America]	Accepted - has been rephrased to "Strengthening coordination, additional funding sources, and access and disbursement points increase the potential of REDD+ in working towards 2°C and 1.5°C targets (Well and Carrapatoso, 2016)." In addition, we already before that clarify "Much of the literature focuses on REDD+ as an institutional mechanism. However, restoration and management activities need not be limited to REDD+ and locally adapted implementation may keep costs low, capitalise on co-benefits and ensure consideration of competing for socio-economic goals (Ellison et al., 2017; Jantke et al., 2016; Perugini et al., 2017; Spencer et al., 2017)."
4386	23	53	23	54	Here "models" refer to the financial architecture of REDD+. However, the use of the word "model" can cause confusion, as it can be associeated with regional simulation model of REDD+, such as in "West et al., 2018, A hybrid optimization-agent-based model of REDD+ payments to small farmers in the old deforestation frontier of the Brazilian Amazon. Environmental Modelling & Software 100, 159-174." Hence, I suggest the word "model" to be replaced in the sentence. [Thales A. P. West, Brazil]	Accepted - the word "model" has been removed.
47148	23	54	23	54	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted
57874	23	55	24	4	There is far stronger evidence than presented here on the role that secure land tenure for indigenous peoples and local communities plays in maintaining secure forest carbon stocks. A recent study estimates that 24% of the total above ground carbon stored in tropical forests globally is held within lands claimed and managed by local communities and indigenous peoples. Further carbon stocks are “located in collective forestlands lacking formal [land title] recognition, placing over 22 GtC [81 GtCO2] at risk from external deforestation.” (Rights and Resources International (2016) Toward a global baseline of carbon storage in collective lands. http://rightsandresources.org/wp-content/ uploads/2016/10/Toward-a-Global-Baseline-of- Carbon-Storage-in-Collective-Lands-November-2016- RRI-WHRC-WRI-report.pdf). This highlights the magnitude of Indigenous Peoples’ and local communities’ contributions to climate change mitigation, underlining the urgent need to make collective tenure security a critical part of national emission reduction strategies. This section should be re-written to reflect this literature, and the strong body of evidence on the importance of secure land tenure for efforts such as REDD+. [Kate Dooley, Australia]	Taken into account - We expanded the land tenure and indigenous people text.
2396	24		29		Uneven treatment of challenges and opportunities associated with informality and growth of informal settlements in various subsections of 4.3. Also important to provide figures related to the existing scale of informality and projected growth in this sector. [Debra Roberts, South Africa]	Accepted. Two sections in 4.3.3 draw on underlying literature on informal settlements, but much of the evidence on responses is in sections on governance and institutional capacity in 4.4. Chapter 5 also has material on this.
17848	24				In the part of Forest, temperate Forest of Mid-Latitude should be also explained.The mid-latitude zone can be broadly defined as part of the hemisphere between 30°–60° latitude. This zone is home to over 50 % of the world population and encompasses about 36 countries throughout the principal region, which host most of the world’s development and poverty related problems. In reviewing some of the past and current major environmental challenges that parts of mid-latitudes are facing, this study sets the context by limiting the scope of midlatitude region to that of Northern hemisphere, specifically between 30°–45° latitudes which is related to the warm temperate zone comprising the Mid-Latitude ecotone – a transition belt between the forest zone and southern dry land territories. The ongoing climate change reveals a substantial increase of temperature and simultaneous decrease in the amount of precipitation across vast continental regions in the mid-latitudes. According to climatic predictions, these tendencies will continue during the 21st century, which will likely increase the frequency and severity of droughts and water stress of vegetation. Along with climate change, ongoing land degradation and deforestation are observed in many regions of the mid-latitude region. For example, the Korean peninsula, which is divided into South and North Korea, is characterized by drastically different forest conditions. Deforestation in North Korea has been exacerbating at a noticeable pace due to excessive logging and human intervention. Such problems are not confined to Korean peninsula but are witnessed across vast regions of the mid-latitude region. Within this context – acquiring better understanding in the role of terrestrial ecosystems located at different latitudes is critical – for building resilience against the negative impact of climate change and for maintaining the stability of the environment and landscapes. Moon, J., Lee, W.K., Song, C., Lee, S.G., Heo, S.B., Shvidenko, A., Kraxner, F., Lamchin, M., Lee, E.J., Zhu, Y., Kim, D., Cui, G. 2017. An introduction to Mid-Latitude ecotone: Sustainability and environmental challenges. Sib. J. For. Sci. N. 6:41-53 [Republic of Korea]	Taken into account - we now mention the "tropical, subtropical, temperate and boreal biomes" in the text. However, due to extreme space restrictions and because we can't have any overlap with the upcoming special report on land, we couldn't go into regional details in the assessment and add more references, though the point raised in valid and well taken.
17850	24				In the part of Restoration, Land Developent Phases can be esplained. To implement appropriate land management strategies, it is essential to identify past and current land cover and land use conditions. In addition, an assessment of land development phases (LDPs) in a human-dominated landscape coupled with an analysis of the water-food-ecosystem(WFE) nexus can deepen our understanding of sustainable land management. In this study, we proposed the concept of land development phases(LDPs) by forestandGDPchangesusingpreviously-applied theoretical and empirical approaches. The positive relationship between GDP growth and forest stock changes was used to analyze the timing of forest stock changes as ?ve-year averages, which were aggregated over 20 years to classify LDPs. In addition, forest area changes compared with GDP and GDP per capita changes were analyzed to identify LDPs. Based on two conceptual approaches, we suggested global land into three LDPs: degradation, restoration and sustainability. Using this approach,most o fEurope ,North America and northeast Asia were classi?ed as sustainability phases, while Africa and Central Asiain the Mid-Latituderegionappearedtohavedegradationorrestoration phases. The LDPs described could be improved with further incorporation of solid data analysis and clear standards, but even at this stage, these LDP classi?cations suggest points for implementing appropriate land management. In addition, indices from comparative analysis of the LDPs with the WFE nexus can be connected with socio-economic global indices, such as the Global Hunger Index, the Food Production Index and the Climate Change Performance Index. The LDPs have the potential to facilitate appropriate land management strategies through integrating WFE nexus and ecosystem services; we propose future research that uses this integration for the Mid-Latitude region and worldwide. Song, C., Kim, S.J., Moon, J., Lee, W.K., Lee, S.J., Kim, N., Wang, S.W., Lee, W.K. 2017. Classification of Global Land Development Phases by Forest and GDP Changes for Appropriate Land Management in the Mid-Latitude. Sustainability 9:1342. [Republic of Korea]	Noted - However, due to extreme space restrictions and because we can't have any overlap with the upcoming special report on land, we couldn't go into regional details in the assessment and add more references, though the point raised in valid and well taken.
10088	24				Section 4.3.4: Most of the literature reported is neither 1.5c specific nor necessarily 1.5c consistent. It is important to note that limitation at the start of the section reasoning that the studies are relevant to informing 1.5c world. [Saudi Arabia]	Noted. This section is about systemic change required to meet the pace and scale of a 1.5C world. The Kennedy paper (and other more recent papers) have been added and is specific to 1.5, but much of the other literature relates to urban systems and accelerated climate responses.
52094	24	3	24	3	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
8240	24	4	24	4	After "which is not often the case for Indigenous communities (Brugnach et al., 2017)." please insert: "The Forest Landscape Restoration Approach seeks to implement REDD+ while at the same time considering other land uses and benefits, thus avoiding leakage, protecting biodiversity, and fostering sustainable development (Bastos et al., 2017; Mansourian et al., 2017; Nielsen, 2016; Pistorius et al., 2017; Weatherley-Singh and Gupta 2017)." References: Bastos Lima, Marion G.; Visseren-Hamakers, Ingrid J.; Braña-Varela, Josefina; Gupta, Aarti (2017): A reality check on the landscape approach to REDD+: Lessons from Latin America. Forest Policy and Economics, 78, p. 10–20. Mansourian, Stephanie; Dudley, Nigel; Vallauri, Daniel (2017): Forest Landscape Restoration: Progress in the Last Decade and Remaining Challenge, Ecological Restoration 35:4, p. 281–288. Nielsen, Tobias D. (2016): From REDD+ forests to green landscapes?: Analyzing the emerging integrated landscape approach discourse in the UNFCCC. Forest Policy and Economics, 73, 177–184. Pistorius, Till; Carodenuto, Sophia; Wathum, Gilbert (2017): Implementing Forest Landscape Restoration in Ethiopia, Forests, 8, 3, p. 61. Weatherley-Singh, Janice; Gupta, Aarti (2017): An ecological landscape approach to REDD + in Madagascar: Promise and limitations?, Forest Policy and Economics, 85, p. 1–9. [Angela Geck, Germany]	Noted - However, due to extreme space restrictions and because we can't have any overlap with the upcoming special report on land, we couldn't and add more references, though the point raised in valid and well taken.
9370	24	7	24	39	Urban energy, transport and communication systems are all criticial infrastructure elements which must be more resilient than previous. Inclusion of concept of critical infrastructure and about 3-4 sentences about its importance would be great. [Attila Buzási, Hungary]	Rejected. Length constraint prohibits the "critical infrastructure" perspective.
10578	24	7	24	39	4.3.4 Urban and infrastructure transitions. The text directly under this subheading should give a clear guidance to the subsequent sub-sections. The current text does not provide this guidance. The subsections below contain some repetitions of the text here. [Hong Yang, Switzerland]	Noted. Text revised to address this.
28512	24	7	28	26	Land conflicts between cities and their hinterland (e.g. afforestation, food security) as well as within cities (e.g. between housing and environmental services for adaptation) should be addressed (esp. in sections in 4.3.4.6 and 4.3.4.7) . Two articles describing the problem and ways to address it: http://www.pnas.org/content/114/34/8939.short https://www.eea.europa.eu/signals/signals-2015/articles/soil-and-climate-change [Germany]	Noted. See reference to city-region, and also Section on multi-level governance in "enabling conditions".
30608	24	7	24	7	Rename: urban, building and infrastructure, because buildings are not only urban. [France]	Accepted. Text changed to "urban buildings, urban infrastructure and appliances"
37032	24	7	24	7	Recommend that you define what is included in urban and infrastructure (or cities). Cities all over the world do include manufacturing facilities and industrial parks. We found that this is especially true in China, where even heavy industry is still located within cities. We found that in 2010 62% of energy-related CO2 emissions in Chinese cities were from industry (Ohshita, S.B., L. Price, N. Zhou, N. Khanna, D. Fridley, and X. Liu. 2015. The Role of Chinese Cities in Greenhouse Gas Emission Reduction. Briefing prepared by the China Energy Group, Lawrence Berkeley National Laboratory, for Stockholm Environment Institute and Bloomberg Philanthropies. September. http://www.bloomberg.org/content/uploads/sites/2/2015/09/LBNL_SEI_China_Final.pdf). [Lynn Price, United States of America]	Noted. The specific citation is interesting but cannot be included at this stage as it is grey literature. This section relates to those urban features that are listed in 4.3.3. Manufacturing and industry are covered elsewhere in this chapter.
60942	24	7	28	32	Why the emphasis on urban environments? Is this a part of the 1.5°C pathways? Is "urbanization" an option that is required to reach 1.5°C? What about rural transitions? Aren't those important too? It seems like rural areas are where it may be harder to mitigate because of a lack of high efficient options (e.g., public transit). [United States of America]	Rejected. This sub-section is explicitly about urban systems, and the rationale for this is explained by way of the massive demographic transition in the global south and associated energy and resource intensity (including proportion of emissions in 2050). Rural issues are dealt with elsewhere.
13966	24	9	24	14	4.3.4 Urban and infrastructure….. This paragraph should probably mention the rate of urbanization as well? [Natalie MAHOWALD, United States of America]	Accepted. Revised text will include reference to rapidly urbanising countries and rates of urbanisation adopted from the "urban box" in Chapter 5.
58330	24	14	24	14	Suggest to add: "Air pollution has become a major political issue in urban areas around the world. Strong synergies exist with GHG reduction actions which can be exploited to improve the political acceptability of climate action (IEA, 2017f World Energy Outlook). [Andrew Prag, France]	Accepted. Text added to reference this overlap and potential to address air pollution and mitigation.
5082	24	16	24	16	Saying "may be untenable" is really far too mild a statement. There is no way to attain a 1.5 C World without including cities--stop using the word "may" and not being forthright about how much must be done. [Michael MacCracken, United States of America]	Noted. This is (for better or for worse) the required, non-prescriptive language of IPCC.
10574	24	16	24	16	The transition to a 1.5°C World should be 1.5C warmer world. [Hong Yang, Switzerland]	Editorial.
48104	24	16	24	16	Change to '1.5 degree world' [Sarah Connors, France]	Editorial.
48108	24	17	24	17	Please check if the reference Villarroel Walker et al., 2014 is relevant for this statement. The paper does not relate to 1.5 C [Sarah Connors, France]	Rejected. The paper does relate to urban systems and the energy-water-food nexus and this section is about systems. The Satterthwaite paper, similarly, does not reference 1.5C but is important to strengthened change.
3296	24	22	24	28	The city development is important for the transition, but the meaning of this paragraph is not clear. Development of city or urbanization will increase the ability to adapt climate change. [Xiu Yang, China]	Accepted. Text amended for clarity.
10576	24	23	24	24	Thomson and Newman (2016) and Fink (2013), equate the building of cities with a form of climate “geoengineering”. ',' should be removed. [Hong Yang, Switzerland]	Accepted. This point remains important but has been worded differently so as to avoid confusion regarding "geo-engineering".
58382	24	26	24	26	Whle very descriptive the phrase "heamorrhage economic opportunity" is confusing. What about "If they do not, cities may amplify both climate and economic risks"? [Peter Marcotullio, United States of America]	Noted. Text revised.
60944	24	26	24	26	The claim that cities will "hemorrhage economic opportunity" is quite dramatic. Is this justified by the cited literature? [United States of America]	Accepted. Text revised to remove the word haemorrhage
46916	24	28	24	28	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Noted. Uncertainty language is not used in this section.
5084	24	30	24	31	I don't understand what "focussing on" means? Does this mean they aer finally viewing this as a coming upper end possibility and so are planning to be able to adapt to 1.5 C warming, or does it mean that they are so worried about warming going much higher than that that they are thinking about getting the increase back down to 1.5 C? Please clarify. [Michael MacCracken, United States of America]	Accepted. Text revised to remove this phrase.
10080	24	30	24	39	No doubt that cities development, particularly in developing countries, represent an import dimension for addressing transition to 1.5c. Yet, an equally important aspect that is missing in the related literature is the consequences of focusing attention on cities leaving behind rural areas and their needs for modern energy access and energy infrastructure development. These development patterns may negatively impact SDGs and induce leakage due to business incentives to relocate to the rural areas scaping the stringent energy regulations in the city. [Saudi Arabia]	Rejected. This section references city regions and other sections of the report pay specific attention to rural issues and rural people.
48106	24	30	24	30	Does the reference 'Calthorpe et al.' refer to 1.5 or INDCs? Please check [Sarah Connors, France]	Noted. Calthorpe citation has been removed to be more specific.
54574	24	30			It would be good to reference to contributions of local and regional governments in the evolution and the implementation of the Paris Agreement. It is also important to acknowledge the grey literature developed by the networks of local and regional governments as the achievements in the UNFCCC negotiations. A possible entry could drafted as below "Voluntary global climate reporting of more than 1000 local and regional governments since 2010, their improved dialogue with climate negotiators and increased collaboration among global networks since 2014 played a key role in the historical recognition of the importance of the engagement of all levels of governments in the Paris Agreement." (References; carbonn Climate Registry 2016-2017 and Basic Guide of Paris Agreement for Local and Subnational Governments, both published by ICLEI - Local Governments for Sustainability) [Yunus Arikan, Germany]	Noted. Reference to NUPs and multi-level governance cover this topic in Section 4.4 (enabling environment). The focus of this report, as a "global assessment", cannot draw out regional specificity. That will be addressed in AR6.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12270	24	35	24	39	The equity dimension may need expanding. Urban areas offer rich possibilities for positive transformational change. But at the moment they are locations of considerable inequality and poverty. Focusing on urban systems without a clear recognition of the dangers of further embedding existing inequality could be very dangerous. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. Text revised to reflect this risk.
60946	24	35	24	37	The statement "The capacity for transformative change in cities can be strengthened where social equity and ecological performance are understood to be mutually enforcing dimensions of urban climate response" appears to be qualitative, relies on conceptual terms, and does not have a strong link to 1.5°C pathways. Do the citations provide quantitative support? The level of uncertainty and precision in use of terms should be spelled out; or revise/delete this sentence. [United States of America]	Rejected. The literature is clear on these linkages.
52096	24	42	25	2	Energy intensity tends to be better in urban rather than rural environments. Modern farming practices have improved the crop density, so having more people in cities is a sign that we'll have fewer children and more effective energy use. This section is not well researched or well thought out. Please review the primary literature on this topic more. [Jason Donev, Canada]	Noted. But not clear what the missing literature or point is. This section is not about agriculture, but is about urban energy intensity. Not clear what "better" means - more or less intense?
40364	24	43			Not all urban economies, there are many inequalities. It would be correct to add "the developed ones" [Jonathan Gómez Cantero, Spain]	Accepted. Text amended to "more energy intensive than national economies"
53142	24	43	25	3	The section is mixing up the role of RE with general clean cooking. Yes, electric stoves are one clean cooking solution, but in cities, LPG is likelier a better option than electricity due to cost and access reasons to replace biomass, such as wood and charcoal. Even though LPG is a fossil fuel, its use results in net climate mitigation benefits b/c of its greater energy intensity. Solar lighting is important to displace kerosene lighting, and it brings a whole host of co-benefits, including reduced fire risk. This section could do a better job of citing the suite of economic co-benefits associated with RE and clean cooking in cities, besides indoor air quality, reduced fire risk, and reduced deforestation. For economic benefits for the urban under-served of RE and clean cooking see: Westphal, M.I., Martin, S., Zhou, L., D. Satterthwaite. 2017. Powering Cities in the Global South: How Energy Access for All Benefits the Economy and the Environment. World Resources Institute, Washington, DC. http://www.wri.org/publication/towards-more-equal-city-powering-cities-global-south [Westphal Michael, United States of America]	Noted. The paper has been added in spite of grey literature as it was recommended in previous round of comments prior to grey literature deadline and is relevant.
62058	24	43	24	49	Is it true in general the decoupling between growth of cities and fossil use? [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Decoupling is happening in select cities as per the citations (Newman 2017; Gao and Newman 2018).
13168	24	45	24	45	Replace "fossils" with "energy use". [Eleni Kaditi, Austria]	Noted. Text changed to fossil fuels.
62172	24	47	24	47	After electric vehicles add "mass transit" because the present change is as much about building and managing collective transport and systems as the replacement of cars. [Antoine Bonduelle, France]	Rejected. The point about EV, modal shifts, urban form and ICT is made elsewhere in this section.
50748	24	49	24	49	District solutions (district heating, local energy networks), in particular combined with renewable energies should be mentioned here, since they contribute to resilient and autonomous energy supply in cities. Literature reference: IRENA (International Renewable Energy Agency) 2017 "RENEWABLE ENERGY IN DISTRICT HEATING AND COOLING A SECTOR ROADMAP FOR REMAP". http://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Mar/IRENA_REmap_DHC_Report_2017.pdf [Francisco Javier Hurtado Albir, Germany]	Noted. City-regions mentioned elsewhere. Too late to include grey literature at this stage.
10082	24	51	25	2	Leveraging renewables to improve energy access for African and Asian cities require addressing critical issues such as affordability, reliability of supply, and financing. It is unclear whether the cited literature has addressed these issues. [Saudi Arabia]	Noted. This section is about the potential for that access to drive transformational change. Section 4.4 addresses the enabling conditions for that change.
30610	24	51	24	53	We suggest to add a reference to energy efficient appliances and buidling design as well. [France]	Accepted. Section added to cover this request.
58334	24	53	24	53	Could add: Falling costs of renewables will help to provide universal energy access in those countries, with cities first to achieve full access (IEA, 2017b, Energy Access Outlook) [Andrew Prag, France]	Noted. Added Kennedy paper makes this point, and the revised text pays grater attention to falling cost of renewables (see also 4.2.2 on disruptive change).
13170	24	54	24	54	Replace "renewable energy" with "sustainable, clean energy". [Eleni Kaditi, Austria]	Rejected. The literature is about renewable energy specifically, which is a glossary term.
60948	24	54	25	99	This brief discussion of renewable energy seems more appropriate for the renewable energy section than for urban energy systems. [United States of America]	Rejected. This is about energy as an integral feature of the urban system.
44084	24	55	24	55	It states paraffin, in my reading of many papers kerosene is the most used fuel in the home perhaps it should be added [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Kerosene and paraffin distinction examined for significance at LAM4. For CO2 purposes they are very similar. Kerosene may produce more indoor air pollution but we have not expanded on the distinction here due to space constraints.
49768	24	55	25	1	It should be noted that non-biomass renewables would help to improve also the outdoor air quality that is a major health threat in several cities from developing countries See e.g. Rana Roy "The cost of air pollution in Africa" OECD Development Centre Working Papers,2016 [Fabio Monforti-Ferrario, Italy]	Noted. This point is already made in the peer reviewed literature wrt to indoor air pollution, and is made again in Chapter 5.
1630	25	5	25	17	Section 4.3.4.2 for building seems too simple compared with 4.3.4.3 transport. More disscuion on improving building standard, building envope technology, sloar use for heat and electricity (BIPV) and etc. towards low carbon transtiion for builidng (Referece: Shi J, Chen W, Yin X, 2015. Modelling building's decarbonization with application of China TIMES model. Applied Energy, 162:1303-1312) could be added. [Wenying Chen, China]	Accepted. The building section has been expanded in this section.
28514	25	5	25	17	Please consider to include reference to construction materials and their potential to mitigate emissions (chapter 2 of this report, page 95) [Germany]	Accepted. Text revised to include this.
60950	25	5	25	17	Consider mentioning mentioning use of long-lived wood products as substitute for more fossil-fuel intensive building materials. See Oliver et al. Journal of Sustainable Forestry, 33:248-275, 2014 [United States of America]	Accepted. Text revised to include this.
60952	25	5	25	17	The discussion of energy efficient buildings is helpfully quantitative but should ideally tie back to the IAM results and pathways discussed in Chapter 2. [United States of America]	Noted. The link between this section and IAMs is explained in the chapeau and Sections 4.2.2. This section tries looks forward to Section 4.5, rather than back to Chapter 2, but reference has been added.
62060	25	5	25	5	The term "leapfrog structure" should be explained [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The term used is "leapfrog infrastructure"
37034	25	6	25	6	This seems to be an incomplete sentence (it's not clear what "in the same way" is referring to). [Lynn Price, United States of America]	Editorial.
44086	25	6	25	6	There is something missing in this sentence. In the same way of what [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial.
58386	25	6	25	7	This sentence may not be best to start a new sub-section. It seems to refer to another thought, but it isn't clear what thought. I guess the question is "In what way can cities leapfrog infrstructure, industry and buidlings? What is being leapfrogged? How can this happen? [Peter Marcotullio, United States of America]	Editorial.
60954	25	6	25	8	The section begins with "In the same way", but it is not clear what "way" it is referring to. [United States of America]	Editorial. Text amended to take this phrase out.
12272	25	7	29	26	It seems surprising there is no mention of cooling, or the likely growth in the demand and energy consumed by cooling in an average 1.5C scenario and with a rapidly growing urban population and increasing GDP per head. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. Assume this point relates to air-conditioning and not urban cooling through greening (which is covered). The role of cooling discussed at LAM4 and covered under electricity.
47652	25	7	25	7	Is Rifkin 2014 (The zero marginal cost society: The internet of things, the collaborative commons, and the eclipse of 12 capitalism) needed as a citation fo this text? Does it focus on low-income cities? Is it related to climate change? [Sarah Connors, France]	Accepted. Reference removed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12274	25	10	25	17	Throughout this section but here in particular there appears to be a major focus on new cities to the almost total exclusion of existing cities, mainly in developed nations, which already have a very high energy useage and present a much more difficult decarbonisaiton challenge than buildign a new city. This paragraph present an opportunity to identify the different challenges and scale of savings from retrofit and new build. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. Reference to the distinction between decarbonisation of existing cities and low carbon growth of rapidly evolving cities has been added for clarity.
12276	25	10	25	12	This is supposed to be a feasibility assessment. How do these numbers for efficiency savings compare to those that the scenarios say that we need? You need to link the discussion in this chapter to the scenarios. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. Feasibility is quantified and qualified in Section 4.5 of the chapter. This section is about the systems that generate potentially feasible options. Note changed section heading.
7744	25	10	25	12	The 1.9 Gt/y looks low: direct savings alone are shown as larger in Kuramochi et al. (2017)'s Fig 3. And it's extraordinary that building efficiency merits just five lines despite AR5 WG3 Ch 10's finding—to state it more plainly than that chapter did—that building thermal savings have a flat supply curve up to savings in the neighbourhood of 90%. (As noted in my ignored FOD comments, I think similarly dramatic efficiency opportunities are available in transport and to a considerable degree in many sectors of industry, but this report doesn't mention them.) This report gives much greater emphasis to urban form, which is indeed important, but literature suggestions that they are bigger energy-savers than efficient buildings are incorrect—an artifact of greatly understating what AR5 already found that more-efficient buildings alone could save. I doubt that readers of this report realize what efficient buildings can do, and hope the authors will summarize AR5 WG3 Ch 9. [Amory Lovins, United States of America]	Noted. The Kuramochi ref is useful and has been added elsewhere in the chapter. Buildings have been granted an additional section under 4.3.3.2 See response to comment 7740 on transport, which has been granted additional attention in the revised text.
17744	25	10	25	17	Since the energy of buildings is mostly composed of cooling, heating and lighting energy(Delgarm et al. 2016), the significance of alternatives not only of the lighting energy reduction but also consumption reduction of the cooling energy in summer and the heating energy in winter need to be mentioned. [Republic of Korea]	Noted. Inclusion of the Kennedy et al 2018 paper to make this point.
30612	25	10	25	12	Another source can be UN publication Global Roadmap and the GSR (collaboration with IEA) that you can find in Home page of www.globabc.org [France]	Noted. Too late for inclusion of grey literature.
52098	25	11	25	11	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
926	25	12	25	12	This isimportant' shoud be 'This is important' [Robert Shapiro, United States of America]	Editorial
7924	25	12	25	12	Separate "isimportant" [Christopher Bataille, Canada]	Editorial
29308	25	12	25	12	add comma "isimportant" [Yuanyuan Huang, France]	Editorial
32778	25	12			This isimportant to decarbonise ... insert a blank space before "important" [Manfred Treber, Germany]	Editorial
34626	25	12			Please change isimportant to is important [Mexico]	Editorial
44088	25	12	25	13	It states "This isimportant to decarbonise urban systems" needs apace should read is important [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
55856	25	12	25	12	Space between is and important [Debora Ley, Guatemala]	Editorial
58392	25	12	25	12	changej "isimportant" to "is important" [Peter Marcotullio, United States of America]	Editorial
60956	25	12	25	13	Some words appear to be missing from this sentence: This is important to decarbonize urban systems. [United States of America]	Editorial
48660	25	16	25	16	again we need to accelerate energy demand reduction through energy efficiency and energy sufficiency [Yamina Saheb, France]	Noted. Energy efficiency is a feature of this section.
52100	25	16	25	16	Define 'Internet of Things', the term is thrown around but ill-defined. What does this document mean? [Jason Donev, Canada]	Noted. This is now a glossary term.
62174	25	16	25	16	What is Internet of things (in a few words)? [Antoine Bonduelle, France]	Noted. This is now a glossary term.
50750	25	18	25	18	Under "urban infrastructure, buildings and appliances" it would be interesting to introduce a reference to the use of local available building materials. Reference for this aspect: J.C. Morela, A. Mesbaha, M.Oggerob, P. Walkerc. "Building houses with local materials: means to drastically reduce the environmental impact of construction". Building and Environment. Volume 36, Issue 10, December 2001, Pages 1119-1126 [Francisco Javier Hurtado Albir, Germany]	Noted. Citation is pre-AR5 (and earlier assessment reports) and point has been made with more recent references.
50746	25	18	25	18	The reviewer proposes the insertion of this paragraph. "The use of thermal insulation technologies with adaptation potential in the construction and housing sector with a view in the developing countries will have to be fostered, for instance the use of locally available building materials). Roofing that reduce energy consumption but contribute to adaptation (roof garden systems, coverings with high solar reflectance), or light dependent control systems for sun shading will become even more important. Finally, passive climatization of buildings or alternative heating, ventilation or air conditioning [HVAC] technologies (heat pumps, use of solar thermal or waste energy and absorption or adsorption systems) may play a relevant role." References T.A.J. van Hooff, B.J.E. Blocken, J.L.M. Hensen, H.J.P. Timmermans, "On the predicted effectiveness of climate adaptation measures for residential buildings". Building and Environment, Vol. 82(2014), p. 300-316, 2014 [Francisco Javier Hurtado Albir, Germany]	Noted. New section on buildings added, but specific reference is not included.
32	25	20	25	20	Sub-heading 4.3.4.3 "Urban transport and urban design" is technically mislabeled. There is nothing at all about urban design in this sub-section. The more approprirate sub-heading would be "Urban transport and land use planning." [Jesse Keenan, United States of America]	Accepted. Text and headings revised to address this point.
53868	25	20	26	4	When assessing the potential to reduce urban transport emissions through mode shift, we need to consider how particular transport options interplay with urban structure and the everyday life of urban dwellers (See also my comment 2). This could be reflected in section 4.3.4.3. Suggested reference: Shove, E., Watson, M., & Spurling, N. (2015). Conceptualizing connections: Energy demand, infrastructures and social practices. European Journal of Social Theory, 18(3), 274–287. http://doi.org/10.1177/1368431015579964 and Cass, N., & Faulconbridge, J. (2016). Commuting practices: New insights into modal shift from theories of social practice. Transport Policy, 45(C), 1–14. http://doi.org/10.1016/j.tranpol.2015.08.002; [Grandin Jakob, Norway]	Noted. The point about urban form and energy is made in this section.
17746	25	21	25	23	It is better to give specific inventories about urban forms. Because particular urban forms affect energy consumption in neighborhood scale. For example, building a wind corridor through architectural allocation can reduce summer energy demand. [Republic of Korea]	Noted. Without literature on this it is difficult to include.
5086	25	22	25	22	Is $26 per person per year a big or small number? Context is needed for this remark--what percentage is this of something? [Michael MacCracken, United States of America]	Rejected. This is a citation in which the scale is less important than the observation that form influences expenditure in systemic ways. This is held to be an in important observation in highlighting the links between urbanisation and the rapid and scaled changes required to meet the 1.5C target.
36104	25	22	25	24	Technologies such as Vapor Absorption Chilling Systems offer tremendous potential, especially in commercial sector where energy demand for cooling is expected to increase in coming years. It is used in conjunction with solar concentrators, where solar energy is converted to cold energy forspace cooling. Despite its potential, such technologies due to local barriers, has received less traction, especially in developing countries. Low cost options in Canada may not be 'low cost' options in other countries, in particular - developing countries. (http://mnre.gov.in/file-manager/UserFiles/Sun-Focus_April-June-2014.pdf) [India]	Noted. Vapor Absorption Chilling reviewed with co-authors at LAM4 but not included due to paucity of peer reviewed literature that ca be applied to a global report.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
50958	25	27	25	29	In paragraph "4.3.4.3 Urban transport and urban design" I found very interesting the V. Oldenbroek, et al., 2017: "Fuel cell electric vehicle as a power plant: Fully renewable integrated transport and energy system design and analysis for smart city areas" contribution which, however, analyzes only the case of hydrogen generation from renewable sources (solar and wind). In order to generalize this prospective I suggest to consider the opportunity to insert as reference also my two recent paper: M.V. Romeri "Hydrogen and Fuel Cell: A Cinderella or a Disruptive Low-Carbon Solution?" (2015), ECS Transaction 2016, Vo. 71, <http://ecst.ecsdl.org/content/71/1/227.abstract >; M.V. Romeri "Considering Hydrogen Fuel Cells Powertrain as Power Generation Plant – 2017 review" (2017) in "2nd AIEE Energy Symposium Conference Proceedings" <http://www.aieeconference2017rome.eu/documents/Rome-Proceedings.pdf >, p. 254-260; presentation available at < http://www.aieeconference2017rome.eu/files/ROMERI.pdf >. In these papers I assess the economic possibility (in LCOE terms, in hypothesis of fuel cell vehicles mass production) to use an Hydrogen Fuel Cells Powertrain as Power Generation Plant obtaining surprisingly results. [Mario Valentino Romeri, Italy]	Noted. Original citation retained as it makes the point about urban systems and storage, rather than fuel cells explicitly (which are dealt with elsewhere, but the prospects of which have not changed significantly since AR5 relative to changes in other low carbon energy sources).
47926	25	28	25	28	Kindly check: Rode et al., 2014; year mismatch with the reference given on page 173, line 50 [Sarah Connors, France]	Editorial. This has been amended to reflect Graham Floater as the lead author.
52102	25	33	25	33	I believe 'in situ' should be in italics. [Jason Donev, Canada]	Editorial. This phrase has been removed from the text.
12278	25	35	25	36	I'm not sure fig 2.12 really shows a 50% reduction in demand by 2050 [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Changed to "almost 40%"
60958	25	35	25	36	Appears to be inconsistent with Table 4.1. Should it be 50% reduction in emissions rather than final energy use? [United States of America]	Accepted. Changed to "almost 40%"
60960	25	35	25	40	This discussion of the transport sector is a model for how other sector discussions in this chapter should link back to the IAMs discussed in Chapter 2. [United States of America]	Noted, with appreciation.
40520	25	39	25	41	This amount of decarbonisation is quite large and I believe you need to scrutinise the source of this estimate. This is quite an important statement in the Urban Transport section that is not based on published peer-reviewed publications. While you cite UNEP (2017b), some of the emission reduction potentials are sourced from questionable sources. For example, the Light Duty Vehicle potential estimate (2.0 Gt of CO2 equivalent is shown in Table 4.1 on p35 of UNEP (2017b)) comes from a 2012 report by the ICCT. UNEP (2017b) states that: "In the automobile sector, fuel efficiency measures could potentially reduce emissions by 0.88 GtCO2/year (heavy duty vehicles) and by 2.0 GtCO2/year (light duty vehicles) by 2030 (ICCT, 2012). These numbers include modal shifts. A shift to more electric vehicles is also included. ICCT (2012) assumes that electric-drive vehicles will form a small, but not insignificant, share (up to 9 percent) of new-vehicle sales by 2030". Here is the link to the ICCT report - https://www.theicct.org/sites/default/files/publications/ICCT%20Roadmap%20Energy%20Report.pdf [Thomas Longden, Australia]	Noted. The UNEP report seems to be consistent with the modelling in chapter 2 (with their refereed base), with Bloomberg New Energy Finance (not refereed but a valuable market-based assessment) and with Newman, Beatley and Boyer (2017), a refereed book. Recent years have seen remarkable growth in electric mass transit in China and many other places and rapid growth in electric vehicles (fully referenced in chapter 4) so we are reasonably confident that this is one area of substantial growth in the right direction for 1.5C.
40522	25	39	25	41	While I understand that IAMs have been subject to criticism for their assumptions on modal shift and other aspects (including fuel efficiency), it should be noted that improvements in these models have occurred and that many of their assumptions are realistic. There are a range of papers that have reviewed the importance of key assumptions in IAMs to assess whether they are too conservative. For examples, refer to a special issue in Transportation Research Part D: Transport and Environment https://doi.org/10.1016/j.trd.2017.05.003 . Yeh et al. 2017 is a key paper that compares two IAMs to two global transportation sector models. They find that "the four models differ in terms of the relative roles of various mitigation strategies to achieve a 2 °C/450 ppm target: the economics-based integrated assessment models favor the use of low carbon fuels as the primary mitigation option followed by efficiency improvements, whereas transport-only and expert-based models favor efficiency improvements of vehicles followed by mode shifts". This is a key difference that is relevant to my other comments. The projections and assumptions on decreases in the cost of batteries and improvements in fuel efficiency are two crucial factors that need to be discussed when comparing these types of models. Please also assess whether the models have focused on a 1.5ºC target. [Thomas Longden, Australia]	Noted. The central point here is to compare the rates of change outlined in Chapter 2 with alternatives.
40524	25	39	25	41	A key issue for this report is the focus on a target of 1.5ºC in 2100. When discussing IAMs and global transport models, you should be aware that the estimates are highly contingent upon the emissions pathway focused upon. One example of a paper that has focused on a difficult carbon target consistent with RCP2.6 (and warming of less than 2ºC) does include a notable penetration of battery vehicles of around 20% in 2030. While this is much more than the 9% of new vehicle sales in the ICCT (2012) report, Longden (2014) finds that within a RCP2.6 scenario there is a lower carbon reduction (i.e. less than 1GtCO2) in 2030 than that in ICCT (2012). Note that the ICCT(2012) estimate seems to depend on the achievement of fuel efficiency targets and I wonder what assumptions they make about the lifetime of vehicles, pkm and other important factors. The other difference between Longden (2014) and ICCT (2012) is the specification of EDVs and BIVs - so the assumptions about hybrids may be important. To compare the emission reductions and EDV penetrations, focus on Fig. 8 and 9 of this paper: https://doi.org/10.1016/j.enpol.2014.04.034 . This (and the findings of Yeh et al.) suggests that fuel efficiency assumptions in ICCT (2012) could be very optimistic. [Thomas Longden, Australia]	Noted. The central point here is to compare the rates of change outlined in Chapter 2 with alternatives.
52104	25	40	25	40	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
1632	25	43	25	43	The reference (Yin X?Chen W, Eom, J., Clarke, L. E., Kim, S. H., & Patel, P. L., et al, 2015. China's transportation energy consumption and CO2, emissions from a global perspective. Energy Policy, 82(1), 233-248) provided detail disccusion on transport mode shift, fuel economy improement, biofuel and electricity use for transport towards low carbon transition could be refered.. [Wenying Chen, China]	Noted. Additional reference not included due to space constraints and significant restructuring of this section.
7926	25	53	25	53	Separate "...2016)and" [Christopher Bataille, Canada]	Editorial.
32780	25	53			health (Jennings et al., 2016)and improve ... insert a blank space before "and" [Manfred Treber, Germany]	Editorial
44090	25	53	25	53	needs space between "2016) and" [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial.
52106	25	54	25	54	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial.
40526	26	3	26	16	In addition to this, the current battery cost seems to be approaching (or surpassing) the estimates for 2020. Longden (2014) includes an estimate of approximately $200/kWh for a 85kw battery and compares this to other sources. Refer to Figure 12: https://doi.org/10.1016/j.enpol.2014.04.034 . This paper uses learning curves (based on expert elicitation of battery cost forecasts) to have an endogenous battery cost implemented in the IAM. Note that caution is needed when discussing battery costs as the $/kWh amount will change notably based on the size of the battery. It is also difficult to confirm the numbers used in the media and compare these directly to those in published peer-reviewed papers. Often the size of the battery and the type of vehicle (i.e. hybrid or EDV) is not mentioned and these factors have a notable impact on the $/kWh measure. [Thomas Longden, Australia]	Noted. This point relates to systemic change, a key point to this chapter and section. The citation used was recommended by a reviewer.
1642	26	6	27	3	It is suggested to add discussion on Fuel cell. [Wenying Chen, China]	Rejected. This is an urban section and the focus is on innovations that have shown significant promise for 1.5C consistent pathways since AR5. Fuel cells are covered under "Electrification and hydrogen", "Technologies as enablers"

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10084	26	7	26	30	One should be careful not to generalize on the basis of recent observed trends in transport electrification. There are two concerns need to be assessed: 1- the recent trends are mostly due to the generous government subsidies which are not sustainable and therefore the observed trends could not assumed to be permanent or scalable to the level anticipated for 1.5c unless a breakthrough would occur in electricity storage; 2- the assessment should question the source of electricity and whether technologies such as top-roof solar PV are scalable to a level that meet city transport electrification in a 1.5c world. [Saudi Arabia]	Rejected. The cited literature points to a rapid change across a number of fronts.
48110	26	7	26	7	Title of 4.3.4.4. This should be 'Electrification of transport and Biofuels'? [Sarah Connors, France]	Rejected. The new Kennedy et al paper makes the point that EVs form part of electrified cities.
60962	26	7	26	10	How does electrification of urban systems compare to benchmarks that can be observed from the IAMs or other literature? [United States of America]	Noted. The qualitative links regarding urban systems and rapid change are made in this section, but the quantification is left (mostly) to the IAM discussion.
18596	26	8		16	Why is the development in the leading market China not mentioned? EV sales increased to over 800 000 in 2017 there. Global EV sales increased 57% in 2017 compared to 2016. [Andrea TILCHE, Belgium]	Noted. See new Kennedy et al paper that has been added. This section tries to adopt a global overview, but See references elsewhere, especially to peak car and Gao and Newman 2018.
36106	26	8	26	12	The word 'exclusively' may be dropped. This was a scenario studied in the cited report. [India]	Accepted. Text amended to reflect scenario.
53144	26	8	27	3	On electrification, it is important to note that the carbon intensity of the electricity grid determines whether electrification makes sense. Above a threshold of about 600 tCO2/GWh, electrification would result in increases in CO2 emissions. See: Kennedy, C., I.D. Stewart, M. I. Westphal, A. Facchini, and R. Mele. 2018. Keeping Global Climate Change within 1.5°C Through Net Negative Electric Cities. Current Opinion in Environmental Sustainability. OR Kennedy, C.A. (2015) Key Threshold for Electricity Emissions, Nature Climate Change, 5, 179-181. It is also important to acknowledge that electrification will lead to increase electricity demand (maybe 30%), and in many countries, there are electricity supply challenges. [Westphal Michael, United States of America]	Accepted. Kennedy et al reference added.
60964	26	11	26	11	Clarify what is meant by "electric vehicles." Full battery electric vehicles are different than plug in hybrid electric vehicles in terms of emissions. [United States of America]	Editorial. Glossary term
52108	26	13	26	13	Explain where Shenzen is. [Jason Donev, Canada]	Noted. This section has been cut in effort to save words.
7746	26	14			Update: Shenzhen met that 2017 bus target, and now has more electric buses than the top five US cities have total buses. [Amory Lovins, United States of America]	Accepted. Regrettably the Shenzhen text was dropped in cutting words.
62176	26	14	26	14	does the 48% apply to the fleet of bus or the traffic at large ? [Antoine Bonduelle, France]	Noted. Clarity provided in the revised text.
47464	26	15	26	15	Invalid Reference (Castellanos): No news items or blog posts can be used as references in an IPCC report. Please find alternative reference or remove text. Please follow the IPCC guidelines for grey literature: https://wg1.ipcc.ch/guidancepaper/AR5GuidanceNotes_Literature.pdf [Sarah Connors, France]	Accepted. Citation removed.
52110	26	15	26	15	100% reduction? Um, no, this is an overstatement, there are other sources of PM than just transport. [Jason Donev, Canada]	Noted. This text has been removed.
7748	26	18	26	20	I suggest you add the 2017 data from http://www.ev-volumes.com (1.224M units sold in 2017) here and in the text and cite the non-IEA source (after all, you cite IEA's own non-IEA sources, and this very source is already cited at 4-72:3–4). The graph will need re-scaling. [Amory Lovins, United States of America]	Noted. Discussed with fellow authors at LAM4, but regrettably too late to rescale graph. The EIA figure has been updated using 2018 data.
28516	26	18	26	20	Figure 4.1: Please explain "BEV" and "PHEV" in the legend. [Germany]	Editorial
46990	26	18	2	20	Colourblind check for this figure. Please avoid using greens and reds together in figures as they are hard to distinguish between. [Sarah Connors, France]	Editorial
3256	26	19	26	19	The acronyms "BEV" and "PHEV" have to be defined [Vassilis Daioglou, Netherlands]	Editorial
52112	26	19	26	19	Explain BEV and PHEV. Make your own image, don't just pull from someone else here. Rewrite your own figure caption. [Jason Donev, Canada]	Editorial
52114	26	19	26	19	Not including Internal Combustoin engines here is problematic. [Jason Donev, Canada]	Noted. Efficiency gains in internal combustion engines discussed in AR5 and difficult to reconcile with 1.5C-consistent pathways.
48258	26	22	26	30	In case of countries with economy upon oil and gas revenues, international financial and technology is needed to electrification of cities and biofuels. [Iran]	Rejected. This is not a feature of peer reviewed literature, most of which describes the free subsidy that corporations and governments in hydrocarbon rich countries receive by nit paying for their emissions.
13172	26	23	26	24	Delete the text "For oil importing countries, the electrification of transport provides important macro-economic benefits (Chaturvedi and Kim, 2015).". [Eleni Kaditi, Austria]	Rejected. This is a relevant citation for this section.
55080	26	23	26	24	Need to include some examples of macro-economic benefits for the oil countries. [Yamide Dagnet, United States of America]	Noted. Not totally clear what this comment intends to highlight, but the text in question has been significantly revised. Chapter 5 has a box on oil-exporting countries and their response to 1.5C.
1634	26	29	26	29	Doubt on "Peak car has been reached in Beijing and Shanghai". The number of private car in Beijing in 2010, 2013, 2014, 2015, 2016 were 3715, 4250, 4358, 4393, 4520 thousands respectively. [Wenying Chen, China]	Noted. Peak car refers to car use, not car ownership. Care use is declining in many regions of the work. The data for VKT are based on Gao and Newman 2018, derived from Chinese authorities. See also Box 4.9.
30614	26	29	26	29	See comment in sources, this reference (IEA, 2017g) is listed twice. [France]	Editorial
52116	26	29	26	30	What does 'and beyond' mean here? [Jason Donev, Canada]	Noted. The text has been retained as it refers to beyond the two cities that are referenced.
49918	26	32	26	32	The latest and most disruptive innovation are free floating bike-sharing schemes, which are booming. A scientific reference on the field could be in this addition to the sentence: "An estimated 800 cities globally have operational bike-sharing schemes (Fishman et al., 2015), including free floating systems (Pal A., Yu Z., 2017), and China...". Pal A., Yu Z. Free-Floating Bike Sharing: Solving Real-life Large-scale Static Rebalancing problems, Transportation Research Part C: Emerging Technologies Volume 80, July 2017, Pages 92-116. [Valentino Piana, Italy]	Noted. The sharing economy is addressed elsewhere and again the feasibility assessment.
52118	26	33	26	33	Define ICT. [Jason Donev, Canada]	Editorial. See glossary.
49772	26	34	26	36	The sentence is very important and can enjoy a further bibliographical reference: Civitas Project, Smart choices for cities, Cities towards Mobility 2.0: connect, share and go!, Policy Note, 2016, available at http://civitas.eu/sites/default/files/civ_pol-07_m_web.pdf Indeed the paper quotes also car pooling, van pooling, ride sharing, park sharing, so in principle the sentence might become: "... urban vehicle fleet through car sharing, car pooling, van pooling, ride sharing, park sharing, driverless cars and co-ordinated public transport, especially when electrified (Glazebrook and Newman, 2018; Wee, 2015; Civitas Project, 2016)". [Valentino Piana, Italy]	Rejected as too late for non-peer reviewed literature.
19750	26	38	27	3	An unquestioned increase use of biofules is not socially and ecologically justifiable due to the competition to other land-use needs like food production and ecosystem services and their future security as referenced and discussed above. [Jennifer Morgan, Netherlands]	Noted. Multiple impacts of biofuels is dealt with elsewhere in the report.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
46918	26	38	26	38	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Noted. Uncertainty language is not used in this section.
55082	26	38	26	39	A simple reference to the section on transport (4.3.4.3) would avoid repetition. [Yamide Dagnet, United States of America]	Noted. Text revised.
56058	27	1	27	2	Biofuels are not nessarily carbon netural (corn ethanol according to the US enviornmental protection agency only has a 20% smaller GHG footprint than gas) and additional options are available for particularly urban transport, but most forms of human transportation. Plans that leave this type of bioenergy usage when they are supposedly carbon neutral in 2050 need more explination for their reasoning. [Kelly Stone, United States of America]	Noted. Text revised to refer to literature on international travel only.
10086	27	2	27	3	Avoid generalization that lower emissions are guaranteed by use of biofuels since that will depend on the source of biofuels, their production, and their transport (i.e. their full GHGs footprint). [Saudi Arabia]	Noted. Text revised to refer to literature on international travel only.
928	27	3	27	3	of ethanol and biodiesel' Aren't there other issues with ethanol? [Robert Shapiro, United States of America]	Noted. But not clear what the comment refers to. Text revised to refer to literature on international travel only.
33	27	6	27	46	Architecture should really be in the sub-heading. In addition, this is a poor literature summation of the value and utility of urban adaptation planning. This summation is too negative. There is a lot of positive experience underrepresented here. [Jesse Keenan, United States of America]	Rejected based on literature and citations showing the limits of this approach in developing countries.
30616	27	6	27	6	We suggest to rename this section to better reflect building codes [France]	Accepted. Test revised.
45502	27	6	27	6	A general point at this stage about 1.5 relevance. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - text revised (more reference to 1.5 made)
55694	27	6	27	46	see also" Kabisch et al (2017). Nature-based solutions to climate adpatation in urban areas. Springer. And chapters therein. [David Cooper, Canada]	Noted. Proved impossible to review an entire book and select appropriate citation under the constraints.
58342	27	6			Section 4.3.4.5 is about more than climate resilience. Suggest new title: "The importance of urban land-use and planning for decarbonisation and climate-resilience" [Andrew Prag, France]	Noted. Unfortunately it proved too late to change this title which was kept in an effort to balance adaptation and mitigation.
55084	27	7	27	15	This 1st para of 4.3.4.5 should make reference of "early warning systems" more explicitly. Some initiatives have been launched to make progress on this. [Yamide Dagnet, United States of America]	Rejected - (this section focuses on urban and land use planning. Early warning systems are discussed in section 4.3.5; Cross-chapter Box 9 in Chapter 4; Table 4.9.
28518	27	12	27	15	The authors should also mention the possibilities of reducing heat stress or coping with storm precipitation due to climate adapted urban planning and not focus to much on reduction of fire risk and sea level rise. [Germany]	Accepted - text revised (reference to heat stress made)
31720	27	17	27	24	Are there any solutions to the marginalization of the poor due to the implementation of adaptation policies? [Michael SUTHERLAND, Trinidad and Tobago]	Accepted - text revised (sentence reworded to illustrate solutions)
28520	27	23	27	24	Please add an example, e.g. from the cited literature, that illustrates how adaptation planning can marginalise poor citizens as policy makers would want to know how they can avoid these outcomes and how they can improve the effectiveness of planning processes. [Germany]	Accepted - text revised (example added in)
55086	27	23	27	24	Last sentence of second para: Need to say why adaptation planning could marginalize poor citizens and suggest ways to address this issue (e.g. equivalent to fuel poverty schemes) [Yamide Dagnet, United States of America]	Accepted - text revised (as per responses to above 2 comments, more detail and examples added)
34	27	26	27	34	This passage on building codes is missing one major point. A focus on building codes represents an advancement in resilience. However, it also undermines more necessary transformations (i.e., adaptation) in land use. There conflict and synergies between building codes and land use is complex. In many cases, building codes are subject to and dependent on land use classifications that do no reflect current much less future risks and hazards from climate change. Second, building codes often deflect more important decision at-scale about land use. Finally, the building codes themselves are highly underminded by existing industry interests that seek to weaken them for their own financial gain. If anything, this report should highlight the need for more government oversight of building code development and enforcement, as well as its integration with land use. [Jesse Keenan, United States of America]	Noted in revised text that expands on buildings section.
17748	27	26	27	34	The building stock that increases energy efficiency and the renewable energy facilities such as photovoltaic(PV) panel of zero energy building are vulnerable to climate risk. It would be better to mention the necessity of building codes which can enhance the energy efficiency and consider the risk of natural disasters as well. [Republic of Korea]	Accepted. New references to building codes in this section.
30618	27	26	27	29	You may enlarge the scope to all energy efficiency standards for end-use technologies. There is a long history of success of energy efficiency standards (cf. publication on IEA /clasponline and ACEE .org) [France]	Accepted - text revised (points made by comment addressed in new text added)
48662	27	26	27	34	Please replace in this paragraph and in all other paragraphs where "building codes" are mentioned by "building energy codes" to make it clear that we are talk about codes related to energy and not those related to safety and other issues. [Yamina Saheb, France]	Rejected. Building codes include issues of surface sealing, material (and embedded energy) and spatial lay-out that are not captured by "energy building codes".
31528	27	28	27	28	we suggest the addition of "carbon sequestration" in the cell for "mitigation benefits" for "urban trees planting." in Table 4.3. References: "2006 IPCC Guidelines for National Greenhouse Gas Inventories CHAPTER 8. Kochi TONOSAKI , Katsuya MURAYAMA, Kazutaka IMAI, Yoshiaki NAGINO(2012), Estimation of soil carbon accumulation rate in urban parks, Journal of the Japanese Society of Revegetation Technology 38(3), 373-380" [Japan]	Noted. This change was, however, considered marginal to 1.5C consistent pathways. Note reference to Milan in the text.
930	27	30	27	30	used retrofit' should be 'used to retrofit' [Robert Shapiro, United States of America]	Editorial
7928	27	30	27	30	Add "to" before "retrofit" [Christopher Bataille, Canada]	Editorial
7930	27	31	27	34	Long vague sentence. "require the elevation of new buildings" They have to be buit higher … on stilts? [Christopher Bataille, Canada]	Accepted. Text revised.
28522	27	31	27	34	Please provide a more general perspective to flood risk management of coastal cities. [Germany]	Accepted - text revised (altered wording to make the point more general)
3904	27	36	27	46	The Kuyasa project has met significant barriers in attempting to scale, and codes and regulations are part of the way of addressing this. This aspect is not reflected in this paragraph, resulting in the reference to Kuyasa as a noteable instance of mitigation possibly being misleading. [Emily Tyler, South Africa]	Accepted. Text higher in the paragraph adjusted to reflect this general point but the text around Kuyasa is retained to make the point about co-benefits in poor communities.
14140	27	36		46	The solutions to reducing emission in building sector are described in 4.3.4.5 climate resilient land use and urban planning. These would be more explicitly shown if it can be listed under building sector, which is partitioned from 4.3.4.5. Furthermore, in addition to buiding codes and standards, other suggested solutions also include building information modelling (BIM) and carbon footprint audit system for buildings. These two tools are widely used and can be complementary to official codes and standards in non-governmental circles. [Yi-Chieh Chan, China]	Accepted. Text and ordering revised.
28524	27	36	27	46	Please consider to address social repercussions of enforcing building codes and standards, and add a reference to Section 4.4, p 44 [Germany]	Rejected - first component of the comment there is an absence of literature, second component of the comment it is unclear where in section 4.4. a reference is needed and the comment does not state what in particular should be referenced.
55088	27	36	27	46	Should also highlight the lack of project life cycle consideration, especially maintenance considerations. [Yamide Dagnet, United States of America]	Noted but LCA point not made here due to space constraints.
46410	27	40	27	43	Statement "For example, the relatively…..incentives." is not clear. [Ijaz Ahmad, Pakistan]	Accepted. Text revised.
13174	27	42	27	42	Replace "renewable energy" with "sustainable, clean energy". [Eleni Kaditi, Austria]	Rejected. This statement is about renewable energy.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
53146	27	44	27	46	The Kuyasa project also involved adding more energy efficient building materials to informal settlements (insulation, better roofs), which led to marked decreases in the incidence of respiratory diseases. This underscores how improving building materials brings benefits to informal settlements, not just formal areas, of cities. [Westphal Michael, United States of America]	Accepted. Text revised to include this co-benefit.
60966	27	45	27	45	It would appear that the word "fans" should be inserted after "installing ceilings". [United States of America]	Rejected. There are no fans in the Kuyasa houses. The ceiling themselves reduced condensation and provided thermoregulation.
31530	27	50	28	3	We would like to introduce urban greening case study in Japan. Cities have various green spaces such as parks, forests, agricultural areas, rivers, roadside trees and private gardens. In Japan, the Master Plan for Greenery is prepared to implement comprehensive measures for greening and preserving existing green space in city planning areas by respective municipalities, based on the Urban Green Space Act. The clause concerning this basic plan has been established in 1994.As of March 2018, 674 municipalities have laid down their own plan. References: -Yokohama etc. http://www.city.yokohama.lg.jp/kankyo/etc/jyorei/keikaku/mizutomidori/ The Organization for Landscape and Urban Green Infrastructure in Japan runs a certification system to neutrally evaluate the activities of businesses that are actively working to green the city and are dedicated to improving the social environment. This system is known as the Social and Environmental Green Evaluation System (SEGES), and it currently covers about 90 sites in 2018. References: - Kochi Tonosaki,Yoshihiro Ueno,Naomi Komatsu,Kitsuro Murauchi, yoshiyukiIshikura(2012),Social and Environmental Green Evaluation System (SEGES) in Japan and a Good Practice of Sanden Forest. https://www.fherfurt.de/urbio/httpdocs/content/documents/URBIO2012/URBIO2012-Book_of_Abstracts.pdf [Japan]	Noted. But not included due to space constraints.
13178	28		28		In Table 4.3, replace "green" with "clean". [Eleni Kaditi, Austria]	Rejected. This table is specifically about "green" infrastructure.
47928	28	1	28	1	Kindly check: Bobbins (2016) is not present in the reference list [Sarah Connors, France]	Editorial. Bobbins et al is added subject to peer review of this book.
932	28	2	28	2	Durban similar the cost' delete 'similar' [Robert Shapiro, United States of America]	Accepted. Word removed.
7932	28	2	28	2	Remove "similar" [Christopher Bataille, Canada]	Accepted. Word removed.
32262	28	2			delete the word 'similar' [Jamaica]	Accepted. Word removed.
13176	28	5	28	8	Replace "green" with "clean". [Eleni Kaditi, Austria]	Rejected. This is about green infrastructure.
17750	28	5	28	9	Green Infrastructure(GI) has various benefits. However, as shown in Table 4.3, as shown in Table 4.3, if benefits are classified by GI, it seems that there is no similar or same benefits on each GIs. It seems better to combine the column of benefits into one. [Republic of Korea]	Noted. Unclear exactly what the required response should be as the table distinguishes between adaptation and mitigation.
3772	28	8	28	8	What exactly is the contribution of a healthy lifestyle and/or access to better health care to climate change? Do these not lead to longer lives hence more consumption hence more production hence more rather than less rise in temperature? [Marcel Wissenburg, Netherlands]	Noted. This section is about systemic change which is understood as needed to address multiple incentives at the same time.
33968	28	8	28	9	Table 4.3: Please consider to include the benefit of emission reductions by restoration of degrading peatlands. Also, please consider to rephrase/clarify what "sense of place" means. [Norway]	Noted. Will have to check that is not discussed elsewhere and whether this is best located in the "urban" section.
52120	28	8	28	9	If the permiable surfaces aren't concrete, what are they?? [Jason Donev, Canada]	Noted. But the point is about "permeability" not a specific material. Surfaces could include combinations of concrete and earth, grass, textiles that are permeable.
52122	28	8	29	25	Please be careful about the difference between 'cement' and 'concrete' they aren't the same thing. [Jason Donev, Canada]	Accepted. Text reviewed at LAM 4, and reference is to the broader definition of cement in this document (which includes the common cement bricks used in developing countries and the cement used in concrete) except for the Rockstrom et al 2017 citation that refers to concrete.
4394	28	10	28	10	To the name "Sao Paulo" it should be add the words "in Brazil," similarly to line 19 for "Milan in Italy." [Thales A. P. West, Brazil]	Accepted. Text added, but then this section was subsequently cut to save words.
10580	28	10	28	24	The cases from São Paulo and Milan need to be presented to clearly illustrate the key messages about urban mitigation and adaptation pathways. The current text presented them as two isolated cases. [Hong Yang, Switzerland]	Accepted. Text added, but then this section was subsequently cut to save words.
52124	28	10	28	10	Sao Paulo Brazil, include the names of countries when talking about cities. [Jason Donev, Canada]	Accepted. Text added, but then this section was subsequently cut to save words.
13180	28	19	28	19	Delete the text "greening". [Eleni Kaditi, Austria]	Rejected. This section draws on the literature and the examples with regards to urban greening.
17752	28	20	28	24	It would be better to be mentioned that it is important to select the apporopriate species to plant in the urban environment and climate prior to the continuous monitoring and maintenance of planting in the city. [Republic of Korea]	Noted, but excluded on the ground that space was limited in this urban section, and we trust that the point about species is implicit. We did not find literature referencing this specific point.
47150	28	22	28	22	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Noted. None of those worlds appear in the text. The phrase" need not" does appear.
12280	28	27	28	27	Do we really need all of the text in this section? Aren't we in danger of straying a bit from the scope of the report [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text cut to save words and ensure clarity.
16492	28	27	29	25	Section 4.3.4.7 should consider the importance of urban water demand management and improved residential water efficiency standards as a way of addressing water scarcity, while reducing energy usage and GHG emissions through lower treatment pumping and heating requirements. The Australian Water Efficiency Labelling and Standards (WELS) Scheme, which has applied mandatory water efficiency labels to water appliances in Australia since 2005, is predicted to save 204 GL/a of water with an estimated cumulative reduction of 46 Mt/a of CO2 emissions by 2030. Similar schemes are now in place in New Zealand, the European Union, Singapore, the USA and China. See Fyfe et al. 2015, Evaluation of the Environmental Effects of the WELS Scheme, report prepared for the Australian Commonwealth Government Department of the Environment by the Institute for Sustainable Futures, University of Technology, Sydney. http://www.waterrating.gov.au/about/review-evaluation/environmental-effects [Australia]	Noted. This section has been substantially rewritten. The link between water and CO2 has been difficult to describe in anything but the most global terms die to variations between regions and countries.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
54264	29	1	29	28	Additional point with high additional future mitigation potential . The 2 papers quoted hereabove essentially propose the substitution of steel by carbon fibers made from CO2 by solar power (or possibly other low-GHG power sources, pending lower energy prices). The value of algae based by-products of nutrients and biodiesel have not been take into account, nor is the value taken into account that these new industrial production processes need to be placed in arid and semi-arid areas, bringing labour and income to previously poor regions, with relatively low demand on land use. This would dramatically improve the LULUCF performance of developping countries, while reducing their need for fossil energy sources. We talk world wide about a total area which is comparable with the land surface of Algeria. Spread over the arid regions of the planet, it is easily comparable with the land use being needed for todays chemical and industrial land use for steel and cement production, while removing the need for sand and gravel. Another possibility that is being introduced by carbon fibers is the potential to eventually replace not only steel, but concrete in a next step as well, since the combination of carbon fiber and hard stones like granite, being limitless available in all countries and being producable with pure electrical power as well, has the potential to replace concrete. Also for this reason I believe that the carbon fiber production in replacement of steel has a much higher potential in the future than what is visible today. I have found some grey literature about these capabilities of carbon fiber in combinatons with hard stone like granite to replace steel, concrete and alumninium as well, seem to be promising to get in addition rid of yearly about 3,2 Gt of CO2 being generated by cement production alone. http://technocarbon.de/presse/FTD_2005-09-29.pdf http://www.wipo.int/wipo_magazine/fr/2009/02/article_0004.html http://technocarbon.de/presse/SD_CM_02_08_technocarbon.pdf http://technocarbon.de/presse/JCM38.pdf If CFS (CarbonFiberStone) should be indeed capable of replacing concrete, additional 3,2 Gt of CO2 resultung from cement production could be mitigated (data from 2013). The potential for mititgation and storage of CO2 at the same time is scalable as industrial strength grows, currently in the order of 8,8 Gt CO2 per year, while 4 Gt of CO2 would be permanently bound within the carbon fiber. A yield of 4 Gt CO2 equivalent of carbon negativity would represent permanent and safe storage of 400 Gt CO2 within a century, or 1600 Gt CO2 within 400 years. Assuming a 300 GtCO2 permanent capture and storage by building materials made from carbon fibers and hard stone before 2100 could be implemented, the effect is shown in the following graphics: https://exitcoalnow.org/WECANcumulCO2_agropermacuture.PNG https://exitcoalnow.org/WECANCO2emissionsCCSimpact.PNG	Accept. We included some text on carbon fibres.
7752	29	3	29	7	the six ? signs at the right of Fig. 4.2 are misprinted as º [Excel mistranslates this: it's a degree sign with a centered underscore) [Amory Lovins, United States of America]	Editorial
17754	29	9	29	9	Maybe, we can use "This risk falls disproportionately on vulnerable group such as women, poor and old people, children, the disabled, and so on in cities" instead of "This risk falls disproportionately on women and poor people in cities" [Republic of Korea]	Noted. Text was revised. Hope that the point is implicit here, and note that it is addressed further in Chapter 5.
28526	29	9	29	11	We suggest to revise the last sentence. The chances to experience a heavy rain event are not disproportional higher for poor societies or women. However, the risks for livelihoods might be gender and/or caste specific. [Germany]	Rejected. The text and cited literature refers to the risk of flood damage and relative exposure is drawn from the literature.
52126	29	9	29	11	Yes, the risk falls disproprotionately on the women and poor (and the physically disabled…) but provide some explanation as to why. It's true, just back it up. [Jason Donev, Canada]	Noted. To save world no explanation was given. The cited literature provides some explanations.
32968	29	12			The text refers to urban agriculture. In our view, there should be no difference or distinction between types of agriculture, which may lead to different treatment and means disguised as protection. Therefore we recommend excluding the reference [urban] before agriculture [Brazil]	Noted, the text has been removed in revisions. This is an urban section and references to agriculture are related to urban here as per the Mugagga citation.
52128	29	12	29	25	Explain what is meant by 'nexus' in this context. It seems important, but doesn't quite match the dictionary definition. [Jason Donev, Canada]	Noted. After discussion at LAM 4 on whether to include this as glossary term, it was decided not to. The term is used here and in Chapter 5.
52130	29	12	29	14	This sentence is very awkward. Break it into several sentences. [Jason Donev, Canada]	Accepted. Text revised.
55090	29	12	29	25	This para needs to be illustrated with concrete examples. [Yamide Dagnet, United States of America]	Accepted. Case studies added.
57350	29	12	29	12	Need to be more specific about the potentials of urban agriculture for adaptation and mitigation. [Hans Poertner, Germany]	Noted, the text has been removed in revisions. This is an urban section and references to agriculture are related to urban here as per the Mugagga citation.
60968	29	12	29	25	This section could be shortened or deleted. [United States of America]	Noted. Text considerably revised.
7096	29	13	29	14	This is an important statement, but its unclear why integration provided adaptation opportunities. Maybe a single additional line presenting a short example, ie. …because integration of these systems can contribute to food security by by enhancing resource use efficiency and encouraging greater policy coherence (Rasul and Sharma, 2016) [Jose Di Bella, Canada]	Accepted. Case studies added.
52132	29	14	29	16	This idea is inconsistant with the 'anti city' sentiment of pg 25's statement of increasing urban population (but consistent with my comment there). [Jason Donev, Canada]	Noted. This is an urban section, but efforts at cross chapter consistency introduced in revisions since LAM 4.
32970	29	19			The concept of urban agriculture is used again. For reasons already explained, we request the exclusion of this reference. [Brazil]	Noted, the text has been removed in revisions. This is an urban section and references to agriculture are related to urban here as per the Mugagga citation.
1636	29	28	32	3	Increasing maufacture industry moving from developed countries to developing countires and large infrastructure construction requires the concern on low carbon transition in developing counries' industry to avoid carbon lockin. THe status of current and emerging technologies in these countries should be empazied.. [Wenying Chen, China]	Accept, sentence "In the context of rising demand for construction in developing countries, an increasing share of industrial production is based there, where technical feasibility may differ." added but literature will have to be added as well - no literature references are provided.
17756	29	28	31	8	Recently, industries and large buildings integrage UPS or Energy Storage Systems for the emergency and efficiency. And the main system that is newly adopted is mainly the batteries. It is worth mentioning these trends. [Republic of Korea]	Noted. We would like to accept this comment, but are not aware of peer-reviewed literature on this point.

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28528	29	28	30	14	Section 4.3.5 Considering that Ch 4 is mandated to treat emerging options as well as established technologies, we would have expected a more than cursory discussion of the potential of carbon capture and use, in particular within the industrial sector. The potential of alternative solutions for currently carbon-intensive industrial processes or materials (in the building sector) is also dealt with in a very short and generic fashion. As this sector is one of the most difficult to decarbonize, we'd appreciate a more extensive and substantial discussion on both options, CCU and new processes and materials. [Germany]	Taken into account. We have expanded the discussion on CCU, CCUS and alternatives to current carbon-intensive materials. Unfortunately we are very space-constrained. For a more extensive discussion, AR6 has a significant section on this.
54104	29	28	30	8	Carbon negativity is not quoted as a means of decoupling the industry from CO2 emissions; Please consider adding the following text, or parts thereof: Carbon Capture, Utilizations and Storage (CCUS) by means of construction materials using bio-sourced carbon fiber manufactured using clean electricity, eventually assisted by CSP, has the scaling potential required to bridge the gap between +2°C scenarios and the +1.5°C objective. In fact, it is unlikely that the achievable rates of clean energy build and reforestation will match the CO2 emission reduction rates required by those scenarios. Scalable CCUS from building and construction materials, thanks to CSP-CR-technology for production of energy intensive carbon fibers, that have the potential to store carbon for millions of years and algal-oil-based carbon fiber precursor production have the potential to store and bind scalable amounts of CO2 on a sustainable basis (under current economic conditions at a rate in the 1-5 GtCO2 per year range). Carbon fiber is one of the most stable solid states of carbon element. Carbon fibers can replace steel, if production price is cut by a factor of 2 or more, with respect to current market price. CSP-CR technology brings the price down to that level. When algae is being fed with atmospheric CO2, it is possible to measure and claim actual CO2-negativity. The cited article states that it seems possible to produce between 0,7 and 1.1 Gt of carbon fibers to replace the annually needed 1,6 Gt of steel. 1.1 Gt of annual carbon fiber production based on algae growth would represent about 4 Gt of yearly captured and stored CO2. Furthermore, saving 1,6 Gt steel production would avoid additional 1,6 Gt of CO2 emissions, hence a total gain of 5,6 Gt CO2/annum (sum of avoided emissions and CDR - Carbon Dioxide Removal). It is striking that this technique is not quoted in figure 4.2 nor in chapter 4.3.8 Carbon Dioxide removal. Yet, CSP-CR, combined with agroforestry in semi-arid or desertic land, is one of the few solutions to the dissonance between available solutions and massive requirements for CDR in +1.5°C scenarios, as pointed out in paragraph 4.3.8.7 Overall feasibility assessment of CDR. Although the carbon fiber production is energy intensive, it can be driven by low-carbon electri power alone or assisted with CSP in dry, sunny regions, with an unrivaled capacity to permanently store carbon worldwide in Carbon Negative buildings, transportation, energy, water and other large infrastructure. We emphasise that these new findings should be mentioned in the next IPCC reports to be published in 2018 (SR15) and 2021 (AR6) to stimulate more research in the topic of the potential of carbon fibers to replace CO2-positive materials by CO2-negative ones. References to be published in ACS Journal : 1. main paper: "Energy Efficient Carbon Fiber Production with Concentrated Solar Power: Process-Design and Techno-Economic Analysis" Author(s): Arnold, Uwe; De Palmenaer, Andreas; Brück, Thomas; Kuse, Kolja Submitted to ACS Journal on 25 Nov. 2017 : Industrial & Engineering Chemistry Research / Manuscript ID: ie-2017-048416 2. Support Information (SI) paper: CCU by Algal Polyacrylonitrile Fiber Production: Process-Design, Techno-Economic Analysis and Climate related Aspects, Authors: Arnold, Uwe; Brück, Thomas; Kuse, Kolja; Depalmenaer, Andreas Submitted to ACS Journal on 21 Nov. 2017 : Industrial & Engineering Chemistry Research / Manuscript ID: ie-2017-04828v [Stephan Savarese, France]	Accept. The references are included in the sections on substitution and circularity as well as in CCUS.
37036	29	30	29	30	You should say "global final energy" here. [Lynn Price, United States of America]	Accept. Text revised
36960	29	31	29	32	…, industry will need to reach near-zero emissions in 2050 is a bit too strong, because 2050 CO2 emissions from industry remains to a certain degree, e.g., in Figure 2.23 (especially ETP). Should be revised. [Keigo Akimoto, Japan]	Accept, partially. The IEA ETP number in Fig 2.23 is a below 2 degrees scenario. The 1.5C IAM scenarios would allow for only half of the ETP B2DS number. We adjust the text to reflect the IAM 2050 1.5C number for industry CO2 emissions.
37038	29	31	29	32	The statement that "If global temperatures are to remain under 1.5°C, industry will need to reach near-zero emissions in 2050 (see Chapter 2)." is not really consistent with the information presented in Chapter 2. See Figure 2.24 and this text (on p. 2-68): "In 2050, from REF reduction final energy is increased by 16% [5–22%] (35% [12–52%]) compared with the 2010 level (red dotted line) for 1.5DS (2DS), but CO2 emissions and carbon intensity are decreased by 75% [57–89%] (53% [39– 70%]) and 76% [64–89%] (67% [59–77%]), respectively." This seems to indicate that by 2050 industry CO2 emissions will not yet be near-zero, but would have decreased by about 75%. [Lynn Price, United States of America]	Accept. Text revised to reflect the emission reductions in the 1.5DS scenarios to be over 70%.
60970	29	31	29	32	The pithy statement that "If global temperatures are to remain under 1.5°C, industry will need to reach near-zero emissions in 2050," if perhaps somewhat overstated, but if accurate, should be featured in the chapter summary for Chapter 2 and/or 4 and in the SPM. See also pages 2-67 to 2-68. These numbers don't seem to match up with the policy targets in Table 4.1, however. [United States of America]	Accept. The text is made consistent with chapter 2, figures 2.23 and 2.24 (see comments and responses 36960 and 37038)
62770	29	31	29	32	Not fully true, 1-4 GtCO2/yr still remain in 2050 (see Fig. 2.15 in Chapter). [Elmar KRIEGLER, Germany]	Accept, text revised. See comments 36960 and 37038.
11160	29	37	29	44	This paragraph does not clearly mentions about adaptation options in industrial systems. Business continuity management, supply chain resilience or risk management are shown as examples. Options in mining, insurance and finance are mentioned in the references. However, Pauw et al (2016b) menstions about climate finance of UNFCCC, but no explanation in adaptation options in industry. I recommend to delete some references and put more direct examples instead. Otherwise it is difficult for readers what are adaptation options in industry. Section 4.3.5 is referred to understand "good candidates for adaptation implementation in industrial transformation" at line 1, page 92, but this paragraph does not give good examples for adaptaion measures in industrial energy system. [mikiko Kainuma, Japan]	Accepted -pauw et al reference removed
52134	29	41	29	44	The idea of risk is tricky. It's a commonly used word that is used in different ways by different disciplines and different contexts. There are financial risks, environmental risks, etc. How is it being used here? What is being 'risked'? [Jason Donev, Canada]	Accepted - text in question and reference to risk has been removed
7098	29	42	29	43	Another reason is lack of resource or motivation to document actions that contribute to adaptation. (Pauw and Pegels, 2013). Pieter Pauw & Anna Pegels (2013) Private sector engagement in climate change adaptation in least developed countries: an exploration, Climate and Development, 5:4, 257-267, DOI: 10.1080/17565529.2013.826130 [Jose Di Bella, Canada]	Noted - text in question has been removed from final draft
13232	29	47	29	48	Delete the text "and the development of a circular economy industry". [Eleni Kaditi, Austria]	Reject. This is part of the references cited.
37204	29	52	29	52	Term..."capture and storage" is used, recommend using CCS for consistency. [John Scowcroft, Belgium]	Reject. The phrasing of the sentence does not allow for "CCS". The meaning is the same.

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62178	30	1	30	6	Figure 4.2 is not very useful, because it mixes real life solution with theory, without any ranking or analysis of potentials. The ECEEE and ECEEE littérature is full of better explanation on the options for industries. [Antoine Bonduelle, France]	Accept. Figure is removed.
4290	30	3	30	4	Figure 4.2 is very, very wrong, a very big flaw in this SOD report. The reference Bataille et al. seems irrelevant and incomplete and I wonder why/how has this very low scientific quality material been leaked here. Please read again the caption of the figure ("choices of mitgiation options …to stay below 1.5ºC") and think twice before building a brutally simplistic/wrong answer like this Figure. Example of meaningless rethoric key words in this figure _ "Carbon capture and utilization or storage" (is it the same to store CO2 than to use it ??). CCS (o CCUS) splits in four arrows on the top right hand side of the figure: is it really a representation o the state of the art these categories/arrows : what the hell is the meaning of "Coal NG 1970ºC"?, is a "solid oxide fuel cell NG (900ºC+electricity)" one of the 4 main CCUS options? where is the evidence/reference for such an outrageous claim?, if "chemical looping" is mentioned (a particular set of emerging CO2 capture tech) why not "membranes", "solid sorbents", "advanced solvents" or "calcium looping".... that are equally big emerging CO2 capture techs???. What is "Biomass 1970ºC"?????.... ALSO LACKING ANY LOGIC OR CONNECTION TO REALITY ARE THE FOUR OPTIONS FOR "ALTERNATIVE HEAT SOURCES" (DO YOU REALLY THINK ALL POSSIBLE HEAT SOURCES IN A SECTION FOR INDUSTRIAL SYSTEMS CAN BE SUMMARIZED LIKE THAT????).....I HONESTLY THINK THIS WHOLE FIGURE IS SUCH A HUGE FLAW THAT ALL CONTRIBUTIONS FROM THE LEAD AUTHOR RESPONSIBLE FOR ITS INCLUSSION SHOULD BE EXAMINED WITH CARE.... [Abanades Carlos, Spain]	Accept. Figure is removed.
52136	30	4	30	4	There is no mention of Small Nuclear Reactors (SMRs) as a disruptive technology that can provide reliable electricity with no need to rely on non-existent grid storage technology. With dozens of companies in several different countries having submitted requests for review by the regulatory commissions, this disruptive technology is on the horizon and should be included here. [Jason Donev, Canada]	Noted. Nuclear energy (and electricity supply in general; SNRs are not the only solution for low-carbon electricity for industry) is discussed in section 4.3.1. No references provided for this comment.
48112	30	7	30	7	Mention year for Bataille et al. [Sarah Connors, France]	Taken into account. It was not yet accepted at the time of writing
10582	30	9	30	14	Table 4.4 gives an overview of which mitigation options are applicable to which industrial sectors.' Some elaborations should be given in the text. If the table is self-explanatory, it is better to put the sentence in the previous paragraph. [Hong Yang, Switzerland]	Accepted. Sentence is moved to the previous paragraph.
7934	30	12	30	14	In table 4.4 you may wish to mention alternative chemistries for cement. The "Bataille et al" already mentioned source includes a section on these. [Christopher Bataille, Canada]	Accept, suggestion included in the table
31532	30	12	30	14	The phrase "1.5°C consistent mitigation options" on Table 4.4's legend is a bit strong because the contents of Table 4.4 as a whole tell us that these mitigation options can be or are expected to be used but not necessarily sufficient for 1.5°C. Therefore, we recommend selecting some alternative expressions, e.g., "mitigation options possibly consistent with 1.5°C", or "mitigation options potentially consistent with 1.5°C". [Japan]	Accept, suggestion included in the table caption
34696	30	12	30	14	Table 4.4: Applicability of different 1.5ºC consistent mitigation options to main industrial sectors, including 13 examples of application (Boulamanti and Moya, 2017; Napp et al., 2014; Wesseling et al., 2017). It is suggested to restructure the table because in its current state it is not clear in its contribution to the text. Its title is "Applicability of different 1.5ºC consistent mitigation options" and it does not reach that objective when presenting options and how applicable they are, as well as the criteria for it. [Mexico]	Taken into account The idea of the table is that we show which mitigation options can apply, and how, to which industrial sectors. The sentence in the caption explaining this is revised for clarity.
4292	30	12			Table 4.4 looks also quite poor. It contains a few loose statements that are not supported by the references used in the caption (example "Cokes can be made from biomass instead of coal" REALLY?, reference?) . Also, I have checked Boulamanti and Moya 2017 (Renewable and Sustainable Energy Reviews 68 (2017) 1205–1212) and such paper has little to do with "1.5ºC consistent mitigation options" why is it referred here?? . Also, the reference to CCS is not good , wht do you mean with "...but not near zero" ? .. it is well established in this report that CCS can be even negative when fired with bifuels.. In view of these major flaws, a major scrutiny of this section has to be carried out before publication. [Abanades Carlos, Spain]	Partially accept. Bio-based steel may be obvious to a professor in chemical engineering, but not to the obvious reader. Boulamanti and Moya certainly discuss 1.5C-relevent (but indeed not specific) options in industry. We discuss here only industry and CC(U)S, not bio-based industry and CC(U)S, for that we refer to section 4..3.7.
55092	30	12	30	14	Table 4.4: the previous paragraphs seems to imply that "bio based" should be considered as a sub element of circularity & substitution. Hence the suggestion to merge these two rows. [Yamide Dagnet, United States of America]	Taken into account. Not the two rows are merged, but the paragraph is split.
62772	30	12	30	13	Would not label the options in Table 4.4 "1.5°C consistent". This will depend on the pathway they are embedded in. What about "decarbonisation options"? [Elmar KRIEGLER, Germany]	Taken into account/Reject. Sentence edited to soften the "1.5C consistent" according to comment 31532. However, not all options (such as fossil-based CCS) are decarbonisation options.
52138	30	13	30	13	Please be careful about the difference between 'cement' and 'concrete' they aren't the same thing. [Jason Donev, Canada]	Noted. We have checked the table for this.
1640	30	16	31	8	Considering industrial efficiency in developing countries much lower than in developed countries and increasing maufacture industry moving from developed countries to developing countires, it is suggested to start with the importance (not just necessary but insufficent) of energy efficiecy improvement for low carbon transition of industry. References: 1)Chen W, Yin X, Ma D, 2014. A bottom up analysis of China's iron and steel insustrial energy consumption and CO2 emissions. Applied Energy, 136:1174-1183. 2) Li N, Ma D, Chen W, 2017. Quantifying the impacts of decarbonisation in China's cement sector: A perspective from an integrated assessment approach. APPL ENERG. 185:1840-1848. 3) Ma D, Chen W, Yin X, Wang L, 2016. Quantifying the co-benefits of decarbonisation in China's steel sector: An integrated assessment approach. Applied Energy, 162(C):1225-1237. 4) Ma D, Hasanbeigi A, Price L, Chen W, 2015. Assessment of energy-saving and emission-reduction potentials in China's ammonia industry. Clean Technologies and Environmental Policy, 17: 1633-1644 [Wenying Chen, China]	Taken into account. Two of the references (unfortunately not all because of lack of space) incorporated, the one on the ammonia industry and on cement in China.
37040	30	16	31	8	See this text from Chapter 10 Industry of AR5 (WGIII): "...many options for energy efficiency improvement remain and there is still significant potential to reduce the gap between actual energy use and the best practice in many industries and in most countries. For all, but particularly for less energy intensive industries, there are still many energy efficiency options both for process and system-wide technologies and measures. Several detailed analyses related to particular sectors estimate the technical potential of energy efficiency measures in industry to be approximately up to 25% (Schäfer, 2005; Allwood et al., 2010; UNIDO, 2011; Saygin et al., 2011b; Gutowski et al., 2013). Through innovation, additional reductions of approximately up to 20% in energy intensity may potentially be realized before approaching technological limits in some energy intensive industries (Allwood et al., 2010)." [Lynn Price, United States of America]	Noted. We are supposed to be additional to chapter 10 in the AR5, and this is a feasibility assessment, not a potential assessment.
62062	30	16	31	37	It would be good to provide a quantitative insight on the contribution of energy efficiency, recycling and elettrification in the quest for a decarbonised industrial system. [Sara Giarola, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This is addressed in chapter 2 (section 2.4.3.1). A reference to this section is included.
49770	30	17	31	8	Energy efficiency is even harder to be implemented in non energy intensive industries where the energy bill is a minor part of the costs and the management prioritizes the optimization of other inputs. An example is the food industry. Although the sector as a whole consumes a very relevant amount of energy, energy is a relatively little cost in comparison with e.g., labour or feedstock buying. See again (Monforti and Pinedo - eds -Energy use in the EU food sector: State of play and opportunities for improvement, EUR 27247 EN) and the references therein. [Fabio Monforti-Ferrario, Italy]	Taken into account. The final sentence of this section (4.3.5.1 in SOD; 4.3.4.1 in final draft) makes precisely this point. Admittedly, not very elaborately, but we lack the space to do more.
52140	30	17	30	17	Would it be 'industry' or 'industries' here? [Jason Donev, Canada]	Accept. Revised.
46412	30	19	30	19	The statement "In general, their feasibility depend on lowering…." neeeds correction of verb "In general, their feasibility depends on lowering….". [Ijaz Ahmad, Pakistan]	Accept. Revised.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
51274	30	19	30	19	In general, their feasibility depend on neeeds to be changed to "In general, their feasibility depends on". [Muhammad Latif, Pakistan]	Accept. Revised.
52142	30	20	30	20	ICT? [Jason Donev, Canada]	Taken into account. Abbreviation explained in text.
48664	31	1	31	1	Energy management (see IEA publication mentioned in row 23) is missing for industry [Yamina Saheb, France]	Noted. The reference to IEA is unclear (the rows change in the total batch of comments). Energy management is mentioned in the previous paragraph.
52144	31	1	31	1	SMEs? [Jason Donev, Canada]	Accept. Acronym is explained.
1638	31	2	31	6	Don't understand what "effciency potential of around 20-25%" menas. And please indicate clearly these number is for a certain sepecific country or global average. [Wenying Chen, China]	Accept. It is energy efficiency improvement potential, globally. Text revised
62180	31	2	31	8	Electric motors represent 66% of electricity (IAE) use and can be replaced by systems over two thirds more efficient if one combines new technology, speed variators and sizing. Share of electricity use in industries vary among countries, but these figures misrepresent the potentials. Barriers are numerous, but potentials are much higher. See all the body of litterature from European Council for an Energy Efficient Economy (ECEEE). At least, this paragraph should split on one side the potentials (much higher) and the effective implementation (smaller). [Antoine Bonduelle, France]	Noted. References are unclear here, and the references we cite are detailed on this as well and indicate that in very special cases, higher improvements can be reached but not across the board.
60972	31	4	31	4	Clarify statement: efficiency potential of around 20-25%. Does this mean an efficiency savings potential of 20-25%? Of a process efficiency potential? [United States of America]	Accept. See response to comment 1638.
6416	31	6	31	7	You may want to name here mechanical vapour recompression, sort of heat pump scheme that is particularly efficient in avoiding the latent heat losses [Cedric Philibert, France]	Noted. We could not locate peer-reviewed literature on this technology.
36108	31	6	31	8	In theory, Waste Heat Recovery Systems has potential for emissions reduction. However, when implemented in cement and steel manufacturing units, the surplus power generated is often purchased at a lower rate by distribution companies - thus disincentivising plant mangers to install WHR systems. The excess power must be purchased at a rate that is conducive enough to recover capital costs. Because of these reasons, despite the potential, WHR systems are not sought after by energy intensive industries. (Sengupta P., Dutta S.K., Choudhury B.K. (2018) Waste Heat Recovery Policy. In: Gautam A., De S., Dhar A., Gupta J., Pandey A. (eds) Sustainable Energy and Transportation. Energy, Environment, and Sustainability. Springer, Singapore). More citations are required to substantiate this. [India]	Rejected. We tried to understand this comment, but after some research could not agree on a clear action on this. The abstract of the reference given did not give this barrier to WHR systems. Also not clear what power has to do with WHR systems - many of them will deliver low-caloric heat that cannot generate power, or it is used in the system itself and not sold.
18598	31	10			4.3.5.2 section is inconsistent in contents. Bioenergy should not be discussed here, only material uses (energy could be cross-referenced). The drawbacks of bio-based products go beyond land demand, and include the (often higher) energy requirement than the non-biogenic alternatives. Also, if they are biodegradable, then their carbon is eventually (re) emitted to the atmosphere, whilst non-degradable materials may pose a disposal problem, but can lead to sequestration. [Andrea TILCHE, Belgium]	Accept. Text revised to reflect this.
37410	31	10	31	14	I appreciate that the circular economy is mentioned here as one element of deep decarbonization. In my view, there are many more issues to be mentioned in this context. Raising circularity is important, as it is now a cornerstone of sustainability policies in large and influential regions, e.g. the European Union, so I think they deserve a much more comprehensive treatment. See for example several papers by authors like Daniel Müller (NTNU) and Stefan Pauliuk on metal cycles (e.g. the steel cycle). However, I also think it is important to discuss the fact that the maximum amount of circularity that could in theory be achieved is currently relatively small as a result of the large fraction of resource (material) inputs that are used to build up stocks like buildings, infrastructures (roads, etc.), production capacities, etc. As Haas et al. (2015, J Industrial Ecology vol 19) show, potentials to further raise circularity can only grow substantially if the rapid growth of global in-use stocks of materials (buildings, infrastructures, machinery, etc.) is reduced. Krausmann et al. (2017, PNAS vol 114) have shown that during the last century, the fraction of all material inputs of humanity allocated to building up such stocks has grown from ca20% in 1900 to over 50% today, that stocks grow in unison with GDP over the entire century, and they also analyze the implications of this stock growth for future GHG emissions respectively the possibility of respecting C budgets consistent with the 2°C target (those for 1.5 are even stricter...). So I think this whole discussion about circularity could be strengthened by incorporating these recent literatures. [Helmut Haberl, Austria]	Accept, very useful feedback. The paper by Mueller and Pauliuk is a bit too detailed for this rather generic section, but Haas et al 2015 is included.
60974	31	10	31	21	This section could be shortened or deleted. [United States of America]	Reject. It is already very short, has a number of relevant, peer-reviewed references, and the mitigation options are widely recognised as important for getting industry to near-zero emissions.
62774	31	10	31	37	It would be useful to say something quantitatively about the amount of bionergy and electricity, respective, that would be needed to replace a certain amount of fossil fuels in industry. [Elmar KRIEGLER, Germany]	Noted. We could not find this particular number in the literature. Chapter 2 might make assumptions on this in the IAMs.
13234	31	11	31	11	Delete the text "and developing a circular economy". [Eleni Kaditi, Austria]	Reject. There is no doubt that developing a circular economy is institutionally challenging, and this is document in the literature.
7936	31	12	31	12	Separate "...2006)but" [Christopher Bataille, Canada]	Accept. Done.
36110	31	12	31	12	Add space between '(Henry et al., 2006)' and 'but' [India]	Accept. Done.
52146	31	12	31	12	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Accept. Yes, this is not the only place where this happened, it was not in pdf conversion but earlier and really annoying!
16494	31	18	31	20	Point not clear. Is this section about bio-based materials or bioenergy? [Australia]	Accept. Reference to bio-energy clarified and removed (except for one point where it relates to bio-based feedstocks. Bioenergy is covered in section 4.3.2 (4.3.1 in the final draft).
47152	31	28	31	28	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accept. Text repaired.
11060	31	31	31	31	use of hydrogen, produced either by gas with CCS or electrolysis of water with renewable power, is affected [Wilfried Maas, Netherlands]	Accept, useful further explanation. A sentence is introduced: Low-emission hydrogen can be produced either by natural gas with CCS, by electrolysis of water powered by zero-emission electricity, or in the future potentially by generation IV nuclear reactors. (see also comment 52148)
6418	31	33	31	34	You might have misread Philibert 2017, whose main finding is precisely that with current electrolysers and renewable electricity costs in areas with excellent solar and/or wind resources, use of hydrogen to manufacture some chemicals, notably ammonia and methanol, is economically feasible now. [Cedric Philibert, France]	Accept. Text revised.
7938	31	33	31	33	Replace "and associated public perception, by economic feasibility" with "by associated public perception, and by economic feasibility" [Christopher Bataille, Canada]	Accept. Text revised.
6420	31	34	31	37	Introducing renewable-based hydrogen as a reducing agent in steelmaking might be less disruptive than CCS or CCU, in particular as 30% today, 50% by 2030 of steel is produced through the direct reduction route, in which at least a partial enhancement of syngas from natural gas reforming, with renewable-based hydrogen, could be progressive and done in existing steel-making faciliities (Philiber, 2017). [Cedric Philibert, France]	Accept. Text revised and reference added (in the first sentence of this section)

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6422	31	34	31	37	Philibert (2017) suggests that procurement, private or public (see, e.g. the 2017 Buy Clean Caliofrnia Act) of green or greener materials, could be a way forward to jumpstart deployment of greener industrial processes of materials.At a later stage international sectoral agreements or country's standards can generalise improvement. [Cedric Philibert, France]	Noted. Procurement is discussed (very briefly) in the policy section (4.4.5). This section is only about the feasibility of the mitigation options.
7940	31	34	31	34	Replace "The high costs of disruptive change to hydrogen- or electricity-based international trade-sensitivity of many industrial sectors" wuth "The high costs of disruptive change associated wiht hydrogen- or electricity-based production for trade sensitive " industrial sectors" [Christopher Bataille, Canada]	Accept. Text revised as suggested.
10090	31	34	31	37	Feasibility concerns in terms of costs and competitiveness for industrial processes are true for almost all mitigation options and technologies in the context of 1.5c and not just for electrifications and the use of hydrogen. Both of the cited references Ahman et al and Nabernegg et al seem to agree on this. [Saudi Arabia]	Accept. Text generalised and moved to the chapeau of this section.
50752	31	38	31	38	Hydrogen used with fuel cells needs to be mentioned. One possibility is the use of renewable hydrogen (Tasneem Abbasi S.A.Abbasi, 'Renewable' hydrogen: Prospects and challenges" Renewable and Sustainable Energy Reviews Volume 15, Issue 6, August 2011, Pages 3034-3040) or the use of appropriate fuel cell technologies like direct methanol fuel cells (DMFC) or direct ethanol fuel cells (DEFC). -- A reference for for DMFC: R.Dillona, S.Srinivasana, A.S.Aricòb, V.Antonuccib "International activities in DMFC R&D: status of technologies and potential applications". Journal of Power Sources Volume 127, Issues 1–2, 10 March 2004, Pages 112-126. -- A reference for for DEFC: H. Devianto ; I. Nurdin ; M. Eviani ; A. Yudistira, "Effect of start-stop cycle on Direct Ethanol Fuel Cell for transportation purpose " Electric Vehicular Technology and Industrial, Mechanical, Electrical and Chemical Engineering (ICEVT & IMECE), 2015 Joint International Conference , 4-5 Nov. 2015. [Francisco Javier Hurtado Albir, Germany]	Accept. Fuel cells mentioned but references not included.
52148	31	38	31	38	There is no mention of generation IV nuclear reactors that can provide hydrogen as a fuel. The high temperature heat available from proposed nuclear reactors would make significant contributions to hydrogen as an energy carrier. See for example: "Hydrogen production using high temperature nuclear reactors: Efficiency analysis of a combined cycle" by Jaszczur et al in International Journal of Hydrogen Energy Volume 41, Issue 19, 25 May 2016, Pages 7861-7871. This is one of dozens of papers on this subject. [Jason Donev, Canada]	Accept, included in the sentence in comment 11060.
12282	31	40	31	40	This section could be expanded more, i.e. to reflect that industrial CCS projects (e.g. Quest in Canada, Illinois CCS project in US) are capturing and storing CO2 (non EoR use). It should also be reflected somewhere that CO2 has been permanently stored for over 20 years in the North Sea to address any concerns around the feasibility of permanently storing CO2 offshore (and also addresses some of the public perception issues). [United Kingdom (of Great Britain and Northern Ireland)]	Accept. Statement included on demonstration projects, and also on Sleipner
18600	31	40			4.3.5.4 section should reflect on the inherent energy loss involved in upgrading CO2 (thermodynamic barrier), which makes energy use almost prohibitive, except for some (unlikely) situations, such as where plentiful renewable energy is available without better uses. [Andrea TILCHE, Belgium]	Taken into account. This is indeed a huge barrier that under normal conditions would lead to prohibitive costs and energy balances. However, the recent cost developments in renewable energy have changed the situation somewhat, and studies are now appearing that are looking at low-cost CSP for processing CO2 and overcoming the thermodynamic barriers.
39240	31	40	31	43	The phase 'public perception' prejudges the situation - is perception the only problem, or are there actual negative experiences on which this perception is based? Otherwise, this reads as policy perscriptive. [Lindsey Cook, Germany]	Reject. Public perception is a common and widely used word in this context.
10092	31	41	31	53	The technical and economic potentials of CCS make the technology run at the top of all mitigation options discussed for industrial process in the section. Such evidence need to be brought up to the executive summary and be included in the SPM messages of the chapter on mitigation options. [Saudi Arabia]	Taken into account. There are statements to this avail in the chapter 4 ES.
33970	31	41	31	44	It seems like this sentence refers to 'retrofitting post combustion CO2 capture on existing plants'. In such cases, the sentence is OK. Nevertheless, it is important to note that retrofitting CCS on an (old) emission point, might be less efficient than integrating CCS with a new built plant, e.g. the HISARNA process for steel making, ref: "Renewable Energy for Industry", IEA 2017. In light of that much of the industrial plants – at least in OECD countries - are rather "mature" and could be ready for renewal, CCS might be more relevant where new plants are built and CCS are an integrated part. Please consider to balance this paragraph to reflect this. [Norway]	Accept. Text revised to reflect this.
37240	31	42	31	43	We refute that public perception of CO2 storage is low, please see previous comments. [John Scowcroft, Belgium]	Reject. The statement that public perception is low is not in this paragraph (this comment will be addressed in 4.3.1 where this is discussed more extensively).
24128	31	43	31	43	would leave the production process of materials relatively untouched. I disagree. Many of these processes are many many decades old and have barely changed for a long time. The level of change to the processes that would be needed to effectively integrate CCS looks almost revolutionary in these conservative industries and value chains. [Simon Bennett, France]	Accept. We add "compared to the power sector" and also "although significant investments and modifications have to be made." to make sure this point is not lost.
7942	31	44	31	44	Replace "Some CO2 stacks in industry " with "Some CO2 stacks in industry, e.g. for hydrogen production for ammonia production or refining," One of the best sources for this is Leeson, D., Fennell, P., Shah, N., Petit, C., Mac Dowell, N., 2017. A Techno-economic analysis and systematic review of carbon capture and storage (CCS) applied to the iron and steel, cement, oil refining and pulp and paper industries. International Journal of Greenhouse Gas Control In press, 71–84. doi:10.1016/j.ijggc.2017.03.020. I would add this to Metz et al (2005). [Christopher Bataille, Canada]	Accept the reference, not the edit for lack of words.
33972	31	47	31	50	The Fluor plant in Bellingham reported 4.2 GJ per ton CO2 in the 90's. Ref: https://www.usea.org/sites/default/files/event-/Rochelle-%20research%20opportunities%20and%20problems%20for%20amine%20scrubbing%20short2.pptx, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.204.8298&rep=rep1&type=pdf. The numbers from Idem (2015) might be verified with professor Hallvar Svendsen at NTNU. 1.8 GJ per ton CO2 seems more like a theoretical minimum, rather than an verified number from industrial operation. Moreover, it should be mentioned what type of application these numbers refers to; capture from coal boiler based flue gas or NGCC based flue gas? Also, drawing the conclusion that this improvement have increased "both technical and economic potential for this option", might be a bit too optimistic, since the cost of energy is only one element of the overall cost of the CO2 capture process. Reducing energy use may also increase the complexity of the process and the cost of the amine itself. Please consider to take this reflections into account. [Norway]	Taken into account. The reference is a review of different pilot plants. Upon closer read, the 1.8GJ/tCO2 is a modelled outcome. The best pilot plant is about 2 GJ/tCO2. Number is corrected.
52150	31	47	31	50	This is an impressive improvement, but is a little inconsistent with the previous statement (pg 17 line 53 to page 18 line 5) on the cost not improving. I think this needs to be explained. [Jason Donev, Canada]	Reject. Energy use improvement is not the same as cost improvement.
16496	31	50			It is suggested that this section include two additional notes: 1) that details how many large scale CCS projects are operating in industrial-processes (add to existing sentence on lines 50-51) 2) The opportunities for CCS in industrial processes warrants further attention or recognition given economies' continued reliance on chemicals, cement, steel production etc.; most of which involve CO2 intensive processes. [Australia]	Accept. We are extremely limited in space, but have included reference to demonstrations and also to the inherent CO2-intensiveness of several industries. The point on the difficulty of demand substitution is also taken into account in section 4.3.4.2 (new section numbering).
37208	31	50	31	50	Incorrect that 1MtCO2 is full scale. The references Global CCS Institute's defintion of full-scale (known by Institute as Large-scale Integrated Facility) is 400,000 tonnes per annum CO2 captured from an Industrial facilty and 800,000 tonnes per annum CO2 captured from power sector. [John Scowcroft, Belgium]	Reject. If those numbers are full scale, than 1Mt also is.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
37210	31	52	31	53	The sentence needs clarity and rewriting as unsure of sentiment...."The heterogeneity of industrial production processes might point at the need for specific institutional arrangements for industrial CCS (Mikunda et al., 2014), and may decrease institutional feasibility." [John Scowcroft, Belgium]	Taken into account. Some words added to accommodate this.
14082	31	54	31	54	Suggest adding the following sentence: "For deep CO2 emission cut in many industries, like cement, there are often no alternatives to CCS. CO2 is a by-product in the cement production, and removing most of the CO2 emissions from cement is not possible without CCS" [Aage Stangeland, Norway]	Accept. Slightly shorter sentence introduced in the middle of the para (where it seemed to fit the flow better).
4294	31	55	32	3	The issue of utilisation of Carbon dioxide from industry, CCU, requires more precise wording. In the context of this section (i.e. global CO2 emissions from industry) I assume you are referring only to fossil sources of carbon (i.e. CO2 from the atmophere or from biofuels is out of scope in this section). If this is the case, I think it is important to note that, when the source of carbon is fossil and the final product is a fuel for transport (i.e. with a very short life time before it is burned to CO2 again), the climate mitigation potential is very small (maximum 50% of the CO2 used) because the carbon is finally released as CO2 to the atmosphere (Abanades et al. 2017). Furthermore, the potential benefits can only be realised using surplus carbon-free electricity, that tends to be available only as peaks of high power in relatively brief periods of time . Both papers (MacDowell 2017 and Abanades 2017) can be used to support the claim that this makes CCU non-economic in most applications. [Abanades Carlos, Spain]	Partially accept. This is all true and will be more clearly incorporated in the text. Other review comments and references are pointing out, however, that the chances of availability of cheap, zero-emission electricity have increased dramatically over the past years, and that this should be reflected too (see comment 6424, and also comments in the hydrogen section).
10096	31	55	32	3	The conclusion that carbon dioxide utilization in industry has a limited role to play is rather strong given that only one study is cited (MacDowell et al). There seems to be a growing list of applications to carbon utilization in industry such ac building and construction materials that may have large potentials for scale up given the high expected demand for building and construction materials in developing countries due to population growth and income growth [Saudi Arabia]	Taken into account. Some words added to accommodate this.
17758	31	55	32	3	Until now, a comparative analysis of various CO2 utilization and storage technology has no been done well. (Comparison analysis should be done by Life-cycle assessment analysis etc.) [Republic of Korea]	Accept. Is adopted in the Knowledge gaps section: in the knowledge gaps section, the sentence is "Life-cycle assessment-based comparative analysis of CCUS options are missing, as well as life-cycle information on electrification and hydrogen."
45504	31	55	32	3	I rather agree, but there is a huge current emphasis on CCUS whch mght be worthwhile explaining [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Further explanation added, the section was indeed very short.
62776	31	55	32	3	I am not fully convinced by the MacDowell et al analysis, assessment should look for more literature if there is any. I think in particular carbon fibre (including as part of compound materials), bioplastics, methanization and synthetic hydrocarbon use (e.g. in chemical sector) are promising candidates for CCU. It is important to separate between CO2 captured from fossil fuel combustion and captured from air (via DAC, algae etc.) in the discussion of CCU. Only the latter can remove CO2 from the atmosphere. [Elmar KRIEGLER, Germany]	Accept. This is incorporated in the section on circularity (4.3.4.2)
6424	32	1	32	3	Abanades et al. 2017 make clear that the main challenge to CCU cost reduction is not the CO2-to-fuel conversion step but the production of required carbon-free electricity at very low cost. This is precisely what is changing very rapidly now. Costs below USD 30/MWh are now seen in some new renewable capacities and many auctions to new capacities. According to Hannula (2016), Breyer (many articles) and Philibert (2017) this is the threshold below which synthetic hydrocarbon from recycled CO2, as well as green ammonia, become economically feasible. [Cedric Philibert, France]	Accept, text added that reflects this.
6426	32	1	32	3	Also note that under in the paper by Abanades et al. 2017, the preference for CCS is all the more important that they suppose that the carbon-free electricity (which would be required for making hydrogen to recycle CO2) could be left available to reduce the unabated carbon emissions of a coal plant. However, it may well be that past some large share of variable renewable energy it becomes very difficult to introduce more. Moreover, immense resources are available in remote parts of the world where there is little demand for electricity, so a deployment of renewable assets would only be possible to fuel some process for manufacturing exportable fuels or energy-intensive materials. [Cedric Philibert, France]	Accept, text added that reflects this.
24130	32	1	32	3	This gives the impression that the conversion of CO2 to fuels using renewable energy is equivalent to CCS. It is not. CO2 conversion serves a different purpose: the stabilisation of hydrogen as a fuel in situations where direct use of hydrogen or its transport and storage are prohibitively expensive. Treating it as a CO2 mitigation option opens a pandora's box of lifecycle accounting. As an editorial comment, I would replace "renewable" with "low carbon" or "CO2-free" in this sentence and throughout the report when the orgin of the electricity is less important than its CO2 footprint. [Simon Bennett, France]	Taken into account. This is indeed not the impression we want to give. As for the text suggestion: accepted.
31654	32	1	32	3	CO2 conversion to fuel does not reduce emissions since there is only a temporary storage in the fuel, unless e.g. geological storage is added at some point. In the best case this could be fossil-based CO2 that is temporarily stored, and maybe renewable energy linked to CO2 fuel production could replace some new fossil fuel. [Asbjørn Torvanger, Norway]	Accept. This is reflected in the text.
63244	32	3	32	3	Add paragraph like: On the other hand, spontaneous conversion of point-source CO2 to bicarbonate and carbonate would have very large commercial and especially environmental applications. For example, ocean acidification can be neutralized with such alkalinity, and considering the size and degree of ocean area affected, the demand for such alkalinity to restore ocean pH could dwarf commercial markets for all other beneficial carbonateous compounds derived from waste CO2 (Rau 2011, Albright et al 2016, Feng et al. 2016; Renforth and Henderson 2017). Consideration of marine biotic and abiotic approaches to commercial and benficial uses of waste CO2 could grealty expand production and consumption potentials in a way that aleviates pressures on land resources that are so critical for achieving SDGs. This needs to be incorporated into climate and SGD policy, roadmapping, modeling and R&D. refs: E. Y. Feng, D. P. Keller, W. Koeve, and A. Oschlies. Could artificial ocean alkalinization protect tropical coral ecosystems from ocean acidification? Environmental Research Letters, 11(7):074008, 2016. Rau, G.H., 2011. CO2 Mitigation via Capture and Chemical Conversion in Seawater. Environ. Sci. Technol. 45, 1088–1092. doi:10.1021/es102671x. Albright, R. et al. 2016. Reversal of ocean acidification enhances net coral reef calcification. Nature 531, 362–365. [Greg Rau, United States of America]	Taken into account, though not in this section. Section 4.3.7 on CDR includes the notion that increasing ocean alkalinity helps counter ocean acidification, including some of the references mentioned in this comment. For further discussion of this option, we refer forward to the AR6, which will have more space to go into details.
18602	32	5			4.3.6 The section should emphasize ecosystem-based adaptation as it is essential and often cost-effective. In addition, the adaptation needs of forests would deserve attention, as they need a very significant lead time (due to the long production cycle, forests planted today would be expected to live in 2100), their fundamental dependence on (and vulnerability to) climate, and their crucial role in stabilising the environment and providing essential raw material, optional renewable materials and (for now) the bulk of renewable energy. [Andrea TILCHE, Belgium]	Rejected - EBA and discussion of forests is covered in 4.3.3.
57352	32	5			The listed adaptation options are discussed extremely briefly and superficially. How these adaptation options “cut across systems” is not clear and therefore there is little added value of this section. [Hans Poertner, Germany]	Accepted - text revised
60976	32	5	33	16	It is not clear why these five categories of "Overarching adaptation options" were identified here (and in 4.5) at the expense of others. For instance, "climate forecasting" and climate services (mentioned in Table 4.9 as an option related to land and ecosystem transitions) is relevant across many adaptation issues and sectors. [United States of America]	Accepted - we have moved Indigenous knowledge systems and Climate services to the overarching adaptation options section.

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60978	32	5	33	16	This section would benefit from brief discussion of the social context of adaptation and the role of values across scales, importance of culture, heritage, and place. These concepts link components of adaptation listed and provide a means for following connections between them. An important starting reference for this topic is Adger et al. 2009, "Are there social limits to adaptation to climate change?" [United States of America]	Accepted - text revised (added discussion on socio-cultural context of adaptation to a number of adaptations discussed. Noting section 4.4. also deals in greater depth with such issues)
54012	32	7			add "efficient, agroecological and peasant based food production". Delete afforestation, as monoculture plantations are a hinder to adaptation, not a sinergy. Ref: World Rainforest Movement, http://wrm.org.uy/browse-by-subject/deforestation/direct-causes/large-scale-monoculture-plantations/ [Elenita Daño, Philippines]	Not applicable - comment not relevant to text (e.g. afforestation in not mentioned here)
31992	32	16	32	24	4.3.6.1 Disaster risk management - the missing point is the public/people risk perception. The people risk perception are crucial in a disaster risk management like the experts' technical assessments. [Sisira S. Withanachchi, Germany]	Accepted - text revised
49974	32	16	32	24	Additional discussion on case studies on converging or integrating DRM and adaptation (CCA) will enrich this section. In Indonesia for example, the GoI is already put a framework on converging DRR and CCA. [Perdinan Perdinan, Indonesia]	Accepted - reference added but focusing on the Philippines not Indonesia
28530	32	19	32	24	These sections should be added to the SPM (page SPM 7, section 2.1, additional bullet [7th] point, line 47 onwards) and reflected in the executive summary. It shows the interlinkages between extreme events and their impacts, adaptation needs and disaster prevention - and the need for an integrated view. [Germany]	Accept. We have included part of this in the ES and elements have also made it into the SPM.
7754	32	22			for 1.5C read 1.5?C. [Amory Lovins, United States of America]	Accepted - text revised
60980	32	22	32	23	Is there any evidence of increased capacity for integration of DRM into adaptation (including existing practices that double as adaptation)? [United States of America]	Accepted - text revised (new text and references added)
30620	32	27	32	35	This paragraph on education is quite succint. The findings in the different studies quoted could be more expanded. [France]	Noted - text not amended because detailed assessment is given in Supplementary Material 4 A. Further details on awareness, knowledge and their impacts on mitigation and adaptation behaviour are made in Sec 4.4.3.1.
37238	32	27	17	35	We would strongly agree with these points about education and learning and add that from our experience on CCS deployment, that when adequate time and investment is made in improving public education and understanding of new technologies does not just improve peoples ability to adapt but also to accept mitigation technologies and even new build infrastructure. (GCCSI, 2016) [John Scowcroft, Belgium]	Accepted - text revised (reference made to section 4.4.3 which examines adaptation and mitigation benefits of education)
55094	32	27	32	35	Education & Learning should be treated as a crosscutting issue. It can be noted that the gaps are more important on adaptation, but we are not where we should be on education and learning on mitigation and understanding ways to scale support, to achieve the transition we want to see. [Yamide Dagnet, United States of America]	Noted - text has not been amended here since the role of education and learning for mitigation (and to some extent adaptation as well) is discussed in Sec 4.4.3.1.
55696	32	27	32	35	education and learning: add reference to gender, importnace of girls education [David Cooper, Canada]	Accepted - text revised (Gender is one of a number of factors affecting vulnerability to climate change along with age, class, ethnicity etc. In the chapeau to 4.3.6. we note the importance of these factors, which are addressed in more detail in chapter 5)
55698	32	27	32	35	education and learning: add reference to education and training of farmers. Eg Zhang et al (2016) Closing yield gaps in China by empowering smallholder farmers. Nature 537-671 [David Cooper, Canada]	Accepted, text amended to include the reference.
31994	32	28	32	34	Education and learning- Informal education plays a big role in the climate change mitigations. I refers the vital documents from UNESCO: UNESCO Climate Change Initiative. (2010). Climate change education for sustainable development. Paris: Decade of Education for Sustainable Development: UNESCO. [Sisira S. Withanachchi, Germany]	Noted - addressed in section 4.4.3
28532	32	38	32	44	This paragraph is difficult to understand, please restructure and provide a more balanced assessment of insurance solutions as a mitigant of climate risk. For example, it should be mentioned that insurance schemes have to be developed very carefully in order to avoid opposed effects. [Germany]	Taken into account - text revised (new references added in along with a note on index based insurance. The feasibility statement remains the same however, with the scholarship clearly identifying significant challenges to insurance across sectoral and regional contexts, even where new insurance products have been developed).

Comment No	From Page	From Line	To Page	To Line	Comment	Response
34742	32	38	33	1	Adaptation efforts will ultimately be essential if we are to protect valuable infrastructure, homes, businesses, natural spaces, and individual livelihoods from climate change impacts. In order to deploy these efforts, substantial capital investment must occur. Potential sources for this capital, including governments, households, and businesses, are mentioned, but only in the context of how to reduce the financial burden on them. There is no discussion of how some businesses, i.e. fossil fuel companies, in helping to propagate the climate crisis, may rightfully be asked to bear the financial burden of adaptation. Considering the amount of investment that will be required, there will ultimately be disagreement over who should supply capital. Should it be those who will be most impacted if they do not adapt, or should it be those who bear the responsibility for worsening climate change and therefore created the need for adaptation? The issue with placing the burden on the people most impacted is that those individuals may not have the means to effectively adapt. The people who will be most impacted are likely to be the most disadvantaged, including the poor, the elderly, and communities of color. It would be wrong to place the burden of adaptation on those most vulnerable to climate change. The burden should therefore be placed on those who are most responsible for bringing about climate change. A study that analyzed emissions primarily from companies that produce fossil fuels found that 63 percent of global industrial CO2 and methane emissions between 1751 and 2010 came from just 90 international entities. These entities included 56 crude oil and natural gas producers, 37 coal extractors, and 7 cement producers (Heede, R., Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854-2010, 122 Climatic Change 229 (2014)). Based on historical data and climate modeling, emissions from these 90 fossil fuel entities have contributed an estimated 57 percent to the observed rise in atmospheric CO2, approximately 50 percent to the rise in global mean surface temperature, and approximately 32 percent to global mean sea level rise between 1751 and 2010 (Ekwurzel, B. et al., The rise in global atmospheric CO2, surface temperature, and sea level from emissions traced to major carbon producers, 144 Climatic Change 579 (2017)). A separate study attributed 71 percent of global industrial greenhouse gas emissions since 1988 to just 100 fossil fuel producers, with 51 percent of emissions since 1988 attributed to just 25 corporate and state producers, including ExxonMobil, Shell, BP, Chevron, and Peabody (CDP and Climate Accountability Institute, The Carbon Majors Database, CDP Carbon Majors Report 2017, July 2017). Therefore, fossil fuel companies can be directly linked to climate change based on their extraction and distribution of fossil fuel resources. Furthermore, fossil fuel companies, despite an awareness of the role of fossil fuels in climate change, failed to change their business practices or inform the public. The year 1988 marks when James Hansen testified in the U.S. Congress that the human signal of climate change had been detected. 1988 was also the year in which the Intergovernmental Panel on Climate Change was formed to provide a scientific basis for policy action on climate change (Frumhoff et al., The climate responsibilities of industrial carbon producers, 132 Climatic Change 157 (2015)). Yet, half of all industrial emissions of CO2 since the Industrial Revolution have been emitted since 1988. In the face of scientific evidence of the dangers of fossil fuel emissions and resulting climate change, fossil fuel producers failed to reduce their emissions or disclose climate risks, and instead often worked in direct contradiction to emissions reduction goals and supported climate misinformation. For instance, between 1988 and 2005, ExxonMobil invested over $16 million into front groups that spread misleading claims about climate science. Rather than changing their business models, fossil fuel companies remain focused on not only exploiting existing oil, gas, and coal reserves, but also on developing new ones. Rather than supporting fair and effective climate policies, fossil fuel majors including Chevron, Shell, and ConocoPhillips remain members of the American Legislative Exchange Council's (ALEC) Energy, Environment and Agriculture Task Force which is focused on repealing renewable energy standards and regional climate policy initiatives in U.S. states (Frumhoff et al., The climate responsibilities of industrial carbon producers, 132 Climatic Change 157 (2015)). Rather than disclosing climate risks, ExxonMobil consistently focused on the uncertainties surrounding climate change in its New York Times advertorials, while only acknowledging the true risks in less public internal and peer-reviewed communications (Supran, G. and Oreskes, N., Assessing ExxonMobil's climate change communications (1977-2014), 12 Environ. Res. Lett. 084019 (2017)). Finally, fossil fuel companies have not even begun to pay their fair share of the costs for climate damages and adaptation (Union of Concerned Scientists, The	Rejected - the gist of the comment is unclear and it appears not to be relevant to the section to which it refers. Furthermore, issues of justice in climate policy and financing are covered in chapter 5.
49976	32	38	32	45	Crop insurance? In Indonesia the GoI is already do pilot project on crop insurance. [Perdinan Perdinan, Indonesia]	Accepted - explicit reference to agriculture added
55096	32	38	32	55	Agree with the 3 points, but still need to highlight the need for high capital investment and therefore the sloidarity among countries and the need to scale up grant-making. [Yamide Dagnet, United States of America]	Accepted - reference to financial barriers added
60982	32	38	32	55	Discussion of financial options is incomplete and unbalanced. Should first acknowledge the literature on the inherent benefits of baseline development and economic prosperity in reducing vulnerability of households. While social protection programs, including cash transfers, are one policy option to advancing this overarching objective, there are others. For example, microfinance institutions, including ones that facilitate savings, are another major avenue for building a social safety net that allows households to navigate shocks and manage risks according to individual household preferences. [United States of America]	Accepted - expansion of options noted under social protection programs, the role of general development noted earlier on with movement of social protection as the first option discussed, and combined with addition of text on general development and vulnerability reduction.
51276	32	39	32	39	1.5C needs to be replaced with "1.5 oC". [Muhammad Latif, Pakistan]	Accepted
54734	32	39	32	50	In general the discussion of finanical options is weak and disconnected from the emerging climate and green bond markets. Although the climate bond market has been dominated by renewable eneryg issues, the market for adaptation and resilience bonds is growing rapidly: http://www.mondovisione.com/news/sandp-global-ratings-global-green-bond-issuance-is-expected-to-shoot-up-further/ and this is seriosuly understated in report, which risks discouraging national policy makers from designing appropriate climate resilient infrastructure investments when there is in fact a ready market to buy these issues. [Henry David Venema, Canada]	Accepted - text and references added on green bonds, noting limited literature at present to assess feasibility
60984	32	50	32	50	Although there is little experience to date with using catastrophe bonds for climate adaptation, there has been significant interest in this concept. Suggest citing some of the literature exploring the concept (e.g., https://hbr.org/2017/08/how-the-insurance-industry-can-push-us-to-prepar... http://www.cii.co.uk/media/4043809/ch6_capital_markets_and_climate_chang...) [United States of America]	Accepted - new references cited and text added
61974	33	2	33	16	Better integration with related sections of chapter 3 is needed. [Valérie Masson-Delmotte, France]	Accepted - reference made to specific sections in chapter 3. Key messages checked against findings of chapter 3
3774	33	3	33	9	What exactly is the contribution of a healthy lifestyle and/or access to better health care to climate change? Do these not lead to longer lives hence more consumption hence more production hence more rather than less rise in temperature? [Marcel Wissenburg, Netherlands]	Rejected - outside of scope (the ethical issues around enhancing health and how this might affect mitigation through people living longer is not within the remit of the chapter)
16498	33	3	33	9	Should heat related illness and similar be considered here as well? Also mental illness associated with heat stress, drought impacts etc? There are studies showing an increase in heat related illness and death with small increases in temperature or increased lengths of heatwaves. [Australia]	Accepted - (reference to heatwaves mentioned noting that it is chapter 3 that focuses primarily on assessing impacts)
34698	33	3	33	9	Seccion 4.3.6.4 Population health and health system adaptation options It does not reach the objective of proposing or mentioning adaptation options for health services. It should be rethought to point to the activities that this sector of public and private services should attend to be more prepared for events of: heat waves, drastic increases in diseases related to climate change, floods, other events due to climate change [Mexico]	Rejected - out of scope (it is outside the scope of the section to examine specific options per health risk of climate change. Rather the focus is on overarching adaptation. Specific examples are given in articles cited in the feasibility assessment)

Comment No	From Page	From Line	To Page	To Line	Comment	Response
48320	33	3	33	9	It is suggested to enlarge the paragraph (lines 3-9) with one relevant reference about effects of climate change on human health. The paragraph would be reformulated as: "4.3.6.4 Population health and health system adaptation options Until mid-century, climate change will primarily exacerbate existing health challenges, with socio-economicfactors determining the magnitude and pattern of climate-sensitive health risks (Smith et al., 2014a). Butler and Harley classify the effects of climate change on population health in primary, secondary and tertiary. Primary refer to the acute and chronic stress of heat waves, and trauma from natural disasters as flooding and water scarcity and fires following drought. Secondary effects include the consequences resulting from a change in the distribution of arthropod vectors, intermediate hosts and pathogens that are able to alter the epidemiology of infectious diseases in vulnerable regions. Tertiary effects include famine and other major conflicts which may end up in war or migration (Butler and Harley, 2010). Enhancing current health services includes providing access to safe water and improved sanitation, enhancing access to essential services such as vaccination, and developing or strengthening integrated surveillance systems (WHO, 2015), with high agreement that when combined with iterative management can facilitate effective adaptation and moderate evidence of feasibility." The full citation is: Butler, C. D., and Harley, D. (2010). Primary, secondary and tertiary effects of eco-climatic change: the medical response. Postgraduate Medical Journal, 86 (1014), 230-234. [Miriam Solera Ureña, Germany]	rejected - outside of scope (chapter 3 focuses on impacts of climate change, and classifying the kinds of impacts expected for health is not within the remit of chapter 4)
31656	33	12	13	16	Disappointingly weak text on migration, which is one major likely indirect effect of climate change, to be reduced in relative terms if 1,5 C is met. The literature is small, and historically experience focussed, thus easily under-estimating future challenges. Climate change is only one of a complex set of interacting drivders. Better talk about building resilience in most exposed countries than adaptation measures. [Asbjørn Torvanger, Norway]	Accepted - the text has been adequately amended to nuance the discussion on migration as adaptation, showing the regionally differentiated costs and outcomes of migration (e.g. see example of SIDS).
33110	33	12	33	16	This section on migration as an adaptation strategy should be enhanced. E.g The Atlas of Environmental Migration (2017) Dina Ionesco, Daria Mokhnacheva, François Gemenne IOM United Kingdom of Great Britain and Northern Ireland Year of Publication: 2017 [Tara Shine, Ireland]	Accepted - the text has been adequately amended to add the reference and expand the discussion on migration as adaptation.
55098	33	12	33	16	very weak section. Need to at least refer to the work of the Warsaw International Mechanism on Loss & Damage and the work of its task force on displacement. This area will require increasing attention. [Yamide Dagnet, United States of America]	Noted. The migration text has been altered and deepened. It is also assessed as an adaptation option in 4.5.3. L&D is discussed in detail in cross-ch box 5.1.
60986	33	12	33	16	Humans have migrated throughout human history and prehistory, often in response to environmental change. While the context of this short section is understood, it would be appropriate to rephrase this to recognize that movement is a very long-standing response to a range of social and environmental stresses, but that modern climate change in the modern global nation-state system is raising new challenges for it as an adaptive option. This section implies that it might be appropriate to recommend that individuals and communities not migrate (given lack of proof of adaptiveness). Given its deep roots in human history and prehistory, this recommendation is unlikely to be successful or tenable. If this could be reframed in terms of approaches that may contribute to more successful migration (such as social ties, transfers of environmental and traditional knowledge), that could provide a more actionable approach to this topic. The field of archaeology has done a great deal of ethnographic work and modeling work on patterns of past migration that might be useful. Relevant scholars that may serve as useful starting points include John O'Shea, Leah Minc, David Anthony, Tim Kohler. Also, a report (Null and Risi, 2016) sponsored by the Woodrow Wilson International Center for Scholars, available at https://www.wilsoncenter.org/publication/navigating-complexity-climate-m..., provides a nuanced perspective on this issue. [United States of America]	Noted - the section has been amended to show how migration has occurred in the past, and in response to or anticipation of various climatic and non-climatic drivers. We do not aim to suggest migration is not adaptive - given the low evidence with medium agreement, we are demonstrating that more evidence is needed on this.
13968	33	19	35	35	Here in this section, all the SLCP are assumed to have co-benefits between climate and air quality, but ignore all the aerosols which cool the planet, and therefore will offset the gains in climate from air quality. This section needs to discuss the point that reductions in air quality, which are needed, it likely to in the net, make the climate problem worse, not better, because of the cooling aerosols (organic carbon aerosol and sulfate). Equal space in this sections needs to address the cooling aerosols, as you have put here on the warming air pollutants. Note that one doesn't really have a choice all the time which air pollutant to address: cutting combustion will reduce all aerosols, and so cause warming from the aerosol part.....(e.g. Kloster et al., 2009' or just cite Myhre et al., 2013) Kloster, S., Dentener, F., Feichter, J., Raes, F., Aardenne, J. van, Roeckner, E., … Swart, R. (2008). Influence of future air pollution mitigation strategies on total aerosol radiative forcing. Atmospheric Chemistry and Physics Discussions, 8, 5563056 [Natalie MAHOWALD, United States of America]	Accepted
24362	33	19	35	22	This section has a lot of repetition and could be streamlined. For example, I suggest to highlight the co-benefits for other societal objectives in one consolidated location/paragraph, and discuss mitigation options for the various species in dedicated paragraphs thereafter. Right now, many sentences make the same point but with different wording. [Joeri ROGELJ, Austria]	Taken into account. Text reduced.
24364	33	19	35	22	This section seems to mainly focus on literature that is supporting or advocating SLCF mitigation. Other literature e.g. Pierrehumbert (2014), Smith and Mizrahi (2013), ... have criticized the focus on SLCFs and point towards the trade-offs between short-term SLCF benefits and lockin of long-term CO2 warming. These studies need to receive balanced attention, and assessment. [Joeri ROGELJ, Austria]	Accepted
24366	33	19	33	19	Short lived climate pollutants is a political term which only speaks to the warming species. Chapter suggests to consequently use the term short lived climate forcers. As an IPCC assessment we cannot just focus on the warming agents, and disregard the cooling agents. Both should be discussed in a balanced way. [Joeri ROGELJ, Austria]	Taken into account by avoiding SLCP and being consistent with ch2.
38602	33	19	35	22	SLCF is a cross cutting issue that should be coordinated for consistency across chapters. [Jan Fuglestvedt, Norway]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
34744	33	19	35	22	In this section, the co-benefits of reducing the emission of short-lived climate pollutants (SLCPs) are discussed. These co-benefits include slowing of the progression of global warming and reducing the risks to human health from air pollution. These benefits occur together because many SLCPs emitted with greenhouse gases contribute to ozone and particulate matter formation, so reducing greenhouse gas emissions reduces these as well. However, there is a manner in which co-benefits could manifest that has not been discussed. Volatile organic compounds (VOCs) are primarily mentioned only in terms of their contribution to the formation of ozone, where ozone is a significant air pollutant. However, this discounts the role of VOCs as air pollutants themselves. For instance, benzene is a known human carcinogen, while the other BTEX compounds (toluene, ethylbenzene, xylene) have varying effects, including damage to the brain and nervous system, kidneys, and liver. Symptoms of exposure include fatigue, drowsiness, headaches, dizziness, confusion, eye and respiratory tract irritation, and loss of muscle coordination (Leusch, F., & Bartkow, M., A short primer on benzene, toluene, ethylbenzene and xylenes in the environment and in hydraulic fracturing fluids, 189 Smart Water Res Centre 1 (2010)). Other hazardous air pollutants such as naphthalene, formaldehyde, and 1,3-butadiene are all classified as carcinogens or potential carcinogens, likewise affecting the respiratory, reproductive, and cardiovascular systems (Agency for Toxic Substances and Disease Registry, November 4, ATSDR A-Z Index (2015)). Such VOCs are directly associated with emissions from refineries and often present in oil field operations, and in addition to contributing to ozone, pose direct health risks in surrounding areas. The co-benefits from shutting down fossil fuel infrastructure such as refineries would be halting greenhouse gas emissions, limiting the formation of ozone and PM, and preventing the spread of harmful VOCs into surrounding communities. Several studies have linked poor health outcomes to proximity to refineries. A 2013 study in Georgia found that non-Hodgkin lymphoma incidence was significantly higher the closer people lived to benzene release sites such as refineries (Bulka, C. et al., Residence proximity to benzene release sites is associated with increased incidence of non?Hodgkin lymphoma, 119 Cancer 3309 (2013)). A 2014 study of a 2010 flaring incident at a BP refinery in Texas City, Texas found that individuals exposed to resulting emissions were at higher risk of developing liver and blood-related disorders (D'Andrea, M. A., & Reddy, G. K, Hematological and hepatic alterations in nonsmoking residents exposed to benzene following a flaring incident at the British petroleum plant in Texas City, 13 Environmental Health 115 (2014)). In a 1984 study in Contra Costa County, it was found that exposure to petroleum refinery and chemical plant emissions was associated with an increased incidence of mouth, throat stomach, lung, prostate, kidney and urinary tract cancer, along with cardiovascular and cerebrovascular disease (Kaldor, J. et al., Statistical association between cancer incidence and major-cause mortality, and estimated residential exposure to air emissions from petroleum and chemical plants, 54 Environmental Health Perspectives 319 (1984)). Similarly, studies have linked fossil fuel extraction sites to adverse health outcomes. A study of 9,384 women in Pennsylvania found an association between proximity to active drilling and fracking sites and a 40 percent increased risk of having premature labor and 30 percent increased likelihood of high-risk pregnancy (Casey, J. A. et al., Unconventional natural gas development and birth outcomes in Pennsylvania, USA, 27 Epidemiology 163 (2016)). Another study in Pennsylvania found that people who live near a higher number of, or larger, active gas wells were 1.5 to 4 times more likely to suffer from asthma attacks than those living farther away, with the closest groups having the highest risk (Rasmussen, S. G. et al., Asthma exacerbations and unconventional natural gas development in the Marcellus Shale, 176 JAMA Internal Medicine 1334 (2016)). When considering mitigation options for SLCPs and other emissions, the infrastructure that produces these emissions in communities should be targeted. As an example, the neighborhood of Wilmington in Los Angeles, CA has some of the worst air quality in the nation because of the proximity of refineries and oil and gas wells. The co-benefit of shutting down this infrastructure would be both to reduce SLCPs and greenhouse gas emissions and improve air quality and health outcomes. Rather than just stating the benefits of reducing emissions, this section and chapter should go a step further and assess the specific benefits of shutting down fossil fuel infrastructure, since this would address emissions, air quality, and public health. [John Fleming, United States of America]	Rejected. This comment raises several issues on a level of detail that is beyond the scope of this section, and not possible to address given the space limitations.
54274	33	19			it might be worth clarifying the difference between SLCFs and SLCPs. SLCFs are a technically definited category of substances, whereas SLCPs are a subset of SLCFs and more of a politically definied category of substances for which there are identified measures that can be brought to scale in a matter of years. This is an important distinction and why we can say, as we do in Section 2.4, that while SLCP mitigation will occur in CO2-focused scenarios, it won't occur anywhere near as fast as it will with focused action on SLCPs. [Nathan Borgford-Parnell, Switzerland]	Taken into account by avoiding the term SLCF and being consistent with ch2.
1604	33	21	33	22	The main short-lived climate forcers… Please include (1) Jacobson, M. Z., Strong radiative heating due to the mixing state of black carbon in atmospheric aerosols, Nature, 409, 695-697, 2001; (2) Jacobson, M.Z., Short-term effects of controlling fossil-fuel soot, biofuel soot and gases, and methane on climate, Arctic ice, and air pollution health, J. Geophys. Res., 115, D14209, doi:10.1029/2009JD013795, 2010; (3) Bond, T.C., S.J. Doherty, D.W. Fahey, P.M. Forster, T. Berntsen, O. Boucher, B.J. DeAngelo, M.G. Flanner, S. Ghan, B. Karcher, D. Koch, S. Kinne, Y. Kondo, P.K. Quinn, M.C. Sarofim, M.G. Schultz, M. Schulz, C. Venkataraman, H. Zhang, S. Zhang, N. Bellouin, S.K. Guttikunda, P.K. Hopke, M.Z. Jacobson, J.W. Kaiser, Z. Klimont, U. Lohmann, J.P. Schwarz, D. Shindell, T. Storelvmo, S.G. Warren and C.S. Zender, Bounding the role of black carbon in the climate system: A scientific assessment, J. Geophys. Res., 118, 5380-5552, doi: 10.1002/jgrd.50171, 2013 [Mark Jacobson, United States of America]	Rejected due to space limitations
38604	33	21	33	30	I don't think an explanation of SLCFs is strictly needed. So redcuing / cutting text here is possible with a pointer to ch1 or 2. (For instance it may not be needed to explain that trop O3 is not emitted) [Jan Fuglestvedt, Norway]	Accepted
62182	33	23	33	30	NMVOCs at line 30 should be defined earlier (line 22) [Antoine Bonduelle, France]	Accepted
54272	33	27	33	27	It's not entirely accurate to say that 'SLCPs are sometimes co-emitted with CO2,' there are many technical and policy measures that target SLCP emissions without significantly impacting emisisons of CO2 (See 2011 UNEP&WMO Assessment of BC and O3), but numerous studies have found that [Nathan Borgford-Parnell, Switzerland]	Taken into account. Text revised to be consistent with chapter 2
38608	33	28	33	29	If you decide to keep the explaining text, it should be added that CH4 produces O3 in the presence of Nox. [Jan Fuglestvedt, Norway]	Accepted
60988	33	28	33	29	It could be helpful to clarify what is meant by "main precursor". That is not true in areas of high boundary layer ozone, for example. [United States of America]	Not applicable due to other changes implemented.
24368	33	32	33	38	Not sure what the logical flow of this paragraph is. It starts with co-emissions and then moves to co-benefits. This could benefit from some edits. [Joeri ROGELJ, Austria]	Taken into account by strong edits of the section.
24370	33	32	33	33	SLCFs and SLCPs are generally mitigated in stringent mitigation scenarios consistent with 1.5°C or 2°C as an integral part of an overall mitigation strategy. This characteristic and wider context of mitigation actions should also be clarified here. [Joeri ROGELJ, Austria]	Accepted
38610	33	32	33	38	I feel the literatature referred to here is a bit too narrow. Many more relevant studies are avilable in the literetaure. E.g. Stohl et al., 2015 (ACP), Rogelj et al PNAS, Sand et al Nature Climate Change etc. : Response of Arctic temperature to changes in emissions of short-lived climate forcers. Nature Climate Change volume 6, pages 286–289 (2016) doi:10.1038/nclimate2880 [Jan Fuglestvedt, Norway]	Taken into account; text revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
48248	33	34	33	35	Mitigating BC emissions could have significant adaptation and sustainable development co-benefits... makes it sound like the reductions of BC emissions would be driven by climate change policy, with fortunate side benefits for other aspects of sustainable development like health etc. Most of the real world works differently: reductions of air pollution are typically driven directly by local tolerance levels being exceeded and reductions being socio-politically acheivable and pushed by pollutant emissions control regulations. This should thus be rephrased as "Mitigating BC emissions in polluted regions,driven particularly air quality concerns, would have significant adaptation and sustainable development co-benefits..." [Mark Lawrence, Germany]	Not applicable due to other changes implemented.
54278	33	36			… slowing down the rate of sea level rise' [Nathan Borgford-Parnell, Switzerland]	Accepted
48242	33	40			I had noted previously that 2 pages seemed far too little for the discussion of SLCPs in this chapter. Although this was sadly not increased, and it still makes a poor impression that CDR and RMMs get 4x as much space as SLCPs in this chapter, fortunately the discussion in Chapter 2 (section 2.2.2.3) has been more than doubled, including discussion of the importance of SO2 emissions largely co-emitted with CO2 from fossil-fuel burning. Only an editorial note that the reference should be to cross-chapter box 1.2 (not 1.1). [Mark Lawrence, Germany]	Partly taken into account within the space restrictions given. More studies and discussion have been added, while some parts of the text (on geophysics that overlap with ch1 and 2) have been reduced.
38606	33	42	33	42	nitrous oxide is N2O. Perhaps you mean Nitrogen oxides, NOx ? [Jan Fuglestvedt, Norway]	Rejected. It is not NOx but N2O (which is made clearer)
24372	33	43	33	43	This estimate should be updated, based on an updated assessment of Chapter 2. It is biased high because it depends on an assumed TCR of 2.4°C for non-CO2 warming, whereas the IPCC AR5 gave a likely range of 1 to 2.5°C. This thus provides an overestimate. [Joeri ROGELJ, Austria]	Accepted
17760	33	45	33	46	(Revise) Myhre et al. (2013) concluded that reduction of SLCPs have contributions comparable to CO2 emissions in the short term, and have more tangible co-benefits [Republic of Korea]	Noted. (Unclear comment, but the text has been changed)
38612	33	45	33	46	I don't think Myhre et al, 2013 (AR5 WGI, ch8) concluded on tangible co-benefits. [Jan Fuglestvedt, Norway]	Taken into account. Text changed
54276	33	46			should say 'and have more tangible co-benefits that are often felt on faster timescales.' [Nathan Borgford-Parnell, Switzerland]	Not applicable due to other changes implemented.
7756	34	1	34	3	Table 4.5: I suggest adding to HFCs “Examples of options to reduce emissions…” a more basic solution such as “Better design and construction to reduce required cooling”, and under black carbon in the same column, after “…electric cooking, efficient cookpots” (which have ~10 options collectively capable of improving cooking efficiency ~3–6x separately from better stove efficiency). [Amory Lovins, United States of America]	Rejected. We find the comment somewhat unclear, and also not possible to take into account due to space limitations.
39242	34	1	34	26	This is a very helpful presentation, for policy purposes. [Lindsey Cook, Germany]	Noted. Thanks.
49042	34	1	34	4	In the column on options to reduce emissions, this table should also reflect measures involving food loss and waste. [David Waskow, United States of America]	Rejected due space limitations
934	34	3	34	3	0.3 GtCH4' It would be helpful to give the GtCO2-eq number !! [Robert Shapiro, United States of America]	Rejected. The readers can use GWP and calculate CO2-equivalents if needed for their application.
11062	34	3	34	3	Intermittent irrigation of rice, application of engineering standards in fossil fuel extraction/transportation, Capture and usage of fugitive methane [Wilfried Maas, Netherlands]	Rejected. We agree that this would be useful, but not taken into account due to space limitation.
36112	34	3	34	4	Table 4.5: Add year of publication of Haines et al. [India]	Editorial
46408	34	3	34	4	Table 4.5, methane gas emission sources, it may be added "Traditional fuel use for cooking in residential sector in developing countries" which is also a main source of methane. [Ijaz Ahmad, Pakistan]	Rejected. Would need scientific papers / reports to build on
48238	34	3			Ozone really should be added to the table, since its forcing is comparable to the HFCs (and it is actually a pollutant, whereas HFCs are not…). Even if it is now stated that ozone is not considered explicitly in the section, since it is not emitted directly, it would still be worth making this clear in the table. Also, if Pierrehumbert (2014) is listed in the title as a "core reference", then it is not needed additionally in the third column of the second row. [Mark Lawrence, Germany]	Rejected since the section focuses on the primary emitted compounds; not the secondary.
52152	34	3	34	3	final box on top right has empty () [Jason Donev, Canada]	Editorial
52154	34	3	34	3	why is (2010) here? [Jason Donev, Canada]	Noted. 2010 is the year for which the emission number is given.
60990	34	3	34	4	In this table, global emissions should be consistently expressed in comparable units (e.g., radiative forcing or CO2e). [United States of America]	Rejected since we think it is more transparent to give mass units when possible. Users can then convert. HFCs are given in CO2 equivalents due to a mix of gases.
36114	34	4	34	6	Mitigation benefits from Black Carbon should be viewed with caution as BC emissions are invariably linked with OC emissions. Putting BC in the same league as CH4 is misleading [India]	Partly taken into account; text revised without having space for going into details
43062	34	5	34	9	SLCP mitigation provides more avoid warming than CO2 mitigation at mid-century, and about the same at end of century. Moreover, the rapid cooling from SLCP mitigation slows down the positive feedbacks, with further reduces warming. SLCP mitigation also has significant co-benefits for health and food security. See Xu and Ramanathan (2017) Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes, Proc. Natl. Acad. Sci., doi: 10.1073/pnas.1618481114; Shindell et al (2012) Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security. [Durwood Zaelke, United States of America]	Partly taken into account; reference added.
55100	34	5	34	5	Delete "more quickly", since we already have "more rapidly cooling". [Yamide Dagnet, United States of America]	Not applicable due to other changes implemented.
62184	34	5	34	7	quickly ? The sentence is not clear [Antoine Bonduelle, France]	Not applicable due to other changes implemented.
24374	34	6	34	6	The claim that cooling effects of SLCF mitigation are more permanently is misleading, as many of the measures to reduce SLCF emissions listed in Table 4.5 can be reversed in a couple of years, leading to a swift reversal in the climate effect. [Joeri ROGELJ, Austria]	Taken into account; the text is changed
54280	34	7	34	9	suggested sentence change - 'But in scenarios in which CO2 emissions are not reduced in harmony with rapid and sustained SLCP mitigation, rapidly accumulating atmospheric concentrations of CO2 will drive continued global temperature rise within a couple of decades. [Nathan Borgford-Parnell, Switzerland]	Not applicable due to other changes implemented.
54282	34	7	34	9	This fact about the importance of also addressing emissions of CO2 was also modeled in the 2011 UNEP&WMO assessment of BC and O3, the accompanying peer reviewed study Shindell et al. 2012, as well as many others since that time. [Nathan Borgford-Parnell, Switzerland]	Accepted
60992	34	8	34	9	The authors could restate here that this approach (reducing SLCPs but not CO2) will also lead to more irreversible climate change for millennia. [United States of America]	Partly taken into account by emphasizing the difference between CO2 an SLCF.
62778	34	11	34	14	CH4 discussion here should be linked to Section 4.3.3 on land transitions. A supply side option to reduce CH4 from livestock is synthetic meat. [Elmar KRIEGLER, Germany]	Rejected due to space limitations, and this may be followed up in AR6
58346	34	14	34	14	Suggest to add: New anlaysis has shown that considerable reductions in methane release from oil and gas production can be reduced in a cost-effect manner, through incerased sales of natural gas (IEA, 2017f World Energy Outlook) [Andrew Prag, France]	Partly taken into account; reference added.
1606	34	16	34	17	Reducing black carbon…has numerous co-benefits, including for health. Please cite (1) Jacobson, M. Z., Control of fossil-fuel particulate black carbon plus organic matter, possibly the most effective method of slowing global warming, J. Geophys. Res., 107 (D19), 4410, doi:10.1029/ 2001JD001376, 2002; (2) Jacobson, M.Z., Short-term effects of controlling fossil-fuel soot, biofuel soot and gases, and methane on climate, Arctic ice, and air pollution health, J. Geophys. Res., 115, D14209, doi:10.1029/2009JD013795, 2010 [Mark Jacobson, United States of America]	Rejected due to space limitations and need to focus on recent studies.
24376	34	16	34	16	Why specifically from vehicles? [Joeri ROGELJ, Austria]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
52156	34	17	34	17	How is this increasing crop yields? Can this be explained? [Jason Donev, Canada]	Rejected. Beyond scope to go into such details.
61976	34	21	35	22	Check coherency with related sections of chapter 2 (SLCF and role in 1.5°C pathways) and chapter 3 (aspects related to health and air quality including ozone). [Valérie Masson-Delmotte, France]	Accepted
48114	34	22	34	24	Please specify the term 'most areas'. As the cited reference (Jeuland) only refers to a study of households in northern India. [Sarah Connors, France]	taken into account; text revised
52158	35	1	35	1	There is surprising resistance to this sort of transformation from social pressures. This is how it has been done for a long time, how do we overcome these social pressures? [Jason Donev, Canada]	Noted.
24378	35	3	35	9	This paragraph should be updated to reflect the new reality of the Kigali Amendment on HFCs. [Joeri ROGELJ, Austria]	Accepted
48240	35	3	35	9	This paragraph is quite vague, so that it's not really useful - if at all possible it should be made more concrete. [Mark Lawrence, Germany]	Taken into account; text revised
42816	35	3	35	9	Include that financing projects are in place through the MLF and the UNEP (Ozone Secretariat); also include that internationally mandated transition will further facilitate this transition, especially with the developed countries phasing down first and then the developing countries tackling the problem years later when costs are likely to have dropped. UNEP (2014) REPORT OF THE TENTH MEETING OF THE CONFERENCE OF THE PARTIES TO THE VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER AND THE TWENTY-SIXTH MEETING OF THE PARTIES TO THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER, UNEP/OzL.Conv.10/7 ("[The parties agree] [t]o adopt a budget for the Multilateral Fund for the Implementation of the Montreal Protocol for 2015–2017 of $507,500,000 on the understanding that $64,000,000 of that budget will be provided from anticipated contributions due to the Multilateral Fund and other sources for the 2012?2014 triennium, and that $6,000,000 will be provided from interest accruing to the Fund during the 2015–2017 triennium."); UNEP (2016) REPORT OF THE TWENTY-EIGHTH MEETING OF THE PARTIES TO THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER, UNEP/OzL.Pro.28/12. [Kristin Campbell, United States of America]	Rejected due to space limitations. But reference to the Kigali Amendment is added
43064	35	3	35	9	Estimates of warming from HFCs without the Kigali Amendment projected that HFCs could reach 4.0–5.3 GtCO2-eq per year in 2050. Velders et al (2015) Future atmospheric abundances and climate forcings from scenarios of global and regional hydrofluorocarbon (HFC) emissions. Avoiding production and usage of HFCs will also avoid banks of the refrigerants that would be emitted at the end of life. Velders et al. (2014), Growth of climate change commitments from HFC banks and emissions, Atmos. Chem. & Phys. 14:4563–4572, doi:10.5194/acp-14-4563-2014 ("If, for example, HFC production were to be phased out in 2020 instead of 2050, not only could about 91–146GtCO2-eq of cumulative emission be avoided from 2020 to 2050, but an additional bank of about 39–64 GtCO2- eq could also be avoided in 2050. Choices of later phaseout dates lead to larger commitments to climate change unless growing banks of HFCs from millions of dispersed locations are collected and destroyed."). Include that financing projects are in place through the MLF and the UNEP (Ozone Secretariat); also include that internationally mandated transition will further facilitate this transition, especially with the developed countries phasing down first and then the developing countries tackling the problem years later when costs are likely to have dropped. UNEP (2014) REPORT OF THE TENTH MEETING OF THE CONFERENCE OF THE PARTIES TO THE VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER AND THE TWENTY-SIXTH MEETING OF THE PARTIES TO THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER, UNEP/OzL.Conv.10/7 ("[The parties agree] [t]o adopt a budget for the Multilateral Fund for the Implementation of the Montreal Protocol for 2015–2017 of $507,500,000 on the understanding that $64,000,000 of that budget will be provided from anticipated contributions due to the Multilateral Fund and other sources for the 2012?2014 triennium, and that $6,000,000 will be provided from interest accruing to the Fund during the 2015–2017 triennium."); UNEP (2016) REPORT OF THE TWENTY-EIGHTH MEETING OF THE PARTIES TO THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER, UNEP/OzL.Pro.28/12 [Durwood Zaelke, United States of America]	Rejected due to space limitations. But reference to the Kigali Amendment is added
60994	35	3	35	9	A key mitigation option that is neglected here is simply the move to shorter-lived HFCs. They can absorb just as much longwave radiation, but they don't hang around in the atmosphere as long. [United States of America]	Rejected. Already included implicitly in the text.
62186	35	3	35	9	The paragraph is centered on abatement costs, when most action is now done through regulatory action, for example air conditioning in cars, leaks in commecial industries… The content should be more balanced … [Antoine Bonduelle, France]	Rejected due to space limitations.
30622	35	6	35	9	The Kigali amendment to the Montreal protocol could have been quoted as it provides a clear schedule for phasing down HFC. [France]	Accepted
46920	35	6	35	6	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted
54284	35	8			While I am unaware of any peer reviewed that speaks specifically to this point related to HFCs, but it's important to be aware that the cited study does not take into account the fact that a large proportion of the HFC mitigation in developing countries will now be addressed by the Montreal Protocol's Multilateral Fund. By addressing production and consumption of controlled substances, the MLF has historically achieved emisisons reductions for the equivalent of pennies per CO2 equivalent tonne. A 2015 study by the Montreal Protocol's Technology and Economic Assessment Panel stated that the 'conversion costs for HFCs are estimated at a factor of 1.5-2 higher than current HCFC funding experience.' (TEAP (2015) Decision XXVI/9 Update Task Force Report Additional Information on Alternatives to Ozone-Depleting Substances). [Nathan Borgford-Parnell, Switzerland]	Noted.
10094	35	11	35	15	Methane produced from fossil fuel extraction is only small proportion of total methane emissions. Agriculture and livestock by far are the major sources. So transitioning away from use of fossil fuels alone would not be sufficient to contain SLCPs to level compatible with 1.5c warming. [Saudi Arabia]	Noted.
13182	35	11	35	15	Delete the text "Section 2.3 indicates that most very low-carbon emissions pathways include a transition away from the use of coal and natural gas in the energy sector and oil in transportation (see Section 2.3), leading to a substantial overlap with SLCP mitigation strategies related to methane from the fossil fuel sector and BC from the transportation sector in such scenarios. However, according to Section 2.3, SLCP reductions may be achieved later in such scenarios.". [Eleni Kaditi, Austria]	Rejected. The suggestion is not based on any reason or argument. The text is based on the assessment in ch2
24380	35	11	35	15	This statement needs to capture the diversity of scenarios and low-carbon emissions pathways of Chapter 2. [Joeri ROGELJ, Austria]	Accepted
24382	35	15	35	15	A comparative statement without anything to compare to is not very informative. Please include more quantitative context. [Joeri ROGELJ, Austria]	Accepted
3258	35	17	35	20	It is claimed that benefits of reducing SLCPs include "energy access", "gender equality" and "poverty eradication". These however are not results from reducing SLCPs, but rather requirements or strategies in order to reduce them. A more appropriate phrasing would be "Strategies that reduce SLCPs can provide large benefits..." [Vassilis Daioglou, Netherlands]	Taken into account; text revised
24384	35	17	35	22	This paragraph mixes SLCPs with SLCFs. Please use a consistent term.Chapter 2 recommends SLCF. [Joeri ROGELJ, Austria]	Accepted
17762	35	18	35	20	gender equality and porverty eradication' -> over-estimated of BC reduction benefit [Republic of Korea]	Rejected. Unclear comment
48250	35	20			Sentence is grammatically incorrect, remove "yet, " to fix. [Mark Lawrence, Germany]	Accepted

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1296	35	21	35	22	I wonder if the following statement is true - "with the absence of international frameworks for integrating SLCFs into emissions accounting and reporting mechanisms being a significant barrier for policy-making to address SLCF emissions." Didn't the Montreal Protocol successfully reduce SLCFs, and the 2016 meeting in Kigali set out a global accord to reduce HFCs? (although it should be noted that the U.S. EPA is currently choosing not to regulate them after a court decision that ruled in favor of an HFC producer - Mexichem Fluor. v. U.S. EPA (Case No. 15-1328)). [Elizabeth Aldrich, United States of America]	Taken into account, reference to Kigali amendment added
48236	35	21	35	22	I appreciate that the terms SLCFs and SLCPs are now used more consistently in this entire section (SLCFs first, then SLCPs introduced and used thereafter. However, at the end of the section, the term SLCFs is still used inconsistently (twice in the lines indicated), these should be changed to SLCPs. (In addition, it's worth noting that the interpretation that SLCPs only include the warming component only applies to a subset of the literature, but I assume the authors are aware of this and have decided intentionally to favor this interpretation; this also applies to Chapter 2.) [Mark Lawrence, Germany]	Taken into account. Text revised to e consistent with chapter 2
5760	35	25	35	27	A brief paragraph that introduces and defines CDR would be useful here. [Govindasamy Bala, India]	Accepted - has been added as a chapeau before 4.3.7.1.
12284	35	25	35	25	The SRM section (4.3.9) references the US National Academy of Sciences (2015) report, (page 42 line 38). Is there some reason why the CDR section does not do likewise? We thought it was a very helpful review which IPCC could use as a starting point, with more up-to-date references also cited where appropriate. [United Kingdom (of Great Britain and Northern Ireland)]	Noted - However, the deployment potentials in previous NETs assessments vary considerably across studies. This assessment spans the entire ranges of estimates for all individual NETs reported in previous reviews (The Royal Society 2009, McLaren 2012, Friends of the Earth 2011, Vaughan and Lenton 2011, McGlashan et al 2012, National Academy of Sciences 2015, Caldecott, B.; Lomax, G.; Workman 2015, Fuss et al 2016, Smith et al 2016a, Rubin et al 2015, Ciais et al 2013, Lenton 2010). Due to lack of space, we cannot go into detail with respect to all of these, even though we agree that they are very useful. We have therefore revised the Figure to show the range of the reviews against the full literature range and our estimate of potentials taking into account feasibility constraints.
12286	35	25	35	25	Suggest change title to "greenhouse gas removal" because 4.3.8.6 is about non-CO2 GHGs [United Kingdom (of Great Britain and Northern Ireland)]	Noted - However, the emerging technologies had to be cut for space constraints and are now only listed in the table. We therefore left the title unchanged, also to maintain consistency with chapter 2.
19752	35	25	36	25	This section only discusses the important field of removing excess of CO2 from the athmosphere with a narrow focus. Even though BECCS is so far discussed as the most viable technocratic solution to remove CO2 from the atmosphere, the discussion about this option is not put into comparison with the more immenently logical and more sensitive approach of storing the maximum potential of CO2 in vegetation and soils of natural ecosystems first. If more removal is needed as scondary objective it needs to compete with the available land,but should not be promoted as more justifiable option before natural carbon storage in ecosystems through forest and ecosystem restoration. Increasing the carbon stock of ecosystems again first can deliver quite some potential of carbon dioxide removal (Kartha & Dooley, 2016) without risking the discussed side-effects of BECCS scale biomass production, unclarity about accounting and uncertainty about scalable storage technology. [Jennifer Morgan, Netherlands]	Noted - In this section we try to discuss both potentials and drawbacks of each option independently rather than providing an ex ante ranking or directly comparing to other possible mitigation options. Reforestation is equally discussed in this section and the potentials range includes also the estimates from Houghton that the suggested reference uses. We also added the new article by Griscom et al. (2018), which is assessed in more depth in the cross-chapter box 7 in chapter 3 and in section 4.3.2.
28534	35	25	43	52	We would prefer a clear distinction between established and emerging/speculative mitigation/geoengineering options. In particular, Carbon Dioxide Removal and Solar radiation Management should not be dealt with on the same level with current mitigation options (like e.g. energy system transition). Both approaches and concepts are in an rather early phase of emergence. There are still a lot of open and rather fundamental questions to be solved. This is especially the case for Solar Radiation Management. So please either change the structure or at least add a chapeaux text that highlights that (most large scale) CDR and all SRM technologies are not emerging or establish mitigation options, but may involve high risk interventions into the Earth system. [Germany]	Taken into account - We agree that SRM as many unsolved issues and that it should not be considered as mitigation. It has therefore been separated from the mitigation section and the main assessment is now in a cross-chapter box. We disagree that all CDR options are in an equally early phase, e.g. there is a lot of experience with afforestation, with changing land practices to enhance soil carbon and even with the individual components of BECCS. Even DACCS costs are already coming down. In addition, it has been a cross-chapter decision for the report that CDR is to be categorized separately from SRM, as it does reduce emissions rather than directly managing radiation. So the CDR section still follows on the more conventional mitigation technologies and it has been noted in chapter 1 and the glossary that the report considers it as a special type of mitigation.
28536	35	25	41	46	It is not clear if AFOLU measures generally belong to CDR or if only afforestation/reforestation and soil carbon/biochar belong. If so, there is literature suggesting significant potentials for removals from AFOLU/LULUCF more broadly defined than just afforestation/deforestation which should be reflected in this chapter. If not, it should be made more clear that landuse is not CDR and negative emission potentials from landuse in the literature should be included in section 4.3.3. Either way, these potentials should be included somewhere in this chapter. See e.g.. the following literature for potentials: 1)Griscom et al 2017: doi/10.1073/pnas.1710465114 2) Grubler et al 2017 (submitted) -cited in chapter 2 (145:48-50) 3) Dooley & Kartha 2018: doi.org/10.1007/s10784-017-9382-9 4)https://www.climatelawandpolicy.com/files/files_publications/Princes-Charities-International-Sustainability-Unit-Tropical-Forests-A-Review.pdf 5)O'Halloran & Bright 2017: doi:10.1088/1748-9326/aa54ec [Germany]	Taken into account - Griscom had already been cited in the SOD, its reforestation potential has now been made more prominent and is further discussed in section 4.3.2. See also cross-chapter Box 7 in chapter 3 on the land-based CDR options. As there is a substantial literature on SCS through conservation agriculture, we have included a sentence on this.
33582	35	25	35	27	To enhance the coherence between the different chapters it would be good if the paragraph on Carbon dioxide removal would reiterate the conclusion of chapter 2, p. 56 that different CDR approaches like BECCS and land restoration are highly competitive. A profound critique on BECCS and other bioenergy scenarios is that they often overlook the potential positive impacts of counterfactual scenarios (see for example Searchinger et al. 2017, referenced in comment 1). [Simone Lovera-Bilderbeek, Paraguay]	Taken into account - Land-based CDR methods and their interaction were the topic of cross-chapter box 7 in chapter 3, but we have added a sentence to section 4.3.7 to highlight that BECCS can compete for resources with other land-based CDR and mitigation options.
36116	35	25			Section 4.3.8: A brief paragraph may be added to introduce and define CDR. [India]	Taken into account - A chapeau has been added to clarify the assessment of CDR and the linkage points within the chapter. CDR is furthermore defined in the glossary.
37212	35	25	38	34	Section 4.3.8.7 does not mention the required scale up of the CO2 capture, transport and storage technology and infrastructure required for the deployments of CDR (BECCS and DACCS). Currently, operating full-scale BECCS and DACCS projects is 1 (1 BECCS, Illinois CCS; Global CCS Institue, 2017). It must be emphasized that the learnings, cost reduction and technology optimisation from CCS deployment today until 2050 will enable the scale-up of BECCS and DACCS technology. For example, it is stated in Chapter 4, Page 35, Line 30: 1.5°C pathways assessed in Chapter 2 that BECCS wil remove 5 GtCO2yr–1 (median) by mid-century. This cannot happen overnight and will require upscaling of carbon capture technology, transport standardisaiton and network optimisation as well as storage characterisation. [John Scowcroft, Belgium]	Taken into account - more space has been devoted to current state and scalability issues additionally a specific cross-reference to the relevant CCS section that discusses scalability issues there, including those referred to by the commenter.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
40450	35	25	35	25	(4.3.8 Carbon dioxide removal) Social and ecological risks need to be addressed much more in depth and detail through this section, in each option. They should also be considered more extensively in the subsection 4.3.8.7 (Overall feasibility assessment of CDR). This applies also to section 4.3.9 (Solar radiation management), including the irreversibility and wide scale of negative effects. (See, for example, Haywood et al .2013. “Asymmetric forcing from stratospheric aerosols impacts Sahelian rainfall”, Nature Climate Change, vol. 3:660H665; Robocket al .2008. “Regional climate responses to geoengineering with tropical and Arctic SO2 injections,“ Journal of Geophysical Research, vol. 113, D16101. Robock et al .2008. “Regional climate responses to geoengineering with tropical and ArcticSO2 injections”, Journal of Geophysical Research, vol. 113, D16101, Trenberth et al .2007. Effects of Mount Pinatubo volcanic eruption on the hydrological cycle as an analog of geoengineering. Geophysical Research Letters, vol. 34:L15702. and references therein) [Pedro Alfredo Borges Landaez, Venezuela]	Noted - However, section 4.3.8 (now 4.3.7) is already at its maximum length, so not much detail can be given in general. We have added some more references in this direction and want to point also to the assessments in chapter 5. As for 4.3.9 (now 4.3.8), some of proposed references are cited in the Cross-Chapter Box 10 in chapter 4, also there is a discussion about ecological risks. Section 4.3.8 on SRM assesses the feasibility, from an institutional, technical, economic and social-cultural viewpoint.
48232	35	25	43	52	The review paper on climate engineering that I mentioned which I am leading with co-authors from the former EuTRACE consortium was submitted prior to the SR1.5 deadline of end of October and was positively reviewed. I sent it to the chapter lead authors and hope that it provided useful insights to you for revising these sections. It is currently being revised and will be resubmitted soon. If it is accepted prior to the cutoff date (May 15), it will appear prior to the SR1.5 and in that case it would appear that the IPCC authors have left out an important part of the recent literature if it is not referred to. I understand that it cannot be built into the draft solidly at this stage, especially not relying on any results from it, since it might of course not be published in time. However, assuming that the authors will want to include brief consideration of its main findings (which are largely in line with the chapter, though with some differences, although it is unclear which of these will remain since both documents are still undergoing revision), I will send the revised version to the lead authors confidentially as soon as it is resubmitted, and also as soon as it is accepted if that is within the cutoff date. [Mark Lawrence, Germany]	Noted - we have not received a published version of this ex ante the literature cut-off.
49044	35	25	41	46	This section does not reflect some approaches that can provide carbon dioxide removal benefits, inlcuding landscape and forest restoration, agroforestry, and conservation agriculture, which are identified in 4.3.3.2. E.g. Griscom 2017 provides important evidence about the potential of these types of approaches. [David Waskow, United States of America]	Taken into account - Taken into account - Griscom had already been cited in the SOD, its reforestation potential has now been made more prominent and is further discussed in section 4.3.2. See also cross-chapter Box 7 in chapter 3 on the land-based CDR options. There is a dedicated subsection for afforestation and reforestation and approaches in the agricultural sector in the soil carbon sequestration subsection.
49050	35	25	41	46	The discussion of CDR in section 4.3.8 should more directly address the adaptation implications of each of the options considered. [David Waskow, United States of America]	Taken into account - adaptation implications (though very little literature) in synergies and trade-off table in Supplementary Material 4E.
50090	35	25	41	46	In general this is a very good section. It provides an extensive discussion on all relevant CDR options and gives quantitative potential and costs for many options. It clearly adds to chapter 2, where IAM studies only cover a limited number of CDR options and thereby give a distorted picture of the feasibility of land-use options in particular. You can say that this section corrects the chapter 2 results. It means these findings need to feature prominently in the SPM. As land-based options are generally seen as more easily implementable and providing many co-benefits, it would be better to reorganise the chapter and put these land-base options first in the section. A reference to the chapter on CDR of the 2017 Emissions Gap Report would be appropriate. [Bert Metz, Netherlands]	Accepted - land-based options come first now, EGR taken up in Figure 4.2.
51198	35	25	41	46	It is crucial to highlight that there are safer and more sustainable ways of removing CO2 from the atmosphere than through technological means. According to Dooley/Kartha (2018), an amount of 370-480 GtCO2 could be removed through forest ecosystem restoration and, to a lesser degree, reforestation. Other ecosystem restoration, such as moors and peatland, can achieve additional CO2 removal. Such ecological options are low- to no-cost, ready to be deployed, tested and proven, safe, provide for adaptation co-benefits and allow for livelihoods, food and water security to be sustained. Given the SDG context of the present report, these options should receive great attention. [Linda Schneider, Germany]	Noted - however, this section does not only deal with technologies, but also with other options, including afforestation and reforestation and also covers the Griscom et al. (2017) study on natural climate solutions (in as far as it pertains to carbon removal) and practices in agriculture enhancing soil carbon, explicitly mentioning the co-benefits. See also cross-reference to cross-chapter Box 7, where land-based CDR is dealt with in the context of chapter 3. There is furthermore no space here to reproduce the assessment of SDG implications in chapter 5.
54178	35	25	44	27	It is unclear why the authors of the report say they include CDR as a form of mitigation and exclude SRM from either mitigation and adaptation in their introduction (p.43), but then discuss both CDR and SRM under the heading 'current and emerging adaptation and mitigation options'. This seems inconsistent. I reinforce my suggestion to abandon the use of the CDR/SRM distinction and to discuss negative emissions technologies and local reflectivity enhancement measures (deployable within sovereign territory) under mitigation and adaptation respectively, while keeping interventions into the global commons (stratospheric aerosol injection, marine cloud brightening, ocean fertilization and ocean liming) as a separate category that continues to be regarded as geoengineering. Making a controversial technology sound more technical does not change the controversy of the technology and adds to the intransparency of an already extremely technical literature. Further, it normalises the concept of geoengineering and blurs the substantial differences between small-scale, conventional mitigation and adaptation measures, vis a vis the intentional, large-scale manipulation of planetary commons. [Ina Möller, Sweden]	Taken into account - In the revised version only CDR is discussed after mitigation and SRM is assessed separately. However, in-chapter and cross-chapter discussions (please note that SRM is now mainly assessed as part of a cross-chapter box) resulted in the decision not to consider SRM adaptation.
60996	35	25	36	26	BECCS is comprised of two components: bioenergy production and use, and carbon capture, utilization, and storage (CCUS). Bioenergy production and use might be done without CCUS, and CCUS may be applied to a number of different energy production facilities, including those using biomass. Suggest focusing on the feasibility of these two component parts independently, rather than treating BECCS as a unique technology. [United States of America]	Noted - we have included more specific cross-references to sections dealing with bioenergy and CCS as the component technologies but as inclusion of BECCS in pathways is so pervasive we address that literature here
60998	35	25	35	25	Should broaden discussion around costs beyond cost of deployment and also at least acknowledge potential cost implications of negative impacts resulting from implementation. [United States of America]	Reject - Ranges are for abatement costs, i.e. not only costs of deployment. Space restrictions do not allow for a broader discussion here. There is no literature base to robustly monetize negative impacts of deployment and - to be fair - this would require a full assessment, i.e. also pricing co-benefits and the costs of inaction, which goes beyond the scope of this section. Negative side effects and risks are discussed, however - wherever possible also with estimates of magnitudes.
55704	35	25	45	27	for discussion of CDR and SRM see the follwiong for comprehensive and comaprative reviews of technilogies, and review of existing regulatory frameworks: , refer to Williamson, P., & Bodle, R. (2016). Update on Climate Geoengineering in Relation to the Convention on Biological Diversity: Potential Impacts and Regulatory Framework. Technical Series No.84. Secretariat of the Convention on Biological Diversity, Montreal, availableat:https://www.cbd.int/doc/publications/cbd-ts-84-en.pdf; also: Williamson, P., Watson, R.T., Mace, G., Artaxo, P., Bodle, R., Galaz, V., Parker, A., Santillo, D., Vivian, C., Cooper, D., Webbe, J., Cung, A. and E. Woods (2012). Impacts of Climate-Related Geoengineering onBiological Diversity. Part I of: Geoengineering in Relation to the Convention on Biological Diversity: Technical and Regulatory Matters. Secretariat of the Convention on Biological Diversity. Montreal, Technical Series No. 66, 152 pages avaiable at: https://www.cbd.int/doc/publications/cbd-ts-66-en.pdf [David Cooper, Canada]	Taken into account – We now mention impacts on biodiversity explicitly, but could not go more deeply into a discussion of this aspect for reasons of space constraints. Please note that we also highlight potential biodiversity impacts for the corresponding technologies in the synthesis figure 4.2.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
28538	35	26	35	26	The section 4.3.8. should not only describe the various CDR-approaches but also have an additional comprehensive / overall description of CDR. A chapeaux text should describe the general idea of the CDR-concept and additionally make clear the early stage of emergence (and that a lot of open questions exist - especially as for the large scale use). So please add this additional description. Please see also our comment on the entire report explaining our reservation to categorize CDR as a mitigation technology. [Germany]	Taken into account - A chapeau has been added defining/framing CDR. The state of emergence of the different options is part of the assessment further below, as we need to differentiate between emerging options like DACCS and options, where we look back at a long experience like afforestation and reforestation.
12288	35	27	35	27	Section 4.3.8 would benefit from the insertion of an introductory section acting as asign-post to other relevant parts of the report, especially Box 3.1 and chapter 2. Currently Box 3.1 isn't mentioned until footnote 7 on page 38, despite its relevance to this section. It should explicitly state that chapter 2 uses the same data and assumptions as contained in 4.3.8 and Box 3.1. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - an introductory text has been added, cross-referencing chapter 2 and Cross-chapter Box 3.1 (now Cross-chapter Box 7 in chapter 3). Assumptions in Cross-chapter Box 7 are indeed the same as in 4.3.8 (now 4.3.7), but chapter 2 partially uses different assumptions - this bottom-up assessment of the technology literature is meant to complement the integrated assessment modelling of chapter 2.
12290	35	27	35	27	Would be helpful to also discuss Mac Dowell and Fajardy (not just Fajardy and Mac Dowell) http://iopscience.iop.org/article/10.1088/1748-9326/aa67a5/meta [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
18604	35	27			4.3.8.1 General remarks on BECCS: BECCS is not a genuine CDR technology, as the technology does not remove carbon from the atmosphere. Only growing plants do, the technology only burns the biomass and sequesters it (no different than fossil CCS). The removals by plants can only be assigned to BECCS to the extent those removals are "additional" (Haberl et al. : Correcting a fundamental error in greenhouse gas accounting related to bioenergy. Energy Policy Volume 45, June 2012, Pages 18-23). However, if they are "additional" (e.g., new plantations on otherwise unproductive land), they will often be indistinguishable from the land use measures mentioned in this chapter, like afforestation in 4.3.1.3., posing a risk of double-counting of land (and removal) potentials. [Andrea TILCHE, Belgium]	Taken into account – The BECCS concept assessed here is based on the cultivation of additional biomass. There is no double counting, as this is a bottom-up assessment and thus the potentials are not additive. We have added a note to the figure with the potentials estimates to clarify this.
31658	35	27	36	25	Mention that BECCS progress requires governance in terms of better and standarized accounting of biomass production, processing and use in a sustainability framing, with a carbon capture and safe storage rulebook, together with an internationally agreed rewarding system for BECCS as a potentially negative emission technology, that eventually provides incentives for business engagement, and with clear linkages to the Paris Agreement and its market mechanisms development, confer Torvanger, A. (2018), Roadmap fro BECCS, submitted to Climate Policy. [Asbjørn Torvanger, Norway]	Accepted - governance discussion has been broadened.
45506	35	27	38	12	This section overlaps with section 3.6.2 (I Think in Chapter 3). I would bring it all together in one chapter (Chapter 4 in my view) with brief cross-reference in the other. It woudk be useful to have a ready reckoner from GTCO2 to EJ bioenergy as is done here with GtCO2 to hecatares [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - Overlaps with 3.6.2 addressed.
51044	35	27	35	33	Insert a sentence in this paragraph that compares outputs of IAMs from chapter 2 (line 30-31) with the BECCS potential range (line 33). You need to explicitly point out that 15 GtCO2/year is almost 3x the highest end of the potential range (1.5-5.8). Somewhere you need to explicitly point out that the IAMs put out numbers that are not feasible, or better yet, ignore the IAM runs that give such crazy numbers. [Doreen Stabinsky, United States of America]	Noted - The comment is comparing 2050 estimates of potentials with 2100 estimates in scenarios. The culprit sentences have been rephrased to avoid this confusion in the future. Combined with comments 30976, 62188
51196	35	27	36	25	This is a highly problematic account of BECCS. First of all, the section should state clearly at the outset that despite contrary assumptions in much of the literature, the carbon neutrality claim for bioenergy is increasingly disproved (see Sterman et al. 2018 Does replacing coal with wood lower CO2 emissions? Dynamic lifecycle analysis of wood bioenergy, Environmental Research Letters and Booth 2018 Not carbon neutral: Assessing the net emissions impact of residues burned for bioenery, Environmental Research Letters). Not only is bioenergy not carbon-neutral, it also leads to higher relative CO2 emissions than coal due to its lower energy content. "Low-productivity degraded and marginal land" (line 43) should not be assumed to not cause sustainability conflicts since such lands are used by marginalised communities for livelihood and sustenance. Nicholson/Burns 2017 Bioenergy and carbon capture and storage (BECCS): the prospects and challenges of an emerging climate policy response, Journal of Environmental Studies and Sciences, Vol. 7, Issue 4, pp. 527-534 provides a good review of the catastrophic environnmental and social implications large-scale BECCS would have, these must be reflected here! Furthermore, Heck et al. 2018 Biomass-based negative emissions difficult to reconcile with planetary boundaries, Nature Climate Change 8, 151-155 finds that in order to remain within, or not further transgress, vital planetary boundaries (above all, freshwater use, further transgression of land-system change, biosphere integrity and biogeochemical flows), BECCS could only be implemented at an order of <0.1tC. This important work should be of utmost importance here, as it analyses BECCS and other biomass-based CDR technologies in relationship with vital planetary boundaries whose transgression our responses to climate change must not exacerbate. [Linda Schneider, Germany]	Noted - All those references taken into account - even if not cited explicitly, they are part of the systematic analysis of side effects. Also carbon neutrality is discussed, see also bioenergy assessment in 4.3.1.
61978	35	27	36	35	My understanding is that there is no real BEECS deployment. If this is the case, it should be said. [Valérie Masson-Delmotte, France]	Accepted - suggestion and cross-reference has been incorporated with scalability discussion
24386	35	28	35	35	Please reflect the variety of options and choices in 1.5°C emissions pathways available in the Chapter 2 assessment to discuss and illustrate the deployment of BECCS in scenarios. Some 1.5°C scenarios use BECCS nor CCS. [Joeri ROGELJ, Austria]	Accepted - we mention that not all pathways deploy BECCS
30976	35	28	35	35	If the literature agrees (line 33) that the potential range of BECCS is 1.5-5.8 Mt, then why in line 30-31 are there pathways with far higher levels of BECCS? [Simon Bullock, United Kingdom (of Great Britain and Northern Ireland)]	Noted - The comment is comparing 2050 estimates of potentials with 2100 estimates in scenarios. The culprit sentences have been rephrased to avoid this confusion in the future. Combined with comments 30976, 62188
53248	35	28	35	35	relevant to *Issues that prevent BECCS from delivering negative emissions* The discussion of BECCS as mitigation in Chapter 4 starting at page 35 is inadequate. This first sentence that says how “BECCS components have been assessed in previous IPCC reports” needs to be followed by a caveat: “But considerable literature has emerged in the meantime that points out the numerous technological and scaling problems that make it unlikely BECCS can provide meaningful mitigation.” [Mary Booth, United States of America]	Noted - the suggested literature has been cited and scaling issues are flagged later in the text.
58180	35	28		35	It would be reasonable to put CDR flow and bioenergy production into perspective. 100 EJ/yr biomass feedstock potential are not considered unsistainable. With this potential 4.5 to 9 GtCO2 / yr CDR can be realized. Bauer et al (2017) discuss this number (see literature in Chapter 2). [Nico Bauer, Germany]	Taken into account – The Bauer et al. 2018 paper is now cited. However, space restrictions prevent us, unfortunately, to go more deeply into the topic.
62188	35	28	35	35	Figures may be contradictory, if potential for storage is 5 and that scenarios involve much more, then feasibility is at stake and should be discussed. Elsewhere this issue was not raised (in chapter 2) thus there might be an error here. [Antoine Bonduelle, France]	Noted -The comment is comparing 2050 estimates of potentials with 2100 estimates in scenarios. The culprit sentences have been rephrased to avoid this confusion in the future. Combined with comments 30976, 62188
12292	35	30	35	33	This is saying that the pathways assessed in chapter 2 remove much larger amounts of CO2 through BECCS than the literature suggests as feasible. This is a major problem but doesn't appear to be clearly communicated; another is that the numbers don't seem consistent with those in Table 2.7. [United Kingdom (of Great Britain and Northern Ireland)]	Noted -The comment is comparing 2050 estimates of potentials with 2100 estimates in scenarios. The culprit sentences have been rephrased to avoid this confusion in the future. Combined with comments 30976, 62188, 12292
19756	35	30	53	31	The following sentence needs updating: "The 1.5°C pathways assessed in Chapter 2 remove 5 GtCO2yr–1 (median) by mid-century and 15 31 GtCO2 yr–1 (median) by 2100 through BECCS." The 1.5°C pathways the Chapter 2 assesses does contain also a pathway that excludes BECCS. (See the Grubler et al. (2017) study elaborated in the Chapter 2). [Jennifer Morgan, Netherlands]	Accepted - updated
55700	35	30	35	32	onlyt some of the pathways assessed in chapter 2 involve BECCS and at different levels. [David Cooper, Canada]	Accepted - combined with 24386

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61000	35	30	35	34	A source should be provided for this information. It is helpful that the discussion links back to the pathways discussed in Chapter 2. It would also be helpful to elaborate on the regional distribution of BECCS potentials. [United States of America]	Noted - in the new version we explicitly give the subsection of chapter 2 whenever we use information from the pathway assessment. However, due to lack of space it was not possible to give a regional assessment for BECCS, though we now note higher productivity in the tropics.
17668	35	32	35	33	The "potential range of 1.5-5.8 GtCO2yr-1" given by literature is in sharp contrast to the actual data of "30 MtCO2 are stored annually in all CCS projects" (Section 4.3.2.3). The readers should be alerted of this huge disparity. [Sai Ming Lee, China]	Accepted - suggestion and cross-reference have been incorporated with scalability discussion
40452	35	33	35	35	There are many concerns in the short, medium and long term, potentially caused by a variety of factors difficult to evaluate with acceptable certainty. They should be considered for a full perspective. Uncertainty levels should be stated. See for example Schneider and Winkler .2016. Threats to the Quality of Water Resources by Geological CO2 Storage: Hydrogeochemical and Other Methods of Investigation: A Review. 40. 31-51. 10.1007/698-2013-232.) [Pedro Alfredo Borges Landaez, Venezuela]	Noted - Uncertainty language has been more systematically applied for the final round and the full range of costs and potentials is given explicitly for 2050 and then put into perspective with respect to the range found in other reviews and in a recent systematic review complemented by expert judgment. In the text, cost and potentials ranges and their drivers are discussed in more detail. However, space constraints don't allow us to go into even more detail here and geological storage is assessed in 4.3.1.
57876	35	33	35	33	Newer literature should be included here that suggests the potential for BECCS is much lower than 1.5GtCO2/year. Heck et al (2017) looking at the impact of BECCS on planetary boundaries suggest that "the potential for NEs from dedicated bioenergy plantation is marginal (<0.1 GtC yr?1), and hence relying on BECCS as a key decarbonization strategy should be considered highly risky" Heck, V. et al., 2018. Biomass-based negative emissions difficult to reconcile with planetary boundaries. Nature Climate Change, 10, p.105007. Two additional papers from Boysen et al published in 2017 also suggest lower limits for bioeenergy, and hence BECCS: Boysen et al (2017). The limits to global-warming mitigation by terrestrial carbon removal. Earth's Future, 5, doi:10.1002/2016EF000469; and Boysen, L.R., Lucht, W. & Gerten, D., 2017. Trade-offs for food production, nature conservation and climate limit the terrestrial carbon dioxide removal potential. Global Change Biology, 23(10), pp.4303–4317. [Kate Dooley, Australia]	Taken into account - planetary boundary literature as been incorporated.
28540	35	34	35	34	Knowledge gaps exist as well as for a) practical implementation on a large scale (which infrastructures are necessary? Which business models can drive implementation?) and b) side effects (for e.g. Land, water etc.). Please add these knowledge gaps. [Germany]	Taken into account - more space has been devoted to the challenges of scaling, including lack of incentives, with cross-references to CCS scaling where appropriate. Land competition discussion has been expanded in section 4.3.1 and cross-referenced here. Land, water and nutrient impacts are furthermore assessed in cross-chapter box 7 in chapter 3. A chapeau has been added to the section to point the reader to this information elsewhere in the report.
7452	35	35	35	35	Insert after "Fuss 2017": "Honegger and Reiner 2018". Reference: Honegger, Matthias; Reiner, David (2018): The political economy of negative emissions technologies: consequences for international policy design, Climate Policy, 18, p.306-321 [Axel Michaelowa, Switzerland]	Noted - We appreciate the message of the paper that international policy for NETs currently does not exist and that the market mechanism under Article 6.4 of the Paris Agreement could be a way to facilitate this, but feel this is outside the scope of the 1.5C-relevant literature and does not rigorously argue the point that a market mechanism is the answer to the question of what international policy mechanism should support CDR.
18606	35	37	35	38	It is misleading to consider "forest residues" for BECCS, as BECCS (if at all feasible) are widely expected to reqire large facilities, which will need a lot of concentrated biomass. Gathering it from dispersed, low-density sources in the landscape would significantly increase its cost and energy requirements. If such facilities are ever built, they are much more likely to use roundwood from dedicated harvest, as large bioenergy facilities do today. [Andrea TILCHE, Belgium]	Rejected - these are estimates from a widely-cited paper, which provides the quantification for exactly this hypothesis: BECCS from forest residues shows the highest land use intensity, especially compared to dedicated crops.
28542	35	37	35	37	What are the implications of BECCS deployment consistent with the 1.5°C target? Please add an assessment of the differential implications between 1.5 and 2°C scenarios (and a reference to Ch 2). [Germany]	Noted - however, differentials between 1.5°C and 2°C pathways are assessed in chapter 2. Chapter 4's mandate is the assessment of the individual technologies to remove CO2 based on the bottom-up literature.
47930	35	37	35	37	Kindly check: Smith et al. (2016), if it is 2016a or 2016b (Pg. 178, line 53) [Sarah Connors, France]	Noted - Reference is to Smith 2016a - Smith, P., and Co-authors, 2016: Biophysical and economic limits to negative CO2 emissions.
58182	35	37		46	This is not reasonable. Already in baseline scenarios bioenergy is used. In climate change miitgation scenarios first of all, biomass is reallocated from pure energetic use towards BECCS use. This needs to be acknowledged. The linear factors here equate every ton of BECCS-CDR with bioenergy use and land use. This is a falacy.Bauer et al (2017) discuss this number (see literature in Chapter 2). [Nico Bauer, Germany]	Accepted – we have qualified the statement and made clear that this is not comparable to IAM studies, which take into account the versatile nature of bioenergy. And cited Bauer et al. (2018) in this context.
53250	35	37	35	42	relevant to *Scaling BECCS* This paragraph states that BECCS in 2 degree pathways requires 25-46% of arable and permanent crop land, a proposition that would strike most people as insane, but is largely treated in this report as not much of an impediment. For additional estimates of land requirements, we recommend citing (Field and K.J. 2017), and (Fajardy and Mac Dowell 2017), who present the following analysis: "Based on the analysis on switchgrass and miscanthus, within a scenario excluding direct and indirect land use changes, removing 3.3 GtC year-1 with BECCS could annually require between 360 and 2400M ha of marginal lands, 3600 and 15,700B m3 of water, 30 to 360 Gt of nutrients, and 1.7 to 2.9 TW of installed BECCS capacity. As a means of comparison, the upper bounds of these values correspond respectively to over three times the world total harvested land for cereal production, twice the world annual water use for agriculture (including evapotranspiration), 20 times the US annual nutrient use, and 1.6 times the world total coal-fired power plant capacity. This underlines the challenges associated with the large scale deployment of BECCS, especially concerning water and nutrient consumption." [Mary Booth, United States of America]	Taken into account - discussion about land use competition has been expanded in section 4.3.1; and planetary boundaries literature and discussion of these issues has been expanded. Suggested references included as appropriate along with some more (note that Field and Mach rely on the data by Smith et al. 2016 for this conclusion).
54732	35	37	35	47	The reference to Schueler et al 2016 is noted and appreciated, however this narrative need far great expliciation of how ecosystem services, food security and landscape ecology functions can be maintained with a heavy BECCS footprint on the landscape. Landscape-level diagrams are required for policy-makers, and government officials and research scientist to grasp this most fundamental physical and policy design issues; how we will reconcile CDR with all the other necessary landsdcape functions and the SDGs. If the literature base is insufficient to provide this level of integration and guidance then it should be noted as such as the need for insight and guidance on this point appears now as fundamental. [Henry David Venema, Canada]	Noted - we have expanded discussion of some of these issues in the bioenergy section in 4.3.1 and have also stressed the scaling issues more in the final draft. However, we cannot delve into this complex issue more fully given space constraints. Having said that, the implications of large-scale CDR deployment for SDGs are assessed in chapter 5, so we have included a cross-reference for this.
61002	35	37	36	25	This discussion refers to 2°C but should address 1.5°C, which is the topic of SR15. [United States of America]	Taken into account - a qualifier has been added to the sentence for clarifying the relevance for 1.5°C.

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56060	35	40	35	43	This argues that gross land amount does not necessarily conflict with food production because biomass production could take place on less desierable or unproductive land. There are several problems with this statement. First, why wouldn't the biomass producers be looking to grow on productive land? It would take government policies to steer them away from agricultural land and effectiveness and feasability of that should require additional consideration. Second, food production is not not sufficient to ensure food security. Access in particular is at risk when large increases in deman for land can leave poor farmers in developing countries at risk of losing their land, which means they have also lost their access to food. Finally, considering the scale of land required, it is neccessary to consider possible conflicts in demand for land and the tradeoffs different policy solutions could offer. Boysen et al (2017) The limits to global-warming mitigation by terrestrial carbon removal. Earth's Future 5: 463-474. doi.org/10.1002/2016EF000469 [Kelly Stone, United States of America]	Taken into account - this was a misunderstanding. The point was a caveat that land area is not necessarily a good indicator for sustainability - a small land footprint could result from planting on highly productive land, which is much more likely to conflict with food production, for example. Has been reformulated to avoid this impression (combined with 51046).
51046	35	42	35	43	The assumption is made here that low-productivity degraded or marginal land is empty land. That is an erroneous assumption. Significant food production happens on these lands. I suggest to look to FAO for data on the substantial quantity of food and livestock that are produced on "degraded" or "marginal" land. Using 25-46% of arable land for mitigation is as crazy as it sounds. [Doreen Stabinsky, United States of America]	Taken into account - combined with 51046 section has been rephrased to take into account these issues
47154	35	44	35	44	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted - reformulated, though this was actually a research need, not a policy prescription.
28544	35	45	35	45	It would also be useful for such studies to especially consider the regional socio-economic impacts and implications of biomass production on such large scales. Please point this out in the text. [Germany]	Accepted - text has been modified as suggested
4542	36	1	36	3	Going by the bibliography, this should probably be "Smith et al., 2016a". In addition, I am unable to find the "59.5 km3GtCO2-1" water footprint in that text [Florian Rabitz, Lithuania]	Taken into account - checked reference. Unit of the number from Smith et al. (2016) converted from C to CO2 and expressed on per ton basis rather than the total amount.
12294	36	1	36	2	This is an important statement but needs caveats eg on what assumptions is it based? And does Chapter 2 use this number? [United Kingdom (of Great Britain and Northern Ireland)]	Noted - due to limited space to go into depth of the assumptions of the different studies cited here, we have added the reference again as backup. Note that chapter 2 generally does not use the numbers of chapter 4, rather chapter 4 verifies what chapter 2 finds by relying on the bottom-up literature.
53256	36	1	36	3	relevant to *Scaling BECCS* This paragraph states that BECCS in a 2 degree pathway "would produce" 170 EJ of energy per year by 2100, but no mention is made of the fact that above, at page 21 (line 53-54) that "There is high agreement that sustainable bioenergy potentials in 2050 may be restricted to 100 EJ Yr–1. How are these to be reconciled? This is the kind of issue that gets lost when the discussion of bioenergy and BECCS are spread out and scattered through the document instead of being contained in a single section. Further, for this analysis, we calculate that to generate 170 EJ of useful energy from BECCS would require about 21 Gt of biomass per year. [Mary Booth, United States of America]	Noted - there is a difference between 2050, where bioenergy potentials are more constrained, and 2100 when technological change, yield improvements, climate change, etc. can augment biomass productivity.
47932	36	3	36	3	Kindly check: Smith et al. (2016), if it is 2016a or 2016b (Pg. 178, line 53) [Sarah Connors, France]	Noted - this is the following reference: Smith, P., and Co-authors, 2016: Biophysical and economic limits to negative CO2 emissions. Nat. Clim. Chang., 6, 42–50, doi:10.1038/nclimate2870. http://www.nature.com/doifinder/10.1038/nclimate2870.
63246	36	4	36	4	Add paragraph like: The preceding impacts on land use, water, nutrients and albedo could, however, be reduced or eliminated if BECCS were fueled by marine sources of biomass that could include aquacultured micro and macro flora (Lenton 2014, Hughes et al 2014). Additionally, the areal productivity of such systems can be significantly higher than that of land production (_____). Consideration of non-terrestial biomass as a fuel is thus far lacking in modeling and IAMs, and could potentially greatly relieve land ecosystem and societal pressures imposed by conventional BECCS. new refs: Lenton T M. 2014 The global potential for carbon dioxide removal. Issues in Environmental Science and Technology 38 52-79. Hughes, A. D., Black, K. D., Campbell, I., Davidson, K., Kelly, M. S., & Stanley, M. S. (2012). Does seaweed offer a solution for bioenergy with biological carbon capture and storage?. Greenhouse Gases: Science and Technology, 2(6), 402-407. [Greg Rau, United States of America]	Taken into account - Due to space constraints a shortened version of this has been added to the section (see table): • The impacts on land use, water, nutrients and albedo of BECCS could be alleviated using marine sources of biomass that could include aqua-cultured micro and macro flora (Lenton 2014, Hughes et al 2014).
11032	36	5	36	5	about the feasibility of timely upscaling, albeit its technical build out potential (Reference IEAGHG (K Burnard, T Dixon, 2017) CCS Industry Build-Out Rates – Comparison with Industry Analogues (2017) that it is technically tenable that the anticipated CCS (BECCS) build-out rates can be realised in a supporting environment) [Wilfried Maas, Netherlands]	Taken into account - CCS is assessed in more detail in 4.3.1 and we take into account the technical feasibility in section 4.5.
28546	36	5	36	11	This paragraph talks about feasibility of BECCS and could also address whether there is sufficient evidence on the long-term safety of underground storage of CO2. [Germany]	Noted - however, long-term storage is assessed in 4.3.1. Added a cross-reference to this.
39244	36	5	36	25	Could be helpful to note that BECCS does not sufficiently promote genuine mitigation of the root causes of anthropogenic climate change. For example, linking line 13 - CCS prolongs profitability of FF industry - withte point that it enables continued use of FF, thus not mitigating root causes. [Lindsey Cook, Germany]	Noted - though this would have been a nice addition, this text is gone due to shortening of the text, which lost some of those nuances, but maintained the substance.
58184	36	5		11	Availability of BECCS can be delayed until 2050, but the required carbon prices would strongly increase. The increase is much stronger than a doubling of the investment cost of BECCS technologies. Bauer et al (2017) discuss this number (see literature in Chapter 2). [Nico Bauer, Germany]	Accepted - integrated and Bauer et al. (2018) cited.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
53252	36	5	36	11	relevant to * Issues that prevent BECCS from delivering negative emissions *The report does not do a good enough job assessing what's required for BECCS to deliver negative emissions. This paragraph is particularly obtuse, making it sound as if laggard countries and lack of financial support is what is holding BECCS back: "There is substantial uncertainty about the feasibility of timely upscaling, exacerbated by CCS being largely absent from the Nationally Determined Contributions (Spencer et al., 2015) and CCS deployment lagging behind what roadmaps in line with a 1.5°C or even 2°C limit foresee (IEA, 2016a; Peters et al., 2017b).4 Economic incentives for ramping up a large CCS or BECCS infrastructure are weak. The 2050 average investment costs for such a BECCS infrastructure for bio-electricity and biofuels are USD138 and USD123 billion yr–1, respectively (Smith et al., 2016). BECCS unit costs vary widely, 50% of the literature agreeing on USD40–100 tCO2–1 (Figure 4.3)." It's really time for the IPCC to get real in this report about the massive technological and scaling challenges that BECCS faces. Technical challenges for BECCS include the fact that burning biomass emits more CO2 at the stack than coal, per unit energy (Domke, Becker et al. 2012, Walker, Cardellichio et al. 2013, Laganière, Paré et al. 2017). Generating a given amount of energy from biomass will generate 40 – 60% more CO2 than generating it from coal; the differential with natural gas is even greater. This has significant implications for the ability to deploy CCS with bioenergy, but it is not clear whether the models take this into account. (Hetland, Yowargana et al. 2016) points out that BECCS requires "compression to supercritical pressure of the CO2 to reach dense phase, consistent with realistic pipeline specifications for transport and injection of the CO2 into deep geological formations." Additionally, due to efficiency losses both from co-firing biomass in coal plants and the energetic costs of BECCS, co-firing with BECCS "offers significantly less net electric energy to the grid." They provide an example: a coal plant where co-firing 13.3% biomass causes an efficiency drop from 38 to 28.74%, going from delivering initially 50 MW to 37.81 MW ; adding BECCS to this causes an additional efficiency loss down to 17.81%, so that electricity delivered to the grid is 23.4 MW. The paper states, "The significant efficiency penalty with CCS makes efficiency a critical parameter in the consideration of BECCS. It seems evident that without a high initial efficiency of the basic biopower plant prior to CCS integration, BECCS will hardly become commercially viable, due to limited amounts of electricity to sell. Most likely, a sufficiently high net efficiency can only be ensured in large plants with advanced steam parameters (i.e. super-critical steam power cycles)." The report needs to include information like this to make the tradeoffs more apparent. Additionally, CCS requires the CO2 stream to be purified and concentrated for injection (Supekar and J Skerlos 2015). Bioenergy plants emit tremendous amounts of steam because fuels tend to be wet, as well as pollutants like particulate matter and nitrogen oxides. It does not appear BECCS can be made to work with conventional plants. The one plant where it has been used is an ethanol manufacturing facility where the CO2 stream differs from the smokestack emissions of a conventional plant burning biomass for electricity generation. Fuss et al (submitted) point out that the lowest cost estimate for BECCS comes from "a variation of oxy-fuel combustion that is still unproven (Abanades et al 2011). Models tend to just ignore these technical challenges. For instance, supplemental information for (Klein, Luderer et al. 2014) makes it clear that the ReMIND model assumes that biomass is largely burned in integrated gasification combined cycle plants for electricity generation – a technology that has been demonstrated but is not currently deployed due to the extreme technical challenges and costs. This is what's required, however, to concentrate the CO2 so that it can be captured. ReMIND assumes that 80% of biomass CO2 from this technology is captured using CCS, and further, that a full 90% of "biomass to hydrogen" carbon is captured – another technology that mostly does not exist except on paper. [Mary Booth, United States of America]	Noted - however, we have to assess also the economic and political feasibility dimensions of BECCS. Issues of upscaling and carbon neutrality of the bioenergy component of BECCS are assessed in more depth in 4.3.1; a cross-reference has been added. For reasons of restricted space we cannot in the text go into detail with respect to the pressure of CO2 needed for transport, but be assured that the reference is contained in the systematic assessment and thus - if applicable - features in the potentials and cost ranges. We have also included a paragraph on the upscaling challenge.
13340	36	6	36	7	CCS deployment "lagging behind" is perhaps not strongly enough stated. Indeed deployment has arguably not commenced, with only limited FOAK large-scale examples and these only in limited regions. See e.g Scott et al 2013 Last Chance for CCS https://www.nature.com/articles/nclimate1695 and Reiner 2016 Learning through a portfolio of CCS demonstration projects https://www.nature.com/articles/nenergy201511. [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reframed
47934	36	10	36	10	Kindly check: Smith et al. (2016), if it is 2016a or 2016b (Pg. 178, line 53) [Sarah Connors, France]	Accepted
8082	36	13	36	13	barriers to CCS: What about the competitiveness, and the risk of leakage over a few centuries? [Quentin Perrier, France]	Noted - However, the CCS assessment is more thoroughly done in 4.3.1 and cannot be fully replicated here due to space constraints. We added a cross-reference!
13184	36	13	36	15	Delete the text "CCS faces concerns of prolonging the profitability of the fossil fuel industry and of safety and environmental issues, particularly in populated onshore regions (see 4.3.2);". [Eleni Kaditi, Austria]	Noted - This statement was just to show what studies find to be behind the public perception problem of BECCS, not our own assessment or a judgment of what the public perception should be. However, this text is anyway gone due to the need for shortening, which lost some nuances, but maintained all substance.
13342	36	13	36	23	The factors discussed here, and others present serious policy challenges to BECCS as explored in Geden et al (in review), Assessing the prospects for carbon dioxide removal in the context of EU climate mitigation policymaking, WIREs Cchange. [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reference taken up in table 4.6.
14084	36	13	36	14	I suggest changing this to: " CCS faces challenges with low public perception because some has claimed that it could prolong the profitability of the fossil fuel industry. Questions related to safety and environmental issues has also been raised. Communication campaigns are needed to meet these challenges" [Aage Stangeland, Norway]	Noted - However, this text is gone due to the need for shortening, which lost some nuances, but maintained all substance. The need for communication has been taken up!
16500	36	13			This sentence requires a citation, especially with regards to the statement on prolonging the fossil fuel industry's profitability: "CCS faces concerns of prolonging the profitability of the fossil fuel industry and of safety and environmental issues, particularly in populated onshore regions" [Australia]	Noted - text doesn't exist anymore due to shortening
28548	36	13	36	26	The list of elements limiting the potential of BECCS are not simply elements of limited public acceptance, though they may have an impact on acceptance. Also the wording "has been challenged" and "are believed to" seems to distance the report from the literature it is citing. Please treat this literature equally to the literature that is more optimistic about BECCS, as 4.3 should critically review feasibility of various options. Please also consider further literature regarding the limitations in potential of BECCS, e.g..: 1) Heck et al. 2018: doi.org/10.1038/s41558-017-0064-y 2) Boysen et al. 2017: doi:10.1002/2016EF000469 3) O'Halloran & Bright 2017: doi:10.1088/1748-9326/aa54ec 4) Boysen et al 2016: doi:10.1088/1748-9326/11/9/095010 [Germany]	Noted - This was a misunderstanding, as a full stop had been exchanged for a colon, so this was not meant to be an exhaustive list of barriers to BECCS. The references have partially been integrated - as applicable - in the assessment of the global potentials ranges, also displayed in the figure, and their costs and side effects.
30624	36	13	36	13	« barrier to BECCS » What about the competitiveness, and the risk of leakage over a few centuries? [France]	Noted - However, the CCS assessment is more thoroughly done in 4.3.1 and cannot be fully replicated here due to space constraints. We added a cross-reference!

Comment No	From Page	From Line	To Page	To Line	Comment	Response
36118	36	13	36	16	Elaborate on the limited public acceptance of BECCS. [India]	Noted - However, this text is gone due to the need for shortening, which lost some nuances, but maintained all substance. More detail on public acceptance of CCS is given in 4.3.1.
42818	36	13	36	23	Should add more on the reasoning as to why the carbon-neutrality of bioenergy is questioned (the timescale for reclaiming the CO2), which would help clarify the statement contained in FN5. Sterman et al 2018, Does replacing coal with wood lower CO2 emissions? Dynamic lifecycle analysis of wood bioenergy, Envtl. Research Letters, doi:10.1088/1748-9326/aaa512. [Kristin Campbell, United States of America]	Noted - carbon neutrality of bioenergy is assessed in 4.3.1 in more detail; cross-reference added.
45508	36	13	36	13	Bonne chance for approval! [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted - However, this text is gone due to the need for shortening, which lost some nuances, but maintained all substance.
43066	36	13	36	23	Note, FN5 says: “utilization of the captured CO2 has been suggested to improve the carbon balance of BECCS. Should add more on the reasoning as to why the carbon-neutrality of bioenergy is questioned (the timescale for reclaiming the CO2), which would help clarify the statement contained in FN5. See Sterman J. D., et al. (2018) Does replacing coal with wood lower CO2 emissions? Dynamic lifecycle analysis of wood bioenergy, ENVTL. RESEARCH LETTERS 13(015007):1–10, 1 (“We simulate substitution of wood for coal in power generation, estimating the parameters governing NPP and other fluxes using data for forests in the eastern US and using published estimates for supply chain emissions. Because combustion and processing efficiencies for wood are less than coal, the immediate impact of substituting wood for coal is an increase in atmospheric CO2 relative to coal. The payback time for this carbon debt ranges from 44–104 years after clearcut, depending on forest type—assuming the land remains forest. Surprisingly, replanting hardwood forests with fast-growing pine plantations raises the CO2 impact of wood because the equilibrium carbon density of plantations is lower than natural forests. Further, projected growth in wood harvest for bioenergy would increase atmospheric CO2 for at least a century because new carbon debt continuously exceeds NPP. Assuming biofuels are carbon neutral may worsen irreversible impacts of climate change before benefits accrue. Instead, explicit dynamic models should be used to assess the climate impacts of biofuels.”); see also Booth M. S. (2018) “Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy”, Envtl. Research Letters. [Durwood Zaelke, United States of America]	Taken into account - carbon neutrality of bioenergy is assessed in 4.3.1 and we integrated Sterman et al. (2018).
58186	36	13		25	The phrasing that "there could be positive side effects of BECCS" means to completely underrate the meaning of BECCS. The reduction of cost is the main and foremost important next to securing achievability of the 1.5°C target. Without BECCS the target becomes infeasible and the 2!C target would become very, very expensive to achieve. Therefore, this must be rephrased. The use of the word "could" must be deleted. [Nico Bauer, Germany]	Accepted - this text has been sharpened
61004	36	13	36	14	The reference to "concerns of prolonging the profitability of the fossil fuel industry" is not balanced and should be deleted. There are also social concerns with diminishing the profitability of the fossil fuel industry. [United States of America]	Noted - This statement was just to show what studies find to be behind the public perception problem of BECCS, not our own assessment or a judgment of what the public perception should be. However, this text is anyway gone due to the need for shortening, which lost some nuances, but maintained all substance.
97	36	16	36	19	The carbon-neutrality of bioenergy has been challenged5 because of i.a. indirect land use change (iUC), site-specific barriers, disagreement on Global Warming Potential of biogenic CO2 emissions, and problems to achieve scale without environmental impacts (e.g. Plevin et al., 2010; Fargione et al., 2008; Searchinger et al., 2009; Havlík et al., 2011; Popp et al., 2014; Harper et al., 2017). [Levihn Fabian, Sweden]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Within space constraints more consideration has been granted to this issue in the bioenergy section 4.3.1 and cross-referenced here.
98	36	16	36	19	It is suggested that the following should be added: “For certain regions and biomass sources this has proven less challenging (see for example Hammar et al, 2015)”. [Levihn Fabian, Sweden]	Noted - Even though we agree that a regional assessment of biomass sources is important, space constraints and overlap with the parallel special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (SRCCL) have kept us from going into this. We have, however, added Hammar et al. (2015) to Supplementary Material 4.D.2.
99	36	16	36	19	Hammar, T., Ortiz, C., Stendahl, J., Ahlgren, S. & Hansson, P.-A. (2015). Time-Dynamic Effects on the Global Temperature When Harvesting Logging Residues for Bioenergy. BioEnergy Research 8(4), 1912-1924. [Levihn Fabian, Sweden]	Noted - Even though we agree that a regional assessment of biomass sources is important, space constraints and overlap with the parallel special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (SRCCL) have kept us from going into this. We have, however, added Hammar et al. (2015) to Supplementary Material 4.D.2.
3262	36	16	36	19	Amongst the references supporting this statement, the paper by Daioglou et al. (2018) is useful since it is one of a few papers to directly investigate the "problems t achieve scale without environmental impacts" (link to paper:https://www.nature.com/articles/s41558-017-0006-8) [Vassilis Daioglou, Netherlands]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Citation has been added and more consideration has been granted to this issue in the bioenergy section 4.3.1 and cross-referenced here.
18608	36	16	36	19	The "carbon neutrality" issue should not be discussed (only) here, but under renewables. [Andrea TILCHE, Belgium]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Within space constraints more consideration has been granted to this issue in the bioenergy section 4.3.1 and cross-referenced here.
18610	36	16	36	19	The "carbon neutrality" argument is highly questionable and should be used with great care and scientific rigor. First, "carbon neutrality" is not a precise term, multiple interpretations exist and, if used, it should be defined (but it would be better to avoid it and refer to "ignoring CO2 emissions from the combustion of biomass", which is the core issue). Second, IPCC never accepted that bioenergy was "carbon neutral": the inventory guidelines (where this comes from) state that CO2 emissions from biomass combustion should not be added to the energy sector emissions (only noted as a "memo item") "to avoid double counting", i.e., this is under the (strong) assumption that the relevant impacts on terrestrial carbon are adequately reflected in the LULUCF (or AFOLU) sector. Therefore, IPCC should just reaffirm that biomass is not (and never has been) considered "carbon neutral", and that land use emissions related to bioenergy should be taken into account (which is not consistently done in this report). Third, it is grossly misleading to suggest that "carbon neutrality" is brought into question by ILUC. In contrast, the problem is when the direct (combustion) emissions are ignored when (also direct) land use emissions are not taken into account either (as is the case in many promotion schemes of bioenergy, where the life cycle considerations ignore both combustion emissions and land use impacts). This essentially assumes that bioenergy emissions are immediately and fully compensated by additional plant regrowth (over and beyond what would otherwise be growing), and/or that all feedstock comes from waste material that would (in the absence of the bioenergy use) be oxidised and reemitted to the atmosphere. Neither assumption is realistic. The mentioned "carbon neutrality" assumption assignes all the CO2 removals on land (where the plants grow) to the energy sector, without considering the foregone carbon benefits (namely that plants would be growing on that land anyway, providing a carbon sink and/or products that need to be replaced if the land is dedicated to energy). [Andrea TILCHE, Belgium]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Within space constraints more consideration has been granted to this issue in the bioenergy section 4.3.1. We thank the commenter for the clarification and limit discussion to carbon intensity with specific references regarding dLUC and iLUC emissions.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
34700	36	16	36	21	Seccion 4.3.8 Carbon dioxide removal Indirect Land Use Change (iLUC) [Mexico]	Accepted - text revised
49646	36	16	16	19	As menitoned above, the effect of biomass use (harvest) on carbon stocks in biomass and soil need to presented here, as well as the additionality argument (Searchinger et al., see references above). They are a major challenge to the carbon-neutrality condition. [Karlheinz ERB, Austria]	Noted - however, we could not go into this detail due to lack of space and have conferred this to the bioenergy section in 4.3.1, as being a bioenergy-related comment first and foremost.
52160	36	16	36	16	What is 'i.a'? [Jason Donev, Canada]	Noted - inter alia, now spelled out.
53240	36	16	36	19	relevant to *Bioenergy is not instantaneously carbon neutral.* The report states that the carbon neutrality of bioenergy “has been challenged,” then goes on to list reasons: indirect land-use change, “site specific barriers” (whatever those are), “disagreement on GWP of biogenic CO2 emissions (in fact we are all pretty clear that the GWP of biogenic CO2 is the same as the GWP of any other CO2), and “problems to achieve scale without environmental impacts.” This list makes it clear that the author of this section is either largely unfamiliar with the literature on bioenergy non-carbon neutrality, or is deliberately excluding much of the relevant literature. This needs to change. There has been a large number of papers published in recent years explaining the problems with bioenergy, largely boiling down to the fact that most new biopower is fueled by wood, and burning wood emits a lot of CO2, whereas regrowing trees to resequester that CO2 takes a long time – much longer than the timeframes of the next couple of decades that climate modeling identifies as necessary to reducing emissions to avoid runaway warming. The following is a selection of literature that could be included in a review of the issues around bioenergy and BECCS: (Hudiburg, Law et al. 2011, McKechnie, Colombo et al. 2011, Domke, Becker et al. 2012, Mitchell, Harmon et al. 2012, Schulze, Körner et al. 2012, Walker, Cardellichio et al. 2013, Stephenson and MacKay 2014, Kittler, Olesen et al. 2015, Laganière, Paré et al. 2017). The literature also includes papers (eg Laganière, 2017 #87; Walker, 2013 #198; Domke, 2012 #55; Booth, 2018 #398} (http://iopscience.iop.org/article/10.1088/1748-9326/aaac88) that make it clear that burning forestry residues releases carbon much more quickly than the alterative fate (of decomposition) does, and thus that the cumulative carbon loading from using forestry residues for fuel is can be large. This is significant because it appears that many models and scenarios assume that large amounts of forestry residues can be burned for energy with no carbon consequences (Rose, Kriegler et al. 2013); see supplemental information for list of models and types of biomass they assume are available. [Mary Booth, United States of America]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Within space constraints more consideration has been granted to this issue in the bioenergy section 4.3.1 and cross-referenced here.
56572	36	16	36	18	Additional citations could include: Sterman, Siegel, Rooney-Varga 2018 http://iopscience.iop.org/article/10.1088/1748-9326/aaa512 and Booth 2018 http://iopscience.iop.org/article/10.1088/1748-9326/aaac88, both in Environmental Research Letters [Eleanor Johnston, United States of America]	Taken into account - suggested citations have been incorporated into section 4.3.1 where overall carbon neutrality of bioenergy discussion has been relegated
61006	36	16	36	16	The carbon-neutrality of bioenergy has been challenged. This sentence presents only a one-sided argument and should be more balanced. Many studies have found that bioenergy can be near carbon neutral and several of these studies are outdated. [United States of America]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Within space constraints more consideration has been granted to this issue in the bioenergy section 4.3.1 and cross-referenced here.
55702	36	16	36	17	carbon-neutrality … challenged because of iLUC. This is an understatement. Because of direct and indrect LUC, plus emissions related to inputs and processing, all of which are, to some degree, are inevitable, bioenergy (without CCS) cannot be "carbon-neutral" whether or not is is more or less C intensive that the fossil fuels it is repalcing will depend on the magnitude of these effects. It is well docuemnted that many biofuels (corn ethanol, most biodiesal etc lead tomore C emissions than the ff they replace. This needs to be discussed, though more properly under bioenergy (page 21-22) ratehr than here. [David Cooper, Canada]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Within space constraints more consideration has been granted to this issue in the bioenergy section 4.3.1 and cross-referenced here.
56062	36	16	36	18	Biomass is not carbon neutral, especially between now and 2100. Thiis is not just from burning the biomass but land-use change (both direct and indirect) and distrubances in the soil among other impacts, as well as risk that regrowth won't completely restore the stored. See Mary S Booth Not Carbon Neutral: Assessing the net-emissions impact of residues burned for bioenergy. 2018 Environ. Res. Lett. 13 035001. John D Sterman et al 2018 Environ. Res. Lett. 13 015007. Searchinger T (2017). Does the world have lowcarbon bioenergy potential from dedicated use of land? Energy Policy 110: 434-446. BECCS depends on the concept that bioenergy is carbon netural, otherwise it likely cannot acheive negative emissions. This is a feasability risk for BECCS that needs signficantly more discussion in this draft. [Kelly Stone, United States of America]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Within space constraints more consideration has been granted to this issue in the bioenergy section 4.3.1. and cross-referenced here
57878	36	16	36	19	A large amount of relevant literature has been excluded from this section assessing the carbon neutrality of bioenergy. This is a key area of concern, with bioenergy emissions needing to be adequately accounted for to allow for real assessment and comparison between different mitigation options. This section must include more of the literature which shows cases of when bioenergy is not carbon neutral, such as Schulze, E.-D. et al., 2012. Large-scale bioenergy from additional harvest of forest biomass is neither sustainable nor greenhouse gas neutral. GCB Bioenergy, 4(6), pp.611–616.. In addition, literature showing that bioenergy from forest residues releases carbon more quickly than decomposition, thus contributing to atmospheric carbon levels. Booth, 2018, Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy, Environ. Res. Lett. 13 035001. This section must conclude that bioenergy crops, forests, and forest residues cannot be burned without carbon consequences – the challenge is to understand and account these, and hence incentivise the levels of bioenergy (and appropriate sourcing) that would truly contribute to mitigation efforts. [Kate Dooley, Australia]	Taken into account - combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062. Within space constraints more consideration has been granted to this issue in the bioenergy section 4.3.1 and cross-referenced here.
3260	36	17	36	17	iLUC abbreviation is incorrect. [Vassilis Daioglou, Netherlands]	Accepted - typo corrected
28550	36	17	36	17	The correct abbreviation should be iLUC, please revise. [Germany]	Accepted - text revised
32264	36	17			Check acronym iUC versus iLUC? [Jamaica]	Accepted - this was a typo
38614	36	17	36	18	The statement about GWP for biogenic CO2 emissions needs a reference or two. You could cite AR5 WGI ch8 (Myhre et al) and papers by Cherubini; e.g.: CO2 emissions from biomass combustion for bioenergy: atmospheric decay and contribution to global warmingGCB Bioenergy (2011), doi: 10.1111/j.1757-1707.2011.01102.x [Jan Fuglestvedt, Norway]	Taken into account - The carbon neutrality of bioenergy discussion has been moved to section 4.3.1 and cross-referenced here combined with comments 43066, 42818, 55702, 61006, 56062, 18608, 18610, 53240, 57878, 49646, 97, 98, 99, 3262, 56062.
61008	36	17	36	17	Change "(iUC)" to ""(iLUC)" [United States of America]	Accepted - text revised
62190	36	17	36	20	iUC at line 17, iLUC at line 20 [Antoine Bonduelle, France]	Accepted - text revised
28552	36	19	36	19	Harper et al. 2017 missing from the literature at the end of the chapter. [Germany]	Noted - however, this part is gone due to shortening.
47936	36	19	36	19	Kindly check: Harper et al., 2017 is no available in the reference list. [Sarah Connors, France]	Noted - however, this part is gone due to shortening.
14066	36	20	36	21	This makes little sense: "Current pathways are believed to have inadequate assumptions on the development of adequate societal support and governance structures" [Ralph Sims, New Zealand]	Accepted - "adequate" has been removed.
16502	36	20	36	21	Sentence implies high agreement on this statement - that is not correct. [Australia]	Accepted - the opposite was meant (that there is little agreement that those standards remove the problem) - has been reformulated
61010	36	20	36	21	This should explain why the policies are assessed as insufficient. [United States of America]	Accepted - explanations added
45510	36	21	36	21	insuffcient against what criteria? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - explanations added

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7454	36	23	36	23	Insert after "Gough, 2016": "Honegger and Reiner 2018". Reference: Honegger, Matthias; Reiner, David (2018): The political economy of negative emissions technologies: consequences for international policy design, Climate Policy, 18, p.306-321 [Axel Michaelowa, Switzerland]	Noted - We appreciate the message of the paper that international policy for NETs currently does not exist and that the market mechanism under Article 6.4 of the Paris Agreement could be a way to facilitate this, but feel this is outside the scope of the 1.5C-relevant literature and does not rigorously argue the point that a market mechanism is the answer to the question of what international policy mechanism should support CDR.
12296	36	23	36	24	How does BECCS reduce "upward pressure on food prices by lowering carbon prices and biomass demand in 2°C scenarios? This is counter-intuitive so should be explained [United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, the statement is gone due to shortening and this literature is part of the pathways literature covered in chapter 2.
16504	36	23	36	25	Sentence is hard to follow. Reword for clarity and ensire it aligns with chapter 2. [Australia]	Noted - however, the statement is gone due to shortening and this literature is part of the pathways literature covered in chapter 2.
18612	36	23	36	25	Please check and critically access the sources. A positive effect of BECCS on food prices is likely to result from unrealisitic assumptions or modelling errors. BECCS has the highest land footprint of any renewable energy regime, and it is hardly conceivable that it could reduce upward pressure on food prices. Compared to what? [Andrea TILCHE, Belgium]	Noted - however, the statement is gone due to shortening and this literature is part of the pathways literature covered in chapter 2.
54026	36	23		25	Sentence is abundantly contested and unsusbtantitated in the given reference. Delete sentence from "There could be …. BECCS deployment". See Biofuelwatch report on BECCS, 2015 [Elenita Daño, Philippines]	Noted - though the sentence has changed for other reasons, please note that without BECCS in the scenarios, the 1.5°C target would often not even be feasible (see chapter 2), so we cannot write in chapter 4 that we don't consider meeting the target a benefit.
2184	37				panel a - OIF claimed volume dubious. DAC essentially unconstrained - output can be mineralised, if storage is seen as a constraint http://science.sciencemag.org/content/344/6182/373. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - It is important to note that the represented potentials are specifically 2050 estimates which may consider deployments and other constraints. We now display the full ranges for potentials in panel B and explicitly state in the text and figure that panel A refers to amore narrow range based on identified constraints.
2186	37				panel b - box summaries require citations generally. Eg 'air pollution' for EW is dubious, albedo changes for afforestation are subject to location and management [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - citations for elements in the plot have been added in a table and added as supplementary material.
18614	37				The contribution of the charts in Panel B (line plots of potential deployment wrt number of studies) is not clear. What is it trying to say? Can this be communicated by simpler means? [Andrea TILCHE, Belgium]	Taken into account - we have reconfigured the data to present the information as heat bars, with a clearer mapping of the ranges (full range, range across previous reviews and range from Fuss et al. 2018). We hope that the new presentation is less cluttered. We consider that it is important to maintain some key side-effects in mind in a synthesis figure of this type. We have incorporated the references that inform the various elements of the plot in the accompanying table in the supplementary material.
7758	37				Panel A: It would be helpful to explain in the text why soil carbon sequestration should cost more than not doing it. Most careful assessments of organic and higher-diversity farming and forestry and of intensive rotational grazing (which has similar soil-carbon benefits) are as profitable as or more profitable than conventional soil-depleting techniques, so the claimed extra cost is counterintuitive. I am not referring here to net cost after crediting side-benefits, but to direct cost: in general, for example, organic farming has lower input costs, comparable or sometimes slightly lower yields of specific crops (though often higher total yield across the portfolio of coproduced crops), and higher and steadier net income. [Amory Lovins, United States of America]	Noted - the figure has been substantially revised and negative cost estimates have been taken up in the full SCS range in panel B.
16506	37				The graphical representations with polynomials are hard to understand. Why not provide box plots? The pictograms are unnecessary and clutter the figure; albedo effects vary depending on the specific land-cover transition and the location. It is critical to indicate the references for these figures - eg in a table in appendix - otherwise it is impossible to comment on the adequacy of the review. [Australia]	Taken into account - we have reconfigured the data to present the information as heat bars, with a clearer mapping of the ranges (full range, range across previous reviews and range from Fuss et al. 2018). We hope that the new presentation is less cluttered. We consider that it is important to maintain some key side-effects in mind in a synthesis figure of this type. We have incorporated the references that inform the various elements of the plot in the accompanying table in the supplementary material.
32130	37				Figure 4.3. Figure does not reflect the difference in level of confidence. In particular ocean fertilisation is described in the text as controversial and its potential characterised as low confidence. This should be made clear in Figure 4.3 [Jamaica]	Accepted - we have reconfigured the data to present the information as heat bars, with a clearer mapping of the ranges (full range, range across previous reviews and range from Fuss et al. 2018). This should give an indication of confidence, where literature estimates are concentrated (red) versus more dispersed estimate ranges. Furthermore, we explicitly state the number of studies, which should serve to underpin the amount of evidence. Finally, all references corroborating the estimate ranges have been collated in the accompanying table in the supplementary material for line of sight.
36496	37				Figure 4.3. Figure does not reflect the difference in level of confidence. In particular ocean fertilisation is described in the text as controversial and its potential characterised as low confidence. This should be made clear in Figure 4.3 [Snaliah Mahal, Saint Lucia]	Accepted - we have reconfigured the data to present the information as heat bars, with a clearer mapping of the ranges (full range, range across previous reviews and range from Fuss et al. 2018). This should give an indication of confidence, where literature estimates are concentrated (red) versus more dispersed estimate ranges. Furthermore, we explicitly state the number of studies, which should serve to underpin the amount of evidence. Finally, all references corroborating the estimate ranges have been collated in the accompanying table in the supplementary material for line of sight.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
54028	37				Boxes in page 37 are inaccurate on biochar. The improvement of soil quality is not at all sure -as stated in this same SOD, and the plantations required for biochar pirolysis pose threat to food security resulting from competition for land and water. See Ref: Biofuelwatch, Biochar unproven claims, 2013 http://www.biofuelwatch.org.uk/2014/biochar-3pager/ [Elenita Daño, Philippines]	Taken into account - we include an icon for land competition now as well. However, this is mainly motivated by the large scale of the upper limit of the potentials range because there is a big literature assessing effects of biochar application on soil properties and crop yield and most of this literature suggests that the increase in crop yield would be due to the liming effect of the biochar and thus, to the improvement in soil fertility properties (e.g. meta-analysis of Jeffery et al., 2011;2017; Wang et al. 2015) http://iopscience.iop.org/article/10.1088/1748-9326/aa67bd/meta) (https://www.sciencedirect.com/science/article/pii/S0167880911003197) (https://onlinelibrary.wiley.com/doi/abs/10.1111/gcbb.12266). This liming effect would be due to the fact that biochar particles are formed by heterogeneous aromatic compounds which give the biochar its reactivity and, therefore, the ability to adsorb nutrients. Furthermore, the increase in soil porosity (i.e. lower bulk density) also improves the soil physical properties, leading to an improvement in the soil fertility properties (Bourke et al., 2007; Sohi et al., 2009;Rondon et al. 2007). Regarding competition for land and threats for food security, ideally biochar would can come from internal inputs (i.e. crop residues, pruning debris in woody crops) and burned in the farm itself in a small-scale of pyrolysis process.
58188	37				Figure 4.3: the potential of BECCS is much too small. 8-9 GtCO/yr carbon removal can be achieved with only 100EJ/yr biomass feedstock supply per year. This amount of biomass feedstock production is not considered unsustainable by any author I know. Hence, the upper-end mentioned here, is the lower end. [Nico Bauer, Germany]	Taken into account - we have used a conversion rate of 0.05 Gt CO2 per 1 EJ biomass for 2050 estimates based on the scenario literature discussed in Fuss 2018 (Negative Emissions - Part 2., ERL)
62192	37		37		Graph page 37 is much improved from FOD with now a clear range of options; but DAC might be misrepresented, because of progress in PV solar energy and water dessalination in remote regions might limit the energy penalty of carbon separation, representing a large share of the costs. So DAC is not yet on the industrial scale, but its theoretical costs may be much lower than anticipated in the graph. [Antoine Bonduelle, France]	Noted - It is important to note that the represented potentials are specifically 2050 estimates which may consider deployments and other constraints. Furthermore in panel A, the represented estimates are the estimate ranges of the literature found in a systematic review process adjusted by expert judgment on the basis of identified constraints. This is clearly mapped in panel B to put estimates into perspective and explained in the figure caption. We have integrated a few more papers in the following version and are providing the references that inform each element in the accompanying table in the supplementary material.
28554	37		37		CDR - please write full name and abbreviation in the caption. [Germany]	Accepted
4492	37	1	37	1	Descriptions on CDR in 4.3.8 are quite informative and useful. Especially Figure 4.3 is rather exciting. Only one point I would like to say is that figures are so small and cannot read, especially Panel b. Isn't it possible to make panel A and B separate and improve readability of Panel B? [Mitsutsune Yamaguchi, Japan]	Taken into account - we have reconfigured the data to present the information as heat bars, with a clearer mapping of the estimate ranges. We took care to maintain larger font sizes and hope this addresses readability issues. We consider it valuable to present all the technologies together to facilitate comparison.
10584	37	1	37	2	Figure 4.3 Panel A. The text is not clear. Need to reproduce the Figure for clarity. [Hong Yang, Switzerland]	Taken into account - We took care to maintain larger font sizes and produce the figure at a higher resolution. We hope this addresses readability issues.
14106	37	1	37	2	Are the colors gradation in panel A of figure 4.3 related to some likelihood, degree of confidence or something like that? if so, please indicate it [Meimalin Moreno, Venezuela]	Taken into account - the figure and its colour coding was difficult to grasp, so we completely revised it for the FGD.
4296	37	1	37	1	Figure 4.3 is colourfull and pretty at first sight. But I find it meaningless ¡¡¡. I severely challenge the cost figures of Panel A ¡¡: where are the references supporting these neat cost ranges? Since there are many reference on DAC cost (I believe the most realistic studies yield cost closer to 1000 USD/tCO2: see K. Z. House, A. C. Baclig, M. Ranjan, E. A. van Nierop, J. Wilcox and H. J. Herzog, Economic and energetic analysis of capturing CO2 from ambient air, Proceedings of the National Academy of Sciences, 2011, 108, 20428-20433) how is it that cost are narrowed down only to 90-250 USD..????.. are you aware that capturing CO2 from flue gases is already close to 100 USD/tCO2 ?????. on the other hand: WHAT IS THE MEANING OF THE MANY FIGURE REPRESENTING "ARTICLES" VS "Gt CO2/y" ?????..... WHY DONT YOU SIMPLY REFER TO IPCC INFORMATION ON DAC AVAILABLE IN THIS SAME REPORT (see scenario literature in Ch 2)???? [Abanades Carlos, Spain]	Noted - It is important to note that the represented potentials are specifically 2050 estimates which may consider deployments and other constraints. Furthermore in panel A, the represented estimates are the estimate ranges of the literature found in a systematic review process adjusted by expert judgment on the basis of identified constraints. Note that the literature is rather from the technology literature than the scenario literature! This is clearly mapped in panel B to put estimates into perspective and explained in the figure caption. We have integrated a few more papers in the following version and are providing the references that inform each element in the accompanying table in the supplementary material.
30626	37	1	38	10	Figure 4.3 : The figure on top makes the worst option (ocean fertilization) look like the best: cheap with high potential. The uncertainties and danger should appear clearly, otherwise the figure is misleading. [France]	Accept - ocean fertilization has been taken out of the panel.
31534	37	1	37	1	Although this figure is very useful for policy makers, it is difficult to understand because the figure is too dense, especially panel b. Improvement of the figure is requested. [Japan]	Taken into account - we have reconfigured the data to present the information as heat bars, with a clearer mapping of the estimate ranges. We took care to maintain larger font sizes and hope this addresses readability issues.
32686	37	1	37	1	The font is small and hard to read. The y-axes of the deployment potentials and costs are displayed in consistently, making a comparison of the different CDRs harder. Some key side effects are missing, e.g. albedo for biochar. Air pollution for BECCS should be implementation dependent. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - Figure has been revised in these respects. Only exception is about the albedo change, which is no longer flagged as a side effect, as no robust literature behind this (the biochar would actually be buried, so not darken the surface).
39246	37	1	37	1	Please clarify if 'cost estimates' includes environmental cost, or solely monetary, in which case, an environmental cost model would also be appropriate, since the current paradigm holds readers from appreciating 'true cost' to lives. [Lindsey Cook, Germany]	Noted - however, there is no literature base that would allow us to quantitatively assess the environmental and social costs. In the revised draft, we address these issues as side effects (see icons in figure and discussion in main text). Costs in the synthesis figure remain technology costs.
45388	37	1		32	suggestion to increase readability: This graph section sis too small - it could be split into 6 pages- - one for each sections (ie 1 page for forestation; one for bioenergy, one for CCS etc), there is a lot of information there are the graphs are much too small. [Veryan Hann, Australia]	Taken into account - we have reconfigured the data to present the information as heat bars, with a clearer mapping of the estimate ranges (full range, range across former reviews, range of Fuss et al. 2018). We took care to maintain larger font sizes and hope this addresses readability issues. We consider it valuable to present all the technologies together to facilitate comparison.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
33560	37	1	38	10	I find this find this figure difficult to understand. Panel A looks good but then the caption explains that for some the ranges extend further (but if this figure is put on a PowerPoint slide all those caveats will drop off). Panel B I don't understand why there is a moving-average-type curve on all (except Enhanced Weathering) - what does that curve mean? Also I don't understand why the Manhattan style figures are so chunky if, e.g. for Soil carbon sequestration there are 24 articles why are there more than 24 points, if it is because some papers look at different potentials then why does it not drop to zero in between the numbers which were assessed? [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - we have reconfigured the data to present the information as heat bars with a highlighted estimate range across former reviews and a further narrowed range based on a systematic literature review combined with expert judgment (Fuss et al. 2018). The line graphs overlapped and it was difficult to map the number of estimates with the number of steps in the graph. Some wide ranging estimates might span significant portions of the range, which would prevent the item line from dropping to zero.
52162	37	1	37	1	You're using a cooling tower as a smoke stack, don't do that, it undermines your credibility with the energy sector. They are different shapes. [Jason Donev, Canada]	Taken into account - we have reconfigured the data to present the information as heat bars. This presentation uses the same axis across technologies. We took care to maintain larger font sizes and hope this addresses readability issues.
61012	37	1	37	2	This figure is really hard to read. The text on the graphs is really small. The pictures also take up a lot of space. Might be easier to put that information in a table. [United States of America]	Taken into account - we have reconfigured the data to present the information as heat bars. This presentation uses the same axis across technologies. We took care to maintain larger font sizes and hope this addresses readability issues.
61980	37	1	37	2	Figure 4.3. I do not understand the upper left corner figure (number of articles 6, but more than 6 items from the graph?). I suggest to drop the smooth lines in graphs. [Valérie Masson-Delmotte, France]	Taken into account - we have reconfigured the data to present the information as heat bars. The line graphs overlapped and it was difficult to map the number of estimates with the number of steps in the graph.
62784	37	1	37	1	Add permanence of CO2 storage as further category? See discussion in Section 2.3.4.2 of Chapter 2 [Elmar KRIEGLER, Germany]	Taken into account - permanence is indeed taken up in chapter 2 and discussed here in the text in a complementary way. Figure has been amended with respect to saturation, i.e. certain options are now represented by a dashed box in panel A to illustrate that cumulative potentials in 2100 will likely be much smaller due to saturation effects.
62786	37	1	37	1	Why different entry for food security implications of afforestation and BECCS? Need to be the same in my view as they both compete for land with food crop production (afforestation area is even larger than BECCS area for same amout of CDR) [Elmar KRIEGLER, Germany]	Accepted - Land competition icon added for AR as well.
61014	37	1	37	2	This is an interesting and potentially useful figure. However, the graphical elements relating the scale potential and cost-effectiveness for each measure (e.g., afforestation/reforestation, BECCS, etc.) should be matched to the same graphical scale on the X-axis for each measure for ease of comparison. It would be worth considering whether a similar figure could be developed for energy supply and demand sectors, and perhaps even an analogous figure for RMM approaches. Note also that BECCS is identified as having a negative side effect on food security, but page 46, lines 23-25, refers to "reduced upward pressure on food prices" as a positive side effect of BECCS. [United States of America]	Taken into account - we have reconfigured the data to present the information as heat bars. This presentation uses the same axis across technologies. We took care to maintain larger font sizes and hope this addresses readability issues. The discrepancy with the text has been remedied!
45512	37	2	37	2	Good synthetic figure! [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted - thank you for these encouraging words, we have further improved the figure for the FGD.
56068	37	17	37	36	There is not agreement within the scientific community on soil carbon's potential as an emission strategy. White R E, Davidson B, Lam S K, Chen D (2017). Letter to the Editor – A critique of the paper 'Soil carbon 4 per mille' by Minasny et al. 2017. Geoderma http://dx.doi.org/10.1016/j.geoderma.2017.05.025 Paustian et al (2016) Climate-smart soils. Nature Vol. 532: 49-56. https://www.researchgate.net/publication/300372553_Climate-smart_soils [Kelly Stone, United States of America]	Noted - due to space constraints we cannot go into the details of the controversy, but we have made transparent in the revision that there is far less evidence for global SCS potentials than at local scale (both in the text and by putting the low number of papers in the synthesis figure). We furthermore chose to drop the interquartile range, as misleading, and now display the full range (panel B), the range across previous reviews and a considerably narrowed range based on a systematic literature review combined with expert judgments by Fuss et al. 2018. We hope this does more justice to the evidence base.
55706	37	25	37	27	Figure 4.3. Panel A and consideration of A&R (panel B) needs to be broadened to look at wider range of issues related to ecosystem restoration as per Griscom et al 2017. [David Cooper, Canada]	Noted - we discuss Griscom more broadly now (see also cross-chapter Box 7), but please note that some of their potentials are not CDR and are thus assessed in the ecosystems subsection of 4.3.2.
55708	37	25	37	27	Figure 4.3, Panel A. soemhow needs to addresss questions of feasibility and legitimacy. [David Cooper, Canada]	Taken into account - feasibility issues have been listed as icons. As the figure was getting cluttered, issues pertaining to legitimacy could only be discussed in the text. Note that we have now excluded Ocean Fertilization from the panel.
13344	38	1	38	1	based on missing reference. This is perhaps derived from Haszeldine & Scott 2014 Storing Carbon for Geologically Long Timescales to Engineer Climate, or Haszeldine et al (accepted) Phil Trans R Soc - Negative emissions technologies and carbon capture and storage to achieve the Paris Agreement commitments. [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - this reference indeed got lost and has been repaired now.
16508	38	1	38	1	Sentence incomplete - based on what? Please clarify. [Australia]	Accepted - this reference indeed got lost and has been repaired now.
4298	38	3	38	9	Thi section on Direct Air Capture contains very weak science, in my opinion. The author of this section has been quite picky witht he references. It should be obvious that cost claims in the low range for DAC, as low as 20 USD/t, come from radical advocates and/or ignorants of chemical process technologies, because the literature on CCS (systems dealing with flow rates 2-3 orders of magnitude lower for the same capture rate of CO2 ¡) is overwhelming reporting much higher cost than that ¡. The references currently used in this draft come from experts on fundamental chemiscal and materials aspects (i.e. b y looking at Sanz-Perez 2016 or Goeppert 2012 I cannot see genuine process analysis or cost estimate). Please use at least one reference from those that have reported more robust cost analysis of DAC, from a system or full process perspective: K. Z. House, A. C. Baclig, M. Ranjan, E. A. van Nierop, J. Wilcox and H. J. Herzog, Economic and energetic analysis of capturing CO2 from ambient air, Proceedings of the National Academy of Sciences, 2011, 108, 20428-20433. Also, check with your colleagues in chapter 2: if these optimistic outlook for cost of DAC was accepted in IAMs , what would be the cost of BECCS or CCS ??. [Abanades Carlos, Spain]	Taken into account - section revisited after renewed screening of literature. See also figure update (full ranges now shown in heat bars in panel B, so displaying also more transparently higher-end costs) and especially the accompanying table in the supplementary material with cost and potentials estimates references. House et al. 2011 also cited in main text.
6432	38	13	38	34	DAC should not necessarily be linked with storage, it can be linked with manufacturing of synthetic fuels. Some process are exothermic and thus could provide a very significant share of the energy required for direct air capture. [Cedric Philibert, France]	Noted - CCU is assessed in 4.3.4.5, see table 4.6 further below on our assessment of CCU as CDR option.
13346	38	13	40	16	Relative capacities and permanence of these NETs C/CO2 stores are compared and discussed in Scott et al 2015 Fossil Fuels in a trillion tonne world https://www.nature.com/articles/nclimate2578 [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Noted - CCS and storage are assessed in 4.3.1, however.
12298	38	19	38	20	The references underpinning this very important statement don't include the NAS review of 2015; adding it would strengthen the argument [United Kingdom (of Great Britain and Northern Ireland)]	Noted - NAS is also an assessment/a review and we cover all references therein on potentials and costs. We have now included all previous reviews in the figure to show where they lie on the total literature range and with respect to the narrowed down ranges from Fuss et al (2018). The NAS report is also mentioned in the main text.
61016	38	22	38	25	This discussion refers to 2°C but should address 1.5°C, which is the topic of SR15. [United States of America]	Taken into account - relevance for 1.5°C stated explicitly now.
47938	38	25	38	28	Kindly check: Smith et al. (2016), if it is 2016a or 2016b (Pg. 178, line 53) [Sarah Connors, France]	Accepted
12300	38	27	38	27	Delete " which challenges assessments". The first part of the sentence, and the following sentence, are all the reader needs to know. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
5088	38	27	38	30	I am surprised not to see references directly to claims by, for example, about a process for accomplishing DAC at about $50/ton and similarly by Keith and colleagues. They basically argue that the American Physical Society made errors in their analysis and so DAC really is possible. I don't disagree with the finding, just note a lack of references. Also, however, I would note that it is likely that the cost-effectiveness would become better as mitigation proceeds and it too becomes more expensive. So, it could be said that this is mainly a question of timing based on the economics of the particular situation at a particular time. [Michael MacCracken, United States of America]	Taken into account - see also new subfigures in panel b of the figure showing the full range of the literature including this estimate.
12302	38	32	38	34	Is this paragraph trying to explain research priorities, or say something about the role of CCU projects? It would be better to separate this into 2 paragraphs and include clear statements about (1) how CCU projects can provide a financial return whilst a technology is developed and (2) what the long term potential for CCU is eg seeUK Royal Society report of 2017 [United Kingdom (of Great Britain and Northern Ireland)]	Noted - this is not about research priorities, as knowledge gaps are addressed in 4.6. We reorganized the paragraph to make this clear, but are in any case not giving a full assessment here, as this is done in 4.3.1.
12304	38	33	38	34	Including DACCS into IAM scenarios should not be a priority unless cost-effective, and sufficient energy is available. To include them when not cost-effective and using energy which would be better used for other could mislead policy-makers on what are realistic futures. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - rephrased.
54030	38	33	38	34	Delete sentence. How can it be a priority to include DACCS into IAM when it is not even proven viable or feasible and fraught with uncertainties about prohibitively high costs and energy demand? [Elenita Daño, Philippines]	Taken into account - rephrased.
61018	38	33	38	34	Not really sure that adding DACCS into IAMs has much to do with feasibility of DACCS. Would be better to state that DACCS is missing from most IAM scenarios so its role in 1.5°C isn't fully explored. [United States of America]	Accept - this is a fair suggestion that maintains the message
33580	38	37	39	14	The paragraph on afforestation fails to distinguish between different types of afforestation despite the fact that the environmental and social impacts of what is defined as afforestation are profoundly diversified. Forest ecosystem restoration, analogue forestry and agroforestry with native species tend to have multiple positve social and environmental impacts, while afforestation of grassland ecosystems or diversified agricultural landscapes with invasive alien species can have significant negative impacts on biodiversity, water resources, soil fertility, cultural value systems and associated traditional knowledge and/or rural employment and livelihoods. The chapter would be significant enhanced if a more detailed description would be given of the diversified impacts of different forms of afforestation and reforestation, and if the specific impacts of monoculture tree plantation establishment would be described. [Simone Lovera-Bilderbeek, Paraguay]	Noted - the different forms of AR have been taken into account when assessing the potentials and cost ranges and also the side effects. However, due to space restrictions, we cannot provide details on all of them in the main text, though we agree that this would be helpful. The compromise is now that we mention them and refer to Section 4.3.2, which assesses ecosystems restoration in more detail.
61020	38	37	38	37	For a paper showing soil C sequestration with reforestation, see soon to be published Nave, L. et al. (In Press, PNAS) Reforestation can sequester two petagrams of carbon in U.S. topsoils in a century [United States of America]	Noted - however, due to space constraints, we had to limit the synthesis in this section to global potentials.
29548	38	38	38	39	The definition for reforestation here as well as in glossary is different from the sustainable forest management definitions (the forest sector/actors use). Reforestation (UNFF, FAO) is the "re-establishment of forest formations after a temporary condition with less than 10% canopy cover due to human-induced or natural perturbations". The way the term is used here can cause confusion later when the report is further disseminated. [Finland]	Taken into account - the definition has been changed.
31536	38	38	38	38	The description of afforestation as "planting trees on land not forested over 50 years" is consistent with the CMP decision for LULUCF activities under Kyoto Protocol, but we are not sure that this is common terminology which is widely accepted globally in all communities and/or scientifically; and therefore, we suggest modification to: "not forested for a long time (for example, over the last 50 years in the context of LULUCF CMP decision under the Kyoto Protocol). [Japan]	Taken into account - the definition has been changed.
55710	38	38	38	38	Afforestation implies planting trees on land not forested for 50 yrs. This is UNFCCC use of the term. An ecologist would reagrd native tree planting on land that was previoulsy forested (within human history) as reforestation rather than afforeststion. [David Cooper, Canada]	Taken into account - the definition has been changed.
61022	38	38	38	46	This discussion refers to 2°C but should address 1.5°C, which is the topic of SR15. Note that the reference to 12 GtCO2 is much greater than the amounts depicted in Figure 4.3, even though it presumably reflects a less stringent pathway. [United States of America]	Accepted - source deleted
8260	38	41	38	42	As explained in the subsequent paragraph, carbon sequestration through biological sinks is highly uncertain and potentially impermanent. It should be made clear throughout the chapter that the carbon sequestration potentials mentionned are conditional on assumptions of forest conservation, absence of natural disasters such as wildfires etc. The sentence designated here ("This would sequester at least 3.7 GtCO2yr–1 for decades."), should be modified to read "This could sequester...". [Kelsey Perlman, France]	Taken into account - Permanence of terrestrial and ocean storage is now mentioned in main text. Footnote 7 points to a reference for a more systematic assessment of the permanence issue, which cannot be reproduced here for reason of limited space. The sentence amended as suggested. Saturation has been given consideration in figure 4.2.
47940	38	42	38	42	Kindly check: Smith et al. (2016), if it is 2016a or 2016b (Pg. 178, line 53) [Sarah Connors, France]	Accepted
2188	38	43			unit costs do not hold at high scale, as competition with food crops tends to drive up land prices. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - these were actually abatement costs at scale. Has been corrected.
12306	38	43	38	43	In Box 3.1 the cost is given as 4.5-25.2. Whilst we do not believe the actual costs are hugely important, as the barriers to deployment of afforestation/reforestation are probably not chiefly financial, there should be consistency between chapters. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - cost numbers harmonized.
49648	38	44	38	46	Is this statement on the advantage of BECCS based on BECCS assessments including the impacts of management on carbon stocks, e.g. in biomass? Biomass stock reduction due to management is found to be as large as deforestation. To my knowledge, while deforstation is accounted for in IAMS assessing the carbon effect of BECCS, it is not so with the management effets (see my comments to chapter2). I think it indispensable to check if all carbon effects of BECSS, including managment impacts, are accounted for. If this is not the case, the interpretation might be biased. Furthermore, the potentials of C-sequestration (Houghton and Nassikas 2018 10.1111/gcb.13876, Erb et al., 2018 doi 10.1038/nature25138, Griscom et al. 2017 doi 10.1073/pnas.1710465114) are large and -in contrast to harvest with carbon depts, their effect is immediate, which should be mentioned in the section. [Karlheinz ERB, Austria]	Taken into account - though this part has anyway changed due to a need for shortening, please note that the point was here that energy crops are optimised for biomass production and C can be removed every year through harvest, biomass combustion and CCS – whereas trees (depending on what you plant) tend to be slower growing, and the annual C removal decreases each year as the trees approach maturity. So when time averaged, BECCS removes more C (as a rule) per unit area – which means the ha/C removed is higher for forestry than it is for BECCS (i.e. forestry has a higher land footprint), irrespective of the management impact. We have furthermore taken up the potentials by Griscom et al. (2018) (though the reforestation potential of Griscom is 2030 and thus does not feature in the figure with 2050 potentials) and others, but only in as far as they cover reforestation. Other ecosystems approaches, including avoided deforestation are assessed in 4.3.2.
52164	38	44	38	44	The -1 and 6 in the footnote make it look like -16. [Jason Donev, Canada]	Accepted - footnote deleted.
55720	38	46	38	46	Footnote 7: "Griscom et al find higher potentials, yet their assessment overlaps with mitigtion options." Just because ecosystem/land-based mitigation and ecosystem/land-based CDR, are (of necessity) overalpping categories, does not give a good reason to exclude them from the analysis here! In fact, Griscom et al actually disagregate reduced/avoided emissions from CDR so it is possible to reflect their analysis here. Moreover, as noted elsewhere in this SR, CDR is regarded as a subset of mitigtion (in contrast to SRM/RMM), so this argument is not consistent. Moreover, Chapter 2 does a good job of explaininge the continuum vs distinction between CDR abnd otehr mitigation. see for example section 2.3.3.2 and figure 2.17 for an informative graphical representation. This more integrated approach to land/ecosystem-based approaches needs to be reflected in this chapter and chapter 5. [David Cooper, Canada]	Noted - This was misunderstanding we apologize for. Griscom had not been excluded. His estimate for reforestation is taken into account, though not explicitly featured in the figure, which covers 2050 estimates (Griscom is 2030). We just don't reproduce his analysis for avoided deforestation on top of it in this section, as this is assessed in 4.3.2. We have elevated Griscom to the main text and added a footnote explaining this disentanglement.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
51522	38	47	39	14	CDR options through afforestation is not only limited but is a wastage of land and create livelihood loss by locking lands through monoculture plantations that leads to biodiversity loss and loss of soil fertility. Afforestation in non forest land can lead to food shortage, grabbing of commons and village land for other community economic activities. Reforestation with native species, and through FPIC of communities, clear decentralised governance in favour of communities with tenurial and secured community rights is by far more productive and can better sequester carbon with providing livelihood optiosn to communities. IPCC should avoid mentioning that BECCS is better than AR. That creates a lot of confusion. [Souparna Lahiri, India]	Noted - different forms of AR have been taken into account when assessing the potentials and cost ranges and also the side effects. However, due to space restrictions, we cannot provide details on all of then in the main text, though we agree that this would be helpful. Concerns with the mode of large monocultures has been noted in the text.
18616	38	48	39	1	The assertion on permanence is unsubstantiated and must be reconsidered. The assumptions on CCS are very optimistic, as it has never been attempted at scale, and the limited experience we have is mostly with EOR, which cannot be an option towards a 1.5 degree world (or even 2 degrees). There are very serious doubts about the stability of storage and the ability to safeguard and monitor disposal sites (not to mention the inevitable incentive to cheat, cut corners and ignore expensive problems in a real-life environment). In contrast, forests have been around forever. Individually, all forests are vulnerable (and will be more vulnerable with climate change), but at the system level, the expansion of forest is likely to lead to an expansion of C stocks. Moreover, it can be monitored. Clearly, forest sinks should not be calculated from best-case forest growth estimates, but should take into account risks (incl. non-permanence) at the system level. But the same applies to BECCS. [Andrea TILCHE, Belgium]	Accepted - this sentence became misleading in the process of cutting (seeming to imply that permanence depends on saturation somehow), which has been repaired now.
28556	38	48	39	14	Forest "sinks" do not saturate if management is included in the assessment, not only land cover (sic!) change. NBP may saturate, but GPP and NPP can remain positive even in old forests, and the amount of C sequestered and transferred to other pools by forest management activities will function as a sink. Please ensure that this section discusses the sink-characteristics of old forest adequately. [Germany]	Accepted - this sentence became misleading in the process of cutting, which has been repaired now.
36120	38	48	39	14	Afforestation and reforestation are mitigation options for carbon sequestration with huge positive socio-economic and environmental implications. More citations are required to substantiate this. [India]	Taken into account - we have added more references on side effects. However, it depends on which type of afforestation is deployed to have these huge co-benefits. A sentence has been added to clarify this.
49650	38	48	38	49	Why should the stock be less permanent when the sink saturates? The sink is the balance of gross primary production and autotrophic respiration. During growth, production > respiration, and both paramters are increasing. In maturity, productcon and respiration are both large, but balance each other - but they result in a high steady-state carbon stock which is -all other things kept the same, permanent. Note that this also applies to disturbances - as long as disturbance regimes do not change, the stock is permanent. Land use impacts or changes in dirsturbance regimes render the stocks less permanent, but not the saturation of the sink. [Karlheinz ERB, Austria]	Accepted - this sentence became misleading in the process of cutting and merging, which has been repaired now.
33974	38	48	39	14	We find the current wording on the permanence of biogenic storage inaccurate in two regards. Firstly, the text seems to mix sinks and stocks. The permanence issue relates in our experience to these two concepts in different ways, and the text is unclear as to which of the two is being considered. The carbon sink in an immature forest is not permanent and will not be so until the forest reaches saturation, if indeed it does so. As far as we know, science is yet to conclude as to whether all forests reach saturation. Additional information on this would be welcome. Secondly, there is the issue of permanence related to storage of carbon in forest stocks. This topic is currently being debated and the text could benefit from reflecting this debate. We link to an article/references for consideration: http://www.climateandlandusealliance.org/wp-content/uploads/2017/10/Forest_Mitigation_A_Permanent_Contribution_to_Paris_Agreement.pdf [Norway]	Accepted - this sentence became misleading in the process of cutting, which has been repaired now.
53266	38	48	39	3	relevant to *Plausibility of BECCS vs afforestation* This section contains another example of a false comparison of BECCS versus afforestation that misleadingly treats BECCS like it is a real mitigation option. It states, “The most important caveat of the CDR potential of AR arises from the fact that biogenic storage is less permanent, as forest sinks saturate, a process which typically occurs in decades to centuries compared to the thousands of years of residence time of CO2 stored geologically (Smith et al., 2016b) and is subject to disturbances, e.g. to drought, forest fires and pests that can be exacerbated by climate change. This requires careful forest management after afforestation and makes AR less effective as a CDR option over time.” This is frankly absurd because the statement acts as if BECCS is a real solution that can actually store carbon and therefore the “fact” that biological storage in forests is “less permanent” than BECCS is a concern. This is a false comparison; the section should be rewritten to remove the unnecessary reference to geological storage as if it is a real possibility. It is fine to discuss the deficiencies of afforestation as mitigation but please don’t act as if there is actually a realizable and better alternative out there. [Mary Booth, United States of America]	Noted - this sentence became misleading in the process of cutting (seeming to imply that permanence depends on saturation somehow), which has been repaired now. However, this has nothing to do with BECCS.
55712	38	48	39	1	This "caveat" is not fully correct as written. It also confounds a number of phenomena. (1) Saturation of carbon pool. Yes, there is initally rapid sequestation and this diminishes as forest matures. But in many cases it does not stop -- some old growth forests continue to sequester carbon. See Luyssaert (2008) Old growth forests and global carbon sinks. Nature. 455 213.. See also Thompson et al (2009) Forest resilience, biodiversity and climate change. SCBD. (2) this effect of diinishing returns is not an issue, itslef, of permanance, and does not distinquish forests from geological stores. (2) forests are, howebver, subject to distrubances. some of these are 'natural' and, on average, can be accounted for over longer temporal and spatial dimensions. others may be induced by cliamte change and other environmnetal changes. (3) with regards to disturbances induced by global change, this would also apply to existing forest stocks. therefore worth considering potential for virtuous circle: rapid net GHG reductions, with Ecosystem-based approaches (mature CDR measure) playing a significant role, especially in early stages, limiting temperature increase, thereby increasing ecosystem resilience and permanence. (Contrast with viscous circle of weak mitigation, temp exceeding threhsolds, ecosystem breakdown contriuting to further (possibly runaway) climate change). [David Cooper, Canada]	Accepted - this sentence became misleading in the process of cutting (seeming to imply that permanence depends on saturation somehow), which has been repaired now.
55714	39	1	39	2	makes AR less effective as a CDR option over time not necessarily true. See previous comment. [David Cooper, Canada]	Noted - however, this sentence is gone due to shortening.
16510	39	1	39	1	It may be worth indicating the implication of 1.5 change on the change in fire risk in different regions - ie how much more fire and quantify the negative implications re biomass loss and emissions if possible - compared to biomass gain following reforestation and afforestation? A number of studies have explored this. Same applies as to the extent of negaitve impacts of drought on grwoth rates and the change in the incideence / impact of pests with climate change. This would help to compare with the quantified positive estimates of carbon storage from this activity. [Australia]	Noted - this would have been very interesting, however the evidence quantifying the different items mentioned by the reviewer was not sufficiently robust to conduct the suggested comparison, also given space constraints.
18618	39	1	39	14	All the caveats about AR (distribution, albedo, plantations, etc) apply equally (or even more) to BECCS. For BECCS to deliver "negative emissions", it MUST be based on additional biomass (Haberl et al. : Correcting a fundamental error in greenhouse gas accounting related to bioenergy. Energy Policy Volume 45, June 2012, Pages 18-23), therefore significant new plantings. They would likely take the form of AR, except involving a less stable and more resource-intensive land use pattern with more emphasis on economies of scale and intensity of management (as biomass would need to be efficiently harvested and removed regularly). BECCS would therefore be less compatible with practices that are gentle on water resources or soils, or would involve higher diversity to increase system stability. E.g., BECCS requires removing the biomass including its embedded nutrients) to far-away places for destructive use, which involves regular disturbance of soils (collateral C losses) and a loss of nutrients that will adversely impact the forest and/or will need to be replenished. [Andrea TILCHE, Belgium]	Noted - BECCS caveats are discussed in the BECCS section. AR caveats of saturation effects, etc. are specific to AR and thus only discussed here. Due to space constraints only those side effects backed by the most robust evidence can be mentioned here. BECCS and AR both share the icon of land competition in the synthesis figure, so both are acknowledged to share the accompanying side effects.

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28558	39	2	39	2	Please clarify: "less" compared to what? [Germany]	Noted - however, the sentence is gone due to shortening.
31538	39	2	39	2	Since this section covers both afforestation and reforestation, "after afforestation" should theoretically also mention reforestation; and therefore we would suggest modification to "after afforestation and/or reforestation" (or, saying " after AR" as this phrase often appears in this section. [Japan]	Accepted
55716	39	2	39	4	pace …..will be slow, as forests first need to grow to their full potential Simply not true (and, btw, contradicts "saturation" argument made above.) In fact (1) early sequestyration is relatively rapid. (2) this approach can be rapidly implemented. See Chazdon et al 2016. Carbon sequestration potential of second-growth forest regeneration in the latine American tropics. Science advances e1501639., Griscom et al 2017. [David Cooper, Canada]	Accepted - sentence revised
28560	39	3	39	4	Please clarify what you mean by "slow": the "full potential" of C sequestration of a newly established forest is equal to the age of the highest "current annual increment" of the biomass. Depending on site, climate, species etc. this can be reached much earlier than maturity. [Germany]	Accepted - sentence revised
29550	39	4			It is unclear what "full potential" means: full potential of carbon sequestration, full potential of carbon storage/stock ? [Finland]	Noted - this sentence is gone due to shortening.
5762	39	5	39	7	The local dependence of the benefits of afforestation should be discussed – Bala et al. (2007 PNAS) showed that the climate change mitigation potential is large for afforestation in the tropical regions and least in the boreal regions. There is a vast literature on location dependence of the net benefits with a few good review papers (e.g. Devaraju et al. 2015, Plant, Cell and Environment). Afforestation in the high latitudes also could shift the location of the Inter-Tropical Convergence Zone (ITCZ) and alter the quantum of annual rainfall in the tropical monsoon region via remote effects. This effect was quantified in a recent study in PNAS (Devaraju, Bala, and Modak, 2015 PNAS). This newly identified effect of land cover change should be discussed in this paragraph. [Govindasamy Bala, India]	Accepted - reference added, heterogeneous distribution of potentials mentioned, but unfortunately no space to go into any details.
31540	39	5	39	6	Regarding the description of "by its impact on the albedo in higher latitudes", it seems more understandable if more concrete explanation (a few sentences) on how albedo will change associated with afforestation is provided. [Japan]	Noted - however, this part is gone due to shortening.
36122	39	5	39	7	The local dependence of the benefits of afforestation should also be included. Please refer Bala et al. (2007 PNAS), Devaraju et al. 2015, Plant, Cell and Environment), (Devaraju, Bala and Modak, 2015 PNAS). [India]	Accepted - reference added, heterogeneous distribution of potentials mentioned, but unfortunately no space to go into any details.
2190	39	8			uncited point re geological storage. No reason to believe that basaltic mineralisation (as opposed to anticline pressurised storage) would be controversial http://science.sciencemag.org/content/344/6182/373 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted - CCS and storage are now assessed in 4.3.1, however.
55718	39	8	39	10	Although forest management … acceptable, only medieum agreement on the postive impacts on ecosystems and biodiversity, especially if through plantations of monocultures. This needs to be unpacked: (1) There is high agreement that plantations of monocultures are generally negative for biodiversity (by definition monoculture means no diversity for the trophic level of the trees at least!). (Also there is high agreement that afforestation of naturally non-forested ecosystems is generally negative for biodiversity (2) impacts of ecosystem restoratiion, will generally, be postyive for biodiversity, although there will be some excpetions. The Convention on Biological Diversity has adopted guidance in this respect. https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-05-en.pdf [David Cooper, Canada]	Noted - we have tried to be a bit more differentiated here in the revision, but lack of space prevents us to fully unpack this and other aspects.
12308	39	9	39	10	Perhaps there is only medium agreement because they're considering different things, eg monocultures and plantations designed to support ecosysstems and biodiversity, in which case these points should be better elaborated to explain both the risks and possible benefits. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - this is true and therefore we have added this explanation behind the statement to clarify.
28562	39	10	39	10	From a monoculture rather negative effects arise, e.g. for biodiversity. Therefore please replace "co-benefits" by "side-effects". [Germany]	Noted - however, the sentence has changed, as we are now differentiating between different forms of afforestation.
12310	39	12	39	12	Healthier diets is too vague. Does this mean that meat consumption by humans is restricted to the maximum amounts recommended by the WHO? If so, it should say so. If not, it should say what is assumed. [United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, we do not have the space to go into details of the assumptions of the scenarios and can only give the reference for this, as we do not have the space to expand (which we'd love to for this point!).
12312	39	12	39	13	Synergies with other policy goals could also include flood prevention [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - is mentioned in the synergies and trade-offs table in Supplementary Material 4E.
34794	39	12	39	14	These sentences only mention healthier diets in Western Europe but without reference to other parts of the world. The final sentence on the paragraph could be edited for global application to say "Such land-sparing strategies could also benefit other land-based CDR options and could also benefit from healthier diets in other regions of the world". [Helena Wright, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - this paragraph has been re-written to be more general.
12314	39	17	39	36	It would be useful if this section were divided into separate ones; one for CCS and one for biochar, as they are very different. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - though we only have one section for both, the assessment has ben split into two individual paragraphs.
16512	39	17	39	36	For figures quoted for soil carbon storage potenital (here and elsewhere in report), has consideration been given to soil saturation levels? [Australia]	Noted - soil saturation has been taken into account, see caption text of Figure 4.2.
16514	39	17	39	36	Separate consideration of SCS from biochar - ie create separate sections., as they are quite different strategies in that biochar is stable, so permanence concerns are much less relevant; biochar requires an engineering process to create it; biochar has additional benefits in GHG mitigation due to its absorptive properties and capacity to stabilise added organic matter. Biochar therefore can reduce GHG emissions from soil (eg Cayuela, M. L., van Zwieten, L., Singh, B. P., Jeffery, S. Roig, A. & Sánchez-Monedero, M.A. 2014. Biochar's role in mitigating soil nitrous oxide emissions: A review and meta-analysis. Agriculture, Ecosystems & Environment, 191: 5-16.), and enhance SOC levels (Weng, Z.H., Van Zwieten, L., Singh, B.P., Tavakkoli, E., Joseph, S., Macdonald, L.M., Rose, T.J., Rose, M.T., Kimber, S.W., Morris, S. and Cozzolino, D., 2017. Biochar built soil carbon over a decade by stabilizing rhizodeposits. Nature Climate Change, 7(5), p.371.). [Australia]	Taken into account - though we only have one section for both, the assessment has ben split into two individual paragraphs. The reference has been integrated in the biochar section.
30628	39	17			Could you give examples (other than biochar) that increase soil carbon sequestration? [France]	Accepted: SCS examples added.
36124	39	17	39	36	Elaborate coverage has been for Bio-char. For the 1.5 degree C targets, peatlands are more critical in the short-term, and needs to be covered in this segment. [India]	Noted - however, though we agree that the conservation of peatland is important and can avoid a large amount of emissions, this is not a removal of CO2 from the atmosphere and thus beyond the scope of this section.
49046	39	17	39	36	Section 4.3.8.4 appears to conflate soil sequestration with biochar, while there are soil carbon approaches that do not rely on biochar (e.g. no-till agriculture, addressed elsewhere in Chapter 2). It is important to distinguish among different approaches to soil carbon sequestration. [David Waskow, United States of America]	Taken into account - though we only have one section for both, the assessment has been split into two individual paragraphs.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
18620	39	17			4.3.8.4 "biochar" has generated a lot of interest ("hype"), but its benefits are doubtful and no study considers the full GHG cost/benefit of biochar (taking into account the opportunity cost of land and biomass). It is questionable whether it should be covered as a single mitigation option, when other, more mature and better analysed approaches are ignored (e.g., increasing the use of wood and other biomass for material substitution or using charcoal for energy in industry, such as in steel making). Even if the section is maintained, the discussion should be separated between the "production of biomass for sequestration" (which can be for charcoal or other means), and the "application of char to soil" (which may or may not be desirable or feasible). This is because the latter phase (application to soil) is counterproductive from a mitigation perspective: even if char is produced from biomass (to convert it in a stable form to be sequestered in solid state), it could be sequestered more securely, efficiently and safely (e.g., through landfilling or in abandoned mines) than putting it in the soil. Application to the soil is likely to make the carbon less stable (more likely to be lost), more difficult to monitor, more energy intensive (spreading) and is likely to reduce albedo and increase black carbon emissions. The only case wehre char should be applied to the soil is when it can increase resilience and/or productivity (without significant risk of contamination), but that is a different matter, not an essential phase for mitigation. The mentioned benefits of char application to the soil are attractive, but are more anecdotal than systemic, and the limited uptake of the trechnique suggest that they are far from universal. To the extent biomass (and land to produce it) is available for sequestration in a solid state, charring it may or may not be an attractive proposition. E.g., it can be more efficient to take the biomass (such as wood) and bury it or sink it into the ocean without conversion. Finally, the use of "biochar" (or charcoal, which is objectively indistinguishable from it) is one of the few options available to replace fossil energy carriers in industrial applications, such as steel making or cement. This technology is already used, and it seems much more reasonable and efficient than continuing to use fossil fuels and expecting to use BECCS to remove the "residual" emissions of industry. [Andrea TILCHE, Belgium]	Noted - There is a big literature assessing the stability of biochar in soils and showing a great stability (centuries to millennia) (e.g. meta-analysis of Wang et al., 2015) (https://onlinelibrary.wiley.com/doi/10.1111/gcbb.12266/). The increase in crop yield showed by a meta-analysis by Jeffery et al. (2011) suggests that biochar increases crop yields. On the other hand, the increase in soil organic carbon content (SOC) and the improvement in its fertility properties after the biochar addition makes the soil more resilient to future impact of climate change and thus ensuring food production. The results of these meta-analysis suggest that the benefits of applying biochar to soil are not anecdotal, but biochar affects positively soil properties in many different crops and different type of soils. Therefore, if the biomass was buried or sink into the ocean, benefits on soil in croplands would not take place and it would be a "wasting" of a natural fertilizer. Regarding the effect on albedo, application rates of biochar are small compared to the whole soil surface where it is spread, and together with the fact that biochar should be buried in order to increase soil fertility properties, the effect of biochar on albedo would not be remarkable. Still we have included a side effect in both the figure and the text with a suitable reference - for the case that the full, upper-range potential is carried out with large-scale methods. In addition, we explicitly state that this is about the application of char to soil (with sequestration of CO2 in biomass dealt with in the context of other CDR options), as suggested by the reviewer and we also added a reference to show that other pyrolysis products could be much more interesting as well (Werner et al. 2018).
51524	39	17	39	36	It is best to avoid such market and offset mechanism on land. There are far better mechanisms. [Souparna Lahiri, India]	Noted - however, it is part of the assessment to find these things out, so we cannot discard land-based options ex ante.
54032	39	17	39	36	Highly biased and speculative sub-chapter, without any evidence in reality. Has to be deleted or re-written. See formerly quoted reference from, Biofuelwatch and also http://www.biofuelwatch.org.uk/docs/cooling_the_planet_with_biomass.pdf . [Elenita Daño, Philippines]	Rejected - though the text has been amended in places, we disagree that it is speculative, as based on a systematic review of the full peer-reviewed literature base on biochar. We flag the lack of large-scale field experiments as a major caveat and do not see where the bias is, as we list all the side effects - positive and negative - for which there is a significant evidence base.
55722	39	17	39	36	section 4.3.8.4. Would be better to separate disucssions on SCS and biochar. Also add reference Griscom et al 2017 and analysis therein. [David Cooper, Canada]	Taken into account - though we only have one section for both, the assessment has ben split into two individual paragraphs. Griscom et al. (2017) was already part of the SOD text.
53270	39	17	39	36	relevant to , “Additional implausibility of biochar as mitigation.” This section is dedicated to discussing biochar as mitigation, including the claim that biochar could sequester 1.7 to 4.6 Gt CO2 per year. The report needs to do a better job of explaining that biochar is extreme geoengineering that involves adding a literally toxic material – burned plant material, which contains PAHs, dioxins, and other by-products of burning – to soils (and to the air, since inevitably, the material would be suspended and would add to particulate loading). The report states that 40 – 260 Mha would be required to grow the material to make biochar, a considerable underestimate by our calculations based on an assumption of 30% recovery of char from pyrolysis and typical crop productivity. The report additionally implausibly claims that water requirements for “both” soil carbon sequestration and biochar are “close to zero” – but if biochar requires growing crops on over 260 Mha of land, how is that going to happen without additional water? By this point this report is feeling like such an exercise in fantasy, we suggest these sections should be illustrated with little unicorns and fairies in the margins. Ditto for section that we should grind up rocks and distribute it over land. Just what the planet needs! [Mary Booth, United States of America]	Noted - Although the potentials have been revised downwards (we no longer use the interquartile range), the knowledge about PAHs in biochar is relatively poor, so this has not been included here. Biochar is supposed to contribute to control soil contamination, due to its chemical properties, which makes the surface of the biochar highly active (Bourke et al., 2007; Ahmad et al., 2013) (https://www.sciencedirect.com/science/article/pii/S0045653513015051). Indeed, according to the authors, the aromatic compounds formed during the biochar production process would be, in part, responsible of its high reactivity when it is applied on the soil. As a consequence of this chemical properties, biochar would be able to adsorb some chemical pollutants, as for example, PAHs. Stefaniuk et al. (2018) (https://www.sciencedirect.com/science/article/pii/S0304389418300463) proof in a field study that biochar was able to decrease free dissolved PAHs in soils amended with sewage sludge. Peng et al. (2017) found in a meta-analysis of 1813 observations that the addition of biochar on soils decreases especially Cd and Pb concentrations in edible and indirectly edible plants part and in a lower extent the Zn, Ni, Mn, Cr, Co and Cu concentrations (https://www.sciencedirect.com/science/article/pii/S0048969717329406). Furthermore, some authors (Hale et al., 2012) (https://pubs.acs.org/doi/pdf/10.1021/es203984k) found that the concentration of dioxin in biochars was very low (up to 92 pg g–1) and, more importantly, the concentration of bioavailable dioxin was below the analytical limit of detection. In the case of the bioavailable PAHs, these authors found very low concentrations for slow pyrolysis (ranged from 0.17 ng L–1 to 10.0 ng L–1) "which is lower than concentrations reported for relatively clean urban sediments". The highest concentrations of PAHs were found for gasification, which is only available at a industrial scale and less common than pyrolysis, which we assess here. We are afraid that for reasons of constraints on space, we do not have the possibility to fully go into the PAH discussion. Also, please note that CDR is in this report explicitly not categorized as geoengineering (see glossary). Regarding the land needed for the biochar production, we must remark that biochar can be produced from the residues of forests and crops (e.g. pruning debris) without implying and additional input of water. Furthermore, dedicated crops can be settled in degraded lands and with an appropriate tillage (e.g. conservation agriculture, see section 4.3.2) they could help to improve soil fertility properties and ecosystem restoration. Still, if the full potential was exploited, we agree that additional biomass would be needed, which could run into land competition issues. So we have added the land competition side effects icon to the synthesis figure also for biochar.

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61024	39	17	39	36	What is the level of uncertainty around the biochar analysis (mitigation potential, costs) included in this paragraph? [United States of America]	Accepted - confidence language added and further transparency via the new heat bars in Figure 4.2.
61026	39	17	39	36	The discussion of soil carbon sequestration suggests that it is a potentially cost-effective and an important option that deserves more salient discussion in the chapter summary and perhaps in the SPM. It would be helpful to address social and institutional acceptance in this discussion. [United States of America]	Accepted - soil carbon sequestration has been elevated to the SPM, stressing the co-benefits.
62780	39	17			Include not only biochar, but also biooil sequestration of pyrolysis products, there is also a link to agroforestry here (see BioCAP-CCS project); reference also Griscom et al., PNAS 2017, on nature climate solutions. [Elmar KRIEGLER, Germany]	Accepted - added in the table
16516	39	18	39	19	Suggest changing to "Biochar is obtained from pyrolysis and can be used as a soil amendment to increase soil carbon sequestration, which can also be achieved by changes in land management (soil carbon sequestration, or SCS)". Saying it increases soil carbon stocks could imply you are simply adding extra carbon to the soil. [Australia]	Taken into account - the confusion has been avoided in the revision by separating the SCS from the biochar description.
18622	39	18	39	19	Biochar from animal bones contains high percentage of Phosphorus and can be also used as P fertiliser and not only as soil amendant [Andrea TILCHE, Belgium]	Noted - we found only very specialised papers on this and cannot go into these details in this report, as due to space constraints we need to focus on post-AR5, 1.5°C-specific literature. We hope this can be taken up in the special report on land, which will be more detailed on the land-based mitigation options.
42820	39	18	39	36	Biochar could reduce N2O emissions from soil by 10 to 90%. Cayuela M., et al. (2013) Biochar and denitrification in soils: when, how much and why does biochar reduce N2O emissions? [Kristin Campbell, United States of America]	Taken into account - reference added
43068	39	18	39	36	Biochar could reduce N2O emissions from soil by 10 to 90%. Cayuela M., et al. (2013) Biochar and denitrification in soils: when, how much and why does biochar reduce N2O emissions? According to Smith P. (2016), Soil Carbon Sequestration and Biochar as Negative Emission Technologies, less than a hectare of biochar treated land may be able to draw down approximately a ton of carbon annually. A recent meta-analysis conducted by Wang J., et al. (2016), Biochar stability in soil: meta-analysis of decomposition and priming effect, found that 97% of biochar mass has a mean residence time (MRT) in soil of ~556 years. [Durwood Zaelke, United States of America]	Taken into account - reference all added; these are very useful, many thanks.
61982	39	18	39	36	The reader is asked to look at Fig. 4.3 but where is the associated list of literature assessed to provide these ranges? At the end of the paragraph, "not all land" : where is it suitable, and what are the implications of this? [Valérie Masson-Delmotte, France]	Taken into account - We have incorporated the references that inform the various elements of the plot in a corresponding table in the supplementary material.
16518	39	21	39	36	Please review the statements about biochar for accuracy. Heat is a co-product of pyrolysis; Kammann paper refers to biochar, not SCS; Albedo change could be an issue if biochar is applied at very high rates and left on the soil surface. However, as it is recommended that biochar is incorporated into the soil, this is not likely to be a significant issue in practice. Biochar can be safely applied at very high rates (eg Zhang et al., 2010) particularly if it is composted before application or incorporated into soil some time before sowing. However, the net benefits of biochar are likely to be higher if applied in low volumes over a larger area, especially if targeted at the most responsive soils, and treated to enhance effectiveness fter enhancement through co-composting or nutrient addition (Joseph et al., 2013) Zhang, A.,et al., 2010. Effect of biochar amendment on yield and methane and nitrous oxide emissions from a rice paddy from Tai Lake plain, China. Agriculture, ecosystems & environment, 139(4), pp.469-475. Joseph et al., 2013 . Shifting paradigms: development of high-efficiency biochar fertilizers based on nano-structures and soluble components. Carbon Management, 4(3), pp.323-343 [Australia]	Taken into account - Although we cannot go into so much detail here, we appreciate that trying to put SCS and biochar into one paragraph has caused some inaccuracies that might result in misunderstandings. We have now separated the two options in two paragraphs and hope this has added much clarity. We agree on the point about the albedo effect; there is indeed very low agreement in the literature that there actually is such an effect and so we have removed this point from the text and the synthesis figure.
7456	39	22	39	26	No till agriculture, leading to SCS, is generally seen as having negative, not positive mitigation costs. As normally mitigation cost calculations take into account productivity benefits (e.g. in the renewable energy sector, revenues from electricity sales are considered). So mitigation cost calculation should be revised here, taking into account the productivity gains. Revise the sentence line 22-24 accordingly (as well as Figure 4.3); sentence line 25-26 seems fine. [Axel Michaelowa, Switzerland]	Noted - however, we do not calculate the costs here, but report the ranges from the literature, which covers a broad set of techniques and thus also costs. We hope the revised figure with the new panel representation for SCS helps to shed more light especially on the lower end of the cost spectrum.
61028	39	24	39	26	If SCS has negative cost, why isn't it being done now? Are there some barriers to adoption that are worth noting? [United States of America]	Noted - this is a good question and there is probably a range of barriers ranging from lack of awareness to social inertia, but there is no solid literature base on the barriers, which is why we can't go into detail here.
12316	39	29	39	31	Very sweeping statements relying on just 1 reference. We believe there is evidence to the contrary, and may be geography-dependent eg differ between tropical and temperate regions [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - Section has been revised highlighting more the uncertainties and more references for the (positive) side effects have been provided, where possible from meta-analyses. The decrease in N2O emissions has been removed, as anyway this was more meant for biochar (we have in the revision separated the two options to avoid such confusions).
5090	39	32	39	33	I thought that the icea was to bury the biochar, not to have it lying on the surface for any length of time? [Michael MacCracken, United States of America]	Accepted - Effectively, the biochar would be incorporated and buried into the soil in order to increase its liming effect. We have deleted the sentence.
12318	39	33	39	35	It is unclear what is meant by the maximum safe holding capacity of soils for biochar, but the build-up of contaminants in the soil will also be a constraint and that depends on the source and method for creating the biochar [United Kingdom (of Great Britain and Northern Ireland)]	Noted - unfortunately, we cannot go into this detail due to space constraints and thus only list the corresponding references for further information here.
2192	39	36			no mention of the risks relating to biochar getting into watercourses, which it would do if deployed at scale [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, due to lack of space, we only list the positive and negative side effects with the most robust evidence. Furthermore, one positive side effect -which we can also not mention here - of the application of biochar is that the relatively high reactivity of its surface could lead to a decrease the risk of soil and water pollution, since pollutants would be linked to the biochar.
51210	39	39	40	16	Also, the mining, grinding and distribution of rock material with the help of heavy industrial infrastructure and tools are highly energy intensive processes. The emissions accruing from mining, grinding and distribution are frequently not accounted for, or underestimated. Moreover, rock mining for enhanced weathering would require a great expansion of olivine extraction, perhaps at the order of current global coal mining (Köhler et al (2010). The geoengineering potential of artificially enhanced silicate weathering of olivine. Proceedings of the National Academy of Sciences of the United States of America, 107 (47): 20228-20233), which is a very problematic prospect when considering the human rights abuses record of global extractive industries over the past 500 years. [Linda Schneider, Germany]	Noted - many of the references - including some new ones published since the SOD and taken up in the FGD such as Strefler et al. (2018) in ERL - do take into account the energy need for the grinding. We also have a low confidence statement due to diverse assumptions. Also, the negative side effects from large-scale mining are flagged in the synthesis figure.
55724	39	39	40	16	section 4.3.8.5. Need to indicate the massive scale needed for EW to have a significant CDR impact that implications of this for feasibility and side effect impacts. For analysis, see: Williamson, P., & Bodle, R. (2016). Update on Climate Geoengineering in Relation to the Convention on Biological Diversity: Potential Impacts and Regulatory Framework. Technical Series No.84. Secretariat of the Convention on Biological Diversity, Montreal [David Cooper, Canada]	Noted - massive scales are an issue for many of these options and the associated side effects are captured by our systematic review, see also side effect icons in figure 4.2.

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54182	39	39	40	16	It is, in my opinion, very problematic to address terrestrial enhanced weathering in the same paragraph as ocean alkalinisation. Considering that none of the other approaches are addressed together in this way, it makes little sense as to why the two should be treated together here. While terrestrial enhanced weathering is relatively controllable, ocean liming is subject to much higher uncertainties with unpredictable effects on marine biodiversity and ecosystems. Furthermore, the two approaches are completely different in terms of jurisdiction and legal implications: while the first is free for local or national governments to implement as they wish (within the frame of their own environmental laws), the second would be subject to international law and the prohibition of dumping under the London Protocol. It thus faces similar governance challenges as ocean fertilization, discussed in the following paragraph. [Ina Möller, Sweden]	Noted - due to space constraints, some options had to be summarized and terrestrial and enhanced weathering were more easily compatible than others. We have reworded much of the text to make sure that it is clear that these are distinct options and noted the low confidence for the potentials.
62782	39	39			Add mineralisation of CO2 in basaltic rocks (see CarbFix project). On EW, include new Strefler et al. study in ERL. [Elmar KRIEGLER, Germany]	Taken into account - Strefler et al. 2018 has been added.
63248	39	40	39	47	parag rewrite: Weathering of alkaline minerals (carbonates and silicates) is the natural process of rock decomposition via chemical and physical processes in which CO2 is spontaneously consumed and converted to solid or dissolved alkaine bicarbonates and/or carbonates. The process is controlled by temperature, reactive surface area, interactions with biota and, in particular, water solution CO2/pH. One method of accelerating mineral weathering and effecting CDR is to grind selected rock material to increase areal/volume reactivity and distribute it over land (Hartmann and Kempe, 2008; Köhler et al., 2010; Manning and Renforth, 2013; Renforth, 2012; Taylor et al., 2016; ten Berge et al., 2012; Wilson et al., 2009), shorelines (Schuiling and de Boer, 2011; Hangx and Spiers, 2009; Montserrat et al., 2017) or the open ocean (Harvey, 2008, Hauck et al., 2016; Köhler et al., 2013). In the case of land application of ground minerals, the CDR potential ranges from 0.72 GtCO2 yr–1 (Hartmann et al., 2013) to 88.1 GtCO2 yr–1(Taylor et al., 2016); agreement is low due to a variety of assumptions and unknown parameter ranges in the applied upscaling procedures that need to be verified by field experiments (Fuss et al., 2017). Marine application of ground minerals would appear to be limited by feasible rates of mineral extraction, grinding and delivery and might approach Gts CO2/yr (Renforth and Henderson, 2017). new refs: Schuiling, R. D., de Boer, P. L. Rolling stones; fast weathering of olivine in shallow seas for cost-effective CO2 capture and mitigation of global warming and ocean acidi?cation. Earth System Dynamics Discussions 2011, 2, 551–568. Harvey, L.D.D., 2008. Mitigating the atmospheric CO2 increase and ocean acidification by adding limestone powder to upwelling regions. J Geophys Res 113, C04028. doi:10.1029/2007jc004373 [Greg Rau, United States of America]	Taken into account - We have integrated the main points in a condensed way due to space constraints. We have also take up the references, but Schuiling and de Boer 2011 have not been accepted by ESD, so it dropped out.
19656	39	49	39	49	Statements of potential carbon draw-down from theoretical geoengineering methods should be presented as estimates rather than as absolutes. This could be clarified by inserting the word 'estimated' between 'The' and 'potential' at the start of line 49. [Jennifer Morgan, Netherlands]	Accepted - suggested word added
61030	39	49	40	16	The range in potential for terrestrial EW is very large. Given the potentially large contribution it could make, some further discussion may be warranted. [United States of America]	Accepted - qualification based on new paper by Fuss et al. (2018) added.
63250	39	49	40	1	parag rewrite: A second method of accelerating mineral weathering is to exposed carbonate minerals (e.g., limestone) to water and elevated CO2, such as contained in waste gas streams. This spontaneously consumes the CO2 and mineral to form dissolved bicarbonate and carbonate in solution. Using seawater for the process strongly inhibits the reversal of the reaction. Thus CO2 is captured, converted and stored in the ocean as an already abundant, long-lived form of seawater alkalinity (Rau and Caldeira 1999, Rau 2011, Chou et al 2015). Considering the seawater requirement and the number of coastally located CO2 point-sources presently available, full appliction of this process might reduce global CO2 emissions by 1Gt/yr (https://www.climatecolab.org/contests/2012/electric-power-sector/c/proposal/1304174) . Initial estimates suggest a $/tonne CO2 mitigated costhere that is at least half that of CCS (Rau 2011). Utilization of this process to mitigate CO2 from coastally-located biomass energy production could be useful in generating negative-emissions energy without the use of CCS and it's associated costs and risks. new refs: Chou, W.-C., Gong, G.-C., Hsieh, P.-S., Chang, M.-H., Chen, H.-Y., Yang, C.-Y., Syu, R.-W., 2015. Potential impacts of effluent from accelerated weathering of limestone on seawater carbon chemistry: A case study for the Hoping power plant in northeastern Taiwan. Mar. Chem. 168, 27–36. doi:10.1016/j.marchem.2014.10.008. Rau, G.H., 2011. CO2 Mitigation via Capture and Chemical Conversion in Seawater. Environ. Sci. Technol. 45, 1088–1092. doi:10.1021/es102671x. Rau, G.H., Caldeira, K., 1999. Enhanced carbonate dissolution:: a means of sequestering waste CO2 as ocean bicarbonate. Energy Convers. Manag. 40, 1803–1813. doi:10.1016/S0196-8904(99)00071-0 [Greg Rau, United States of America]	Taken into account - process added to footnote 6 along with suggested references.
19660	40	1	40	1	It would be better for this statement to be made conditional, i.e. 'upscaling procedures that WOULD need to be verified by field experiments'. The sentence would then make clear that field experiments would be needed if the assumptions and parameters were to be verified, rather than implying a judgment that field research into EW is justified. [Jennifer Morgan, Netherlands]	Accepted - replaced by WOULD
28564	40	1	40	1	Please provide a short description to illustrate what is meant by "upscaling procedures". The current terminology is too technical, and conceals the scale of the challenges and the investments needed to build a completely new industry. [Germany]	Noted - "upscaling" here doesn't refer to upscaling deployment, but to the procedure of extrapolating potentials estimates. We reworded to "modelling procedures" to avoid any misunderstandings.
47156	40	1	40	1	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested alternative '...Party submits information…' [Sarah Connors, France]	Accept
63252	40	2	40	2	add parag: A third way to accelerate mineral weathering and CO2 removal is to expose minerals to low pH environments that are directly or indirectly created during the electrolysis of water or seawater (House et al 2007, Rau 2008, Rau et al 2013, Lu et al 2015). Here, strategically placed alkaine minerals consume the strong acids generated, thus forcing the production of excess mineral hydroxide at the cathode. This in turn strongly reacts with CO2 to form dissolved mineral (bi)carbonates that could then be added to the ocean. While this process is energy intensive, about 1/3 of the energy can be recovered in the form of H2. Additionally, when powered by renewable electricity (solar, wind, wave, ocean thermal, etc) the process becomes a way of producing negative-CO2-emissions energy (H2). Given that the global potential of the preceding renewable electricity sources (that include marine wind, wave, solar and thermal energy) is significantly larger than that of biomass energy, the preceding H2 production offers a means of greatly expanding and diversifying negative-emissions energy beyond that offered by BECCS at what appear to be equivalent or lower costs and with lower land use impacts (Rau et al, 2018). new refs: Rau, G. H. Electrochemical splitting of calcium carbonate to increase solution alkalinity: Implications for mitigation of carbon dioxide and ocean acidity Environ. Sci. Technol. 42 8935–8940 (2008). Rau, G. H., Carroll, S. A., Bourcier, W. L., Singleton, M. J., Smith, M. M. & Aines, R. D. Direct electrolytic dissolution of silicate minerals for air CO2 mitigation and carbon-negative H2 production. Proc. Natl. Acad. Sci. 110, 10095-10100 (2013). Lu, L., Huang, Z., Rau, G. H & Ren, Z. J. Microbial electrolytic carbon capture for carbon negative and energy positive wastewater treatment. Environ. Sci. Technol. 49, 8193–8201 (2015). Rau, G.H., H.D. Willauer, Z.J. Ren. The Global Potential for Converting Renewable Electricity to Negative-CO2-Emissions Hydrogen. Nature Climate Change (in review). [Greg Rau, United States of America]	Taken into account - we appreciate the detailed descriptions in this comment and comment 63254 but due to space constraints cannot add this much additional length. We have incorporated a shortened version of these recommendations in footnote 6, as explained above.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
63254	40	2	40	2	2nd added parag: Lastly, synthetic or waste chemical bases or alkainity such as metal oxides, hydroxides or carbonates can be added to the ocean to consume CO2 and again convert and store it as stable, marine bicarbonates and carbonates (Kheshgi 1995, Bobicki et al 2012). In all of the preceding examples, the end products are alkaline carbon compounds that when added to the existing seawater reservoir of these compounds (the Earth surface's largest C repository) to provide long-term carbon storage. Increasing ocean alkalinity in this manner also helps counter ocean acidification that is impacting marine biocalcifiers such as corals and shellfish (Albright et al 2016; Feng et al 2016). new refs: Bobicki, E.R., QingxiaLiuZhengheXuHongboZeng. 2012. Carbon capture and storage using alkaline industrial wastes. Progress in Energy and Combustion Science 38: 302-320. Albright, R. et al. 2016. Reversal of ocean acidification enhances net coral reef calcification. Nature 531, 362–365. Kheshgi, H.S., 1995. Sequestering atmospheric carbon dioxide by increasing ocean alkalinity. Energy 20, 915–922. doi:10.1016/0360-5442(95)00035-F. E. Y. Feng, D. P. Keller, W. Koeve, and A. Oschlies. Could artificial ocean alkalinization protect tropical coral ecosystems from ocean acidification? Environmental Research Letters, 11(7):074008, 2016. [Greg Rau, United States of America]	Taken into account - see 63252
12320	40	3	40	3	Evidence and agreement for global cost estimates are low (low confidence) does not make sense. Does it mean evidence is limited, and agreement is low? But then why is confidence low? [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - sentence structure improved.
12322	40	6	40	7	The evidence base…is even lower does not make sense. Do you mean the evidence base is small? Or agreement on the numbers is low? [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - sentence structure improved to read that the evidence base is sparser for the ocean-based than for the land-based applications.
52166	40	8	40	8	What is meant by the numbers in this line? [Jason Donev, Canada]	Noted - has been reformulated to improve clarity.
2194	40	12			respirable particles are a theoretical risk only, airborne release is not mandated and it makes no biogeochemical sense to deposit such materials in dry environments. http://rsbl.royalsocietypublishing.org/content/13/4/20160859 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, this is highlighted in a large number of peer-reviewed articles, so we cannot discard the point from the assessment. We have (1) changed language to "can", (2) added some references on how to avoid this and (3) do not elevate this to the synthesis figure, which hopefully helps to give an unbiased view here.
2196	40	14			mechanical grinding to fines is unnecessary, seashore wave comminution can do the job from http://onlinelibrary.wiley.com/doi/10.1002/rog.20004/full - "Spreading suitable material into tidal areas of coastal zones [Hangx and Spiers, 2009], where wave action physically maintains fresh reactive surfaces, accelerating mineral dissolution and alkalinity production. In this case, the mechanical decomposition of the grains has not received much attention [Hangx and Spiers, 2009] but may be important to consider [Schuiling and de Boer, 2010; 2011]." [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - point has been incorporated along with reference.
63256	40	16	40	16	Rewrite and add: "...(González and Ilyina, 2016). A further caveat of EW relates to alkalinity saturation state and the potential to trigger spontaneous carbonate precipitation (Cross-Chapter Box 3.1).12 So while the geochemical potential to remove and store CO2 is quite large, a paucity of research on the preceding topics makes it difficult to assess the true capacity, net benefits and desirability of EW and ocean alkalinity addition in the context of CDR. [Greg Rau, United States of America]	Accepted
51208	40	17	40	36	Sustainable biomass supply, land, water and fertilizer requirements for biomass production are major problems of a large-scale rollout of biochar. Also, soil science is far less clear on the actual potential and shows that actual sequestration potential depends on a wide array of soil and ecosystem factors, diminishing the potential we should rely on. Also, soil organic carbon is highly volatile and sequestration can easily be reversed. While small-scale and locally adapted use of biochar appears useful for adaptation and soil quality, industrial-scale biomass appears counterproductive, especially when biochar is contaminated with harmful substances from co-combusted municipal or other wastes. [Linda Schneider, Germany]	Noted - section has been revised and more literature has been taken on. Not clear whether that includes the literature that is implicitly referred to here, but in any case we added clarity in side effects at scale mentioning the need for land/biomass and the possibility to use biochar at lower scales by e.g. taking residues as feedstock.
5092	40	18	40	39	In addition to suggestions for adding iron where that seems to be the limiting nutrient, there is emerging consideration of instead taking all needed nutrients to presently dead (i.e., nutrient-free) regions of the ocean and basically farming in the ocean. I think India, for example, is investigating, for example, if rice hull waste can be made to float long enough for it to lead to biological activity in the photic zone that would then sink the carbon. Others seem to proposed to do this with other waste products, and still others contemplate bringing up nutrient rich water from a kilometer or so deep to promote ocean life for food purposes (indeed, all of these could be designed to promote marine food production, which would presumably help in meeting another SDG. It seems to me that there thus needs to be a subsection on the concepts of doing this--so not iron fretilization, but farming the oceans. [Michael MacCracken, United States of America]	Noted - we tried to consider this process, but so far no significant literature base could be detected and we didn't have much space to go into emerging options. Hopefully, this can be more fully captured in the special report on oceans of the IPCC!
51206	40	18	40	27	You might want to mention that Ocean Fertilisation is subject to an international prohibition under the London Protocol of the London Convention. More to the point, why would you at all discuss a technology on which a multilateral body has already adopted a prohibition under international law? [Linda Schneider, Germany]	Taken into account: governance issues are part of the table below, as often cross-cutting for some CDR options (here: for all ocean options). Furthermore, the following sentence has been added to the ocean fertilization section: "The London Protocol of the International Maritime Organization has asserted authority for regulation of ocean fertilisation (Strong et al. 2009), which is widely viewed as a ‚de facto moratorium' on commercial ocean fertilisation activities."
55726	40	18	40	39	ocean fertilization: Note potential negative imapcts on biodiuversity ; ee: Williamson, P., & Bodle, R. (2016). Update on Climate Geoengineering in Relation to the Convention on Biological Diversity: Potential Impacts and Regulatory Framework. Technical Series No.84. Secretaria [David Cooper, Canada]	Taken into account - biodiversity impacts added
54034	40	19	40	39	This section is based on outdated documents. Ocean Fertilization has been abundatly studied and there is evidence of extensive negative impacts on marine food web and also potential anoxia and emergence of toxic algae. See for instance; Strong et al "Time to move on", 2013, Nature, https://www.nature.com/articles/461347a See also Strong et all, ocean fertilization, science, policy and commerce, 2009. http://tos.org/oceanography/article/ocean-fertilization-science-policy-and-commerce Furthermore, London Convention/Protocol adopted a resolution to ban ocean fertilization in 2013, signaling strong concern about its impacts. Resolution LP/4 (8), 2013. Section should be deleted and re-written to acknowledging the real impacts and low efficiency of OF. [Elenita Daño, Philippines]	Noted - We have actually included all those concerns already in the SOD (impact on the food web, anoxia, and even more).

Comment No	From Page	From Line	To Page	To Line	Comment	Response
62918	40	19	40	39	Replace with Nutrients can be added to the ocean resulting in increased biologic production, leading to carbon fixation in the sunlit ocean and subsequent sequestration in the deep ocean or sea floor sediments. The added nutrients can be either micronutrients (such as iron) or macronutrients (such as nitrogen and/or phosphorous). The aim is to change an oligotrophic region of ocean to be a productive one. There is low confidence in the readiness of this technology to contribute to rapid decarbonisation (Williamson et al., 2012). Only small-scale field experiments and theoretical modelling have been conducted to examine some basic questions, McLaren (2012). Macronutrient fertilisation is different to micronutrient fertilisation (Jones, 2011) in that it induces numerous regenerative production cycles until all the added macronutrient is exported to the deep ocean. The added nutrients need to be complimentary to the nutrient mix already in the ocean. Thus, in regions where the surface waters are LCHN such as polar regions, the addition of iron increases the primary production while the addition of nitrogen and phosphate increases the productivity of LCLN regions. The recent estimate of iron fertilisation potential is 4.4 GtCO2 (Sarmiento and Orr, 1991) while for macronutrient fertilisation it is 1.5 GtCO2yr-1 (Harrison, 2013). The interquartile range of 2050 potentials displayed in Figure 4.3 is 2.2 - 7.7 GtCO2yr-1. Due to scavenging of iron, the iron addition only leads to inefficient use of the nitrogen in exporting carbon (Aumont and Bopp, 2006; Zahariev et al., 2008; Zeebe, 2005). Non-CO2 GHGs may increase (Bertram, 2010; Matear, 2004; Sarmiento and Orr, 1991). Cost estimates have become more realistic from early values (for iron fertilisation) of USD2 tCO2-1 (Boyd and Denman, 2008) to USD457 tCO2-1 (Harrison, 2013). Jones (2014) proposed values greater than USD20 tCO2-1 for nitrogen fertilisation. Fertilisation stimulates the base of the food chain and field measurements by Sastry and Dower (19XX)showed the second trophic level increasing as a result of fertilisation. With time one would expect increased fish stocks (Jones and Young, 1999). Remineralisation of the export production in the thermocline could lead to anoxia if fertilisation were too aggressive. The area with the greatest theoretic potential for iron fertilisation is the Southern Ocean, proposing grand challenges for governance, if you consider that the oceans are a global commons. The London Protocol of the IMO has asserted authority for regulation of ocean fertilisation. Carbon dioxide that reaches the deep ocean will move with the general circulation of the ocean. Williams and Druffel (1987) put the cycle time for returning to the ocean surface at 1600 years. additional references Jones, I S F and Young, H E 2009 The potential ... Jones, I S F 2011 Contrasting ... Jones I S F 2014 The cost ... Harrison D P 2013 A method .. Harrison D P 2017 Sastry and Dower (2006). Mesoplankton ... [ian Jones, Australia]	Taken into account - all points considered, yet not possible to include large pieces of text due to space constraints, even if valid
46982	40	20	40	20	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted
52168	40	22	40	24	This sentence is very awkward. Break it into several sentences. [Jason Donev, Canada]	Accepted
19662	40	23	40	24	As noted in the comment above relating to the potential for EW, it is important here also to qualify the range of figures presented for CDR potential of ocean fertilization as 'estimated', i.e. 'The full range of ESTIMATED CDR potential…' [Jennifer Morgan, Netherlands]	Accepted
61032	40	23	40	24	The lower-bound potential cited here is so low that it raises the question of why it is cited. [United States of America]	Noted - has been amended.
468	40	24	40	24	spatially constrained [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
2198	40	24			constrained not constraint [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
7944	40	29	40	29	Separate "USD2" [Christopher Bataille, Canada]	Accepted
52170	40	29	40	29	Unclear. [Jason Donev, Canada]	Accepted - sentence reworded
61034	40	29	40	30	The use of "impact" here is imprecise: are these positive or adverse effects? [United States of America]	Taken into account - has been clarified.
19666	40	34	40	35	As this sentence touches on challenges for governance, it would be worth making a cross-reference here to the existing governance structure under the London Protocol, perhaps with reference to section 4.3.8.7. [Jennifer Morgan, Netherlands]	Taken into account - The corresponding governance mechanism mentioned at this point now and governance further discussed in the table below.
51452	40	34	40	35	It should be mentioned that there is already international regulation in place on research and deployment of Ocean Fertilization within the Convention on Biological Diversity (see CBD COP Decisions IX/16 C para 4 and X/33 para 8 (w) and relevant London Convention resolutions) that is widely viewed as ‚de facto moratorium' on commercial ocean fertilization activities (Strong et al., 2009). Strong, Aaron L., John J. Cullen, and Sallie W. Chisholm. "Ocean Fertilization: Science, Policy, and Commerce." Oceanography 22.3 (2009): 236–261 [Astrid Schulz, Germany]	Accepted - and reference added
2200	40	35			grand challenges is an exaggeration, as the same language has not been applied to the atmosphere in this document [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - "grand" removed
28566	40	35	40	35	The Southern Ocean also poses a challenging environment regarding infrastructure, logistics and consequently costs. Please note this concern. [Germany]	Taken into account - we could only find a reference for the monitoring challenges and have added this.
61036	40	37	40	37	The text should clarify that this is a matter of technical or scientific controversy rather than political or social controversy. [United States of America]	Accepted - sentence now reads "There is low agreement in the technical literature on the permanence of CO2 in the ocean ".
63258	40	37	40	39	rewrite: The permanence of CO2/carbon storage in the ocean will depend on its chemical form and place of storage. For example deep ocean storage of molecular CO2, biomass, or alkalinity could have a residence time of a thousand years or much longer, especially if injected or buried in or below the sea floor (Williams and Druffel, 1987; Jones, 2014, Schrag, 2009; Strand and Benford, 2009). Surface ocean C storage will generally have a shorter residence (Aumont and Bopp, 2006; Zeebe, 2005), unless in forms that do not easily degrade or exhange with the atmosphere, such as refractory organic material or carbonates. new refs: Schrag DP (2009) Storage of carbon dioxide in offshore sediments. Science 325:1658–1659. Strand SE, Benford G (2009) Ocean sequestration of crop residue carbon: recycling fossil fuel carbon back to deep sediments. Environ Sci Technol 43:1000–1007 [Greg Rau, United States of America]	Taken into account - added the point that the higher end estimate is for deep sea storage and the lower end for surface C storage, but couldn't go into detail. Please note our space restrictions here.
12324	40	38	40	38	the view. We don't want views we want an assessment based on evidence. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reformulated

Comment No	From Page	From Line	To Page	To Line	Comment	Response
24132	40	43	41	4	This section that places CCUS among other CDR options appears to make no sense. I would delete it. BECCS and DACCS both use CCS as the way to prevent captured CO2 from returning to the atmosphere. I think it would be fine to say that the "S" in BECCS and DACCS could be geological storage, any other process that sequesters CO2 permanantly or auditable CO2 displacement from elsewhere in the economy (even if the CO2 is re-emitted, this is ok if the CO2 is from the air or biomass). But other forms of CCUS that capture CO2 from fossil fuels or limestone should not be included anywhere in a section on CDR. [Simon Bennett, France]	Noted - the language has been simplified for this draft and we hope it becomes clear now that CCUS is about using the captured CO2 in long-lived products. There is now a debate that storing CO2 in products causes negative emissions that the literature is critical about.
40454	40	43	40	46	"In the absence of carbon pricing, regarding the captured CO2 as a resource is discussed as an entry point for CDR, although not necessarily leading to negative emissions, particularly if the CO2 is sourced from fossil CCS or if the products do not store the CO2 for climate-relevant." This sentence is very difficult to follow, I suggest rewriting it. The reference to carbon pricing seems unnecessary. [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account - the sentence has been split, but the absence of other incentives is important.
61038	40	43	41	4	The discussion of CCUS is awkwardly drafted and should be carefully revised for clarity, so that the main points can be easily discerned. It would be helpful to include quantitative information in absolute terms rather than simply relating this strategy to the "Paris goals". [United States of America]	Accepted - language has been simplified. Unfortunately, we have no space, however, to go into the details of MacDowell et al. (2017).
17764	40	46	41	4	However, if the industry can develop new processes to replace existing processes using CO2 as a raw material, some technologies are expected to have an effect on GHG. [Republic of Korea]	Noted - Agree on this point, but this would not remove carbon, unless it would be stored in a product that is sufficiently long-lived to be climate-relevant. There now seems to be some research on this in the pipeline, which AR6 can hopefully benefit from for first quantifications of potentials estimates.
63260	41	4	41	4	Add: ....the chemical conversion of CO2 will contribute more than 1% to the achieving the Paris goals. However, such analyses ignore beneficial environmental uses of compounds such as bicarbonates and carbonates (alkalinity) derived from CO2 whose application to soils, freshwater and especially the ocean to counter the effects of CO2-induced acidity could potentially consume and utilize many Gt's of CO2, making a significant contribution to global CO2 managment (Ilyana et al. 2013; Paquay and Zeebe, 2013; Feng et al., 2016; Renforth and Henderson 2017). new refs: Paquay, F.S., Zeebe, R.E., 2013. Assessing possible consequences of ocean liming on ocean pH, atmospheric CO2 concentration and associated costs. Int. J. Greenh. Gas Control 17, 183–188. doi:10.1016/j.ijggc.2013.05.005 . Ilyina, T., Wolf-Gladrow, D., Munhoven, G., Heinze, C., 2013. Assessing the potential of calcium-based artificial ocean alkalinization to mitigate rising atmospheric CO2 and ocean acidification. Geophys. Res. Lett. 40, 5909–5914. doi:10.1002/2013GL057981 . E. Y. Feng, D. P. Keller, W. Koeve, and A. Oschlies. Could artificial ocean alkalinization protect tropical coral ecosystems from ocean acidification? Environmental Research Letters, 11(7):074008, 2016. [Greg Rau, United States of America]	Noted - however, this section had to be significantly shortened and we already added the different approaches to raise alkalinity in the Enhanced Weathering section.
36126	41	5	41	5	May consider adding references from India on cocunut plantations References Ayers, J.M. and Huq, S. (2009). The value of linking mitigation and adaptation: a case study of Bangladesh. Environ Manage 43,753-764) Halsnaes, K. and Verhagen, J. (2007). Development based climate change adaptation and mitigation conceptual issues and lessons learned in studies in developing countries. Mitig Adap Strat Glob Change, 12, 665-684 Klein, R.J.T., Schipper, E.L. and Dessai, S. (2005). Integrating mitigating and adaptation into climate and development policy: three research questions, Environ Sci Pol, 8, 579-588. K.B. Hebbar, D. Balasimha and S. Naresh Kumar. Carbon Sequestration in Plantation Crops. In Impact of Climate Change on Plantation crops. Pages 157-168 Editors: K.B. Hebbar, S. Naresh Kumar & P. Chowdappa 2017, Published by: Astral International Pvt Ltd, New Delhi Horticulture Statistics at a Glance 2017. Horticulture Statistics Division, Dept of Agril. Cooperation & Farmers Welfare, Ministry of Agril. & Farmers Welfare, Government of India. Roupsard O, Lamanda N, Navarra M N V, Serra I m, Daujat J and Sileye T 2008. Coconut carbon sequestration. Part I. Highlights on Carbon cycle in coconut plantations, CORD, 24:1-14. Ayers, J.M. and Huq, S. (2009). The value of linking mitigation and adaptation: a case study of Bangladesh. Environ Manage 43,753-764) Halsnaes, K. and Verhagen, J. (2007). Development based climate change adaptation and mitigation conceptual issues and lessons learned in studies in developing countries. Mitig Adap Strat Glob Change, 12, 665-684 Klein, R.J.T., Schipper, E.L. and Dessai, S. (2005). Integrating mitigating and adaptation into climate and development policy: three research questions, Environ Sci Pol, 8, 579-588. K.B. Hebbar, D. Balasimha and S. Naresh Kumar. Carbon Sequestration in Plantation Crops. In Impact of Climate Change on Plantation crops. Pages 157-168 Editors: K.B. Hebbar, S. Naresh Kumar & P. Chowdappa 2017, Published by: Astral International Pvt Ltd, New Delhi Horticulture Statistics at a Glance 2017. Horticulture Statistics Division, Dept of Agril. Cooperation & Farmers Welfare, Ministry of Agril. & Farmers Welfare, Government of India. Roupsard O, Lamanda N, Navarra M N V, Serra I m, Daujat J and Sileye T 2008. Coconut carbon sequestration. Part I. Highlights on Carbon cycle in coconut plantations, CORD, 24:1-14. [India]	Noted - however, blue carbon is no longer part of this section and is instead covered in 4.3.2.
12326	41	6	41	6	Non-CO2 GHG removal. We welcome the inclusion of this topic but the title of section 3.8 is "Carbon dioxide removal". Suggest the title of 4.3.8 is changed to "Greenhouse gas removal" [United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, the non-CO2 removal is now just flagged in the table, not in an independent section, so we kept the CDR title, which has the additional advantage of ensuring consistency with chapter 2.
5094	41	7	41	7	Instead of "food sector" I'd suggest saying with the "agircultural sector" in that much of the emissions occur on farms, often from animal waste, etc., and well before one gets to calling the product food. [Michael MacCracken, United States of America]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
19670	41	7	41	7	There are also 'difficult-to-abate' emissions of methane from industrial sectors, especially 'fracking' (see e.g. Frankenberg et al. 2016, https://doi.org/10.1073/pnas.1605617113) [Jennifer Morgan, Netherlands]	Noted - industry has been added, but there is no space to accommodate explanations on the example of fracking.
2202	41	8			stolaroff reference needs to be extended with citations to the peer-reviewed response from Lockley, same journal https://pubs.acs.org/doi/abs/10.1021/es303074j [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reference added
46984	41	9	41	9	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted
58350	41	9	41	9	Typo - should say "has been proposed to remove methane"? (not CO2) [Andrew Prag, France]	Accepted
28568	41	10	41	14	What about technological development and new technologies (beyond "existing technologies"). Could they increase the potential? Is there any research here? Please clarify. [Germany]	Taken into account - emerging CDR options are discussed in the table
38644	41	10	41	10	What is mean by "net zero" emissions? This core concept needs explanation in this report. See: Rogelj J, Schaeffer M, Meinshausen M, Knutti R, Alcamo J, Riahi K, Hare W. 2015 Zero emission targets as long-term global goals for climate protection. Environ. Res. Lett. 10, 105007. (doi:10.1088/1748-9326/10/10/105007) AND Fuglestvedt, J., et al. Implications of possible interpretations of "greenhouse gas balance" in the Paris Agreement. Phil. Trans. Roy. Soc. A, doi: 10.1098/rsta.2016.0445, in press (2018). [Jan Fuglestvedt, Norway]	Noted - however, the term is no longer used here.
7458	41	16	41	21	In the literature, the term "blue carbon" also includes carbon sequestration by mangroves and underlying soil as well as salt marshes and their soil. Please ensure that the literature quoted here for seagrass does actually only cover seagrass, or expand the para to cover the entire range of "blue carbon" options. [Axel Michaelowa, Switzerland]	Noted - however, the blue carbon paragraph has been moved to 4.3.2.
19674	41	16	41	21	It is not clear why this brief section on 'blue carbon' focuses only on seagrass meadows, as they are only one of a number of coastal vegetated habitats that exhibit particularly high density and effectively non-saturating 'blue carbon' storage, including also mangroves, saltmarshes, estuaries, kelp forests. While it is the case that, in all these habitats, there is the risk of reversal of storage if they are not properly protected or allowed to recover, taken together, these 'blue carbon' habitats coule represent a greater contribution than from seagrass meadows alone (see e.g. review by Duarte 2017, https://doi.org/10.5194/bg-14-301-2017). The text as drafted in lines 16-21 on page 41 implies that the terms 'blue carbon' and 'seagrass meadows' are synonymous. [Jennifer Morgan, Netherlands]	Noted - however, the blue carbon paragraph has been moved to 4.3.2.
34792	41	16	41	17	Mangrove forests are not mentioned in this sentence despite being one of the most carbon-rich ecosystems and having important adaptation benefits. Mangrove forest is one of the most carbon-rich ecosystems on the planet (see Donato et al., 2011) and there are co-benefits with adaptation and trapping sediment as a shoreline response to sea level rise.as well as being a important habitat for fish (see Alongi, 2008). Links: https://www.nature.com/articles/ngeo1123 https://www.sciencedirect.com/science/article/pii/S0272771407003915 [Helena Wright, United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, the blue carbon paragraph has been moved to 4.3.2.
55728	41	16	41	21	Combione discussion on "blue carbon" with ecosystem-basaed approaches, under mitigation. Add reference to tidal wetlands. [David Cooper, Canada]	Noted - however, the blue carbon paragraph has been moved to 4.3.2.
61040	41	16	41	21	What is the level of uncertainty around the mitigation potential reflected in this paragraph? Note that while definitions of blue carbon vary, many uses of this term encompass not only seagrasses but also coastal wetlands and mangroves. [United States of America]	Noted - however, the blue carbon paragraph has been moved to 4.3.2.
2204	41	21			mention mangroves, relatedly https://oceanservice.noaa.gov/facts/bluecarbon.html [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted - even though we agree that mangroves are important, please note that the blue carbon item has been moved to section 4.3.2, where mangroves are now featured in the assessment.
46922	41	21	41	21	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Noted - however, the blue carbon paragraph has been moved to 4.3.2.
63262	41	21	41	21	Add: ....will thus likely not contribute significantly to meeting the 1.5°C target. However, artificial culture of seagrass or kelp coastallly or in the open ocean could greatly expand the CDR role of marine plants, by one estimate, potentially consuming 100 Gt CO2 over 30 years (Hawken, 2017). ref: Hawken, P. 2017. Drawdown. Penguin, New York; pg 178-180. [Greg Rau, United States of America]	Noted - however, the blue carbon paragraph has been moved to 4.3.2.
63264	41	22	41	22	Add parag.: Negative-emissions hydrogen. It has been shown that CO2 can be consumed and hydrogen generated simultaeously via electrochemical and/or thermochemical means (House et al 2007; Rau 2008; Rau et al 2013, Lu et al 2015; Li et al., 2015; Nikushina et a.,l 2006). When the required energy is supplied by renewable sources (solar, wind, geothermal, etc) such systems become strongly CO2-emissions-negative, and therefore have the potential to greatly expand negative emissions energy production beyond that offered by BECCS, at comparable or lower estimated cost (Rau et al. 2018). new refs: Nikulshina, V., Hirsch, D., Mazzotti, M. & Steinfeld, A. CO2 capture from air and co-production of H2 via the Ca(OH)2-CaCO3 cycle using concentrated solar power - Thermodynamic analysis. Energy 31, 1715–1725 (2006). Li, F. F. et al. Solar fuels: A one-pot synthesis of hydrogen and carbon fuels from water and carbon dioxide. Adv. Energy Mater. 5,1401791 (2015). House, K. Z., House, C. H., Schrag, D. P. & Aziz, M. J. Electrochemical acceleration of chemical weathering as an energetically feasible approach to mitigating anthropogenic climate change. Environ. Sci. Technol. 41, 8464-8470 (2007). Rau, G. H. Electrochemical splitting of calcium carbonate to increase solution alkalinity: Implications for mitigation of carbon dioxide and ocean acidity Environ. Sci. Technol. 42 8935–8940 (2008). Rau, G. H., Carroll, S. A., Bourcier, W. L., Singleton, M. J., Smith, M. M. & Aines, R. D. Direct electrolytic dissolution of silicate minerals for air CO2 mitigation and carbon-negative H2 production. Proc. Natl. Acad. Sci. 110, 10095-10100 (2013). Lu, L., Huang, Z., Rau, G. H & Ren, Z. J. Microbial electrolytic carbon capture for carbon negative and energy positive wastewater treatment. Environ. Sci. Technol. 49, 8193–8201 (2015). Rau, G.H., H.D. Willauer, Z.J. Ren. The Global Potential for Converting Renewable Electricity to Negative-CO2-Emissions Hydrogen. Nature Climate Change (in review). [Greg Rau, United States of America]	Noted - however, the use of electrochemical processes to increase alkalinity (citing many of the suggested references) has already been discussed in the section on enhanced weathering.
13348	41	23	41	25	This section is rather too brief for what is crucial further understanding that needs to be addressed to assess the basic capability of NETs, particulary to deliver net-negative emissions. Kellar et al (in review) Current Climate Change Reports The Effects of Carbon Dioxide Removal on the Carbon Cycle, reviews current knowledge; Kellar et al (accepted) The Carbon Dioxide Removal Model Intercomparison Project (CDR-MIP): Rationale and experimental design Geosci. Model Dev discuss questions of C-cycle response to NETs in framing the CDR-MIP project, and see also Wu et al 2015 The reversibility of CO2 induced climate change https://link.springer.com/article/10.1007/s00382-014-2302-6, and Bouttes et al 2013 The reversibility of sea level rise https://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-12-00285.1 . Line 24 "reverting" should be "reversing"? Better refernce to discussion in chapter 2 (2.2.2 and 2.6.2) would be beneficial. [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - this sentence was not supposed to be a full paragraph, which probably happened in final editing. Has been repaired, though we agree that the space allocated is still too small to add all material we would want to. We have taken up 2 of the suggested references and cross-referenced chapter 2.
28570	41	23	41	25	It is not clear whether these lines refer only to this last subsection, or to all CDR technologies. If the latter is the case, this assessment would better fit to the next chapter 4.3.8.7 ("Overall feasibility…"). Else please clarify. [Germany]	Taken into account - removed title "overall feasibility", which actually belongs to the uncertainty paragraph. Was an editing error. Please note the whole section is now organized in a table.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
55102	41	23	41	25	Need to highlight the need for international governance, and a process/reseraches ofr assessing ways to mitigate the adverse impacts and identify in which part of the world those best options could be applied. [Yamide Dagnet, United States of America]	Accepted - added these aspects in a table with cross-cutting issues.
47942	41	24	41	24	Kindly check: Smith et al. (2016), if it is 2016a or 2016b (Pg. 178, line 53) [Sarah Connors, France]	Accepted - repaired
10098	41	28	41	46	In terms of the overall assessment of CDR, the section seems to stop short of making a clear statement on the need and feasibility of the technology. If the modeling assessment of 1.5c in chapter 2 indicate that CDR is a necessary technology for 1.5c, the question would be how feasible 1.5c in absence of CDR. That question has not been answered by the section yet. It could be more useful then to identify what explicit/concrete policies and measures would be needed to realize the CDR potentials and contribution to 1.5c in a cost effective way. [Saudi Arabia]	Taken into account - removed title "overall feasibility", which actually belongs to the uncertainty paragraph. Was an editing error. The assessment of pathways is indeed confined to chapter 2, while chapter 4 introduces and assesses the technologies in more detail. For example, we compare the bottom-up estimates of BECCS potentials with the BECCS deployment of chapter 2 pathways.
28572	41	28	41	46	This overall assessment should additionally inform and make more transparent how much land is needed when it comes to a combined application of various land-based CDR-approaches (and how much Gt CO2 could be reached). [Germany]	Taken into account - removed title "overall feasibility", which actually belongs to the uncertainty paragraph. Was an editing error. Land footprints assessed along with the technologies in their respective sections and in cross-chapter box 7 in chapter 3.
29758	41	28	41	46	Dooley and Kartha (https://doi.org/10.1007/s10784-017-9382-9) offer a typology of risks implied by CDR options for meeting temperature targets: Type 1 risk invovles technical and biophysical feasibility, Type 2 risk has to do with the acceptability of impacts, while Type 3 risk relates to the effectiveness of CDR measures. This may be a useful framework for the section. [Bård Lahn, Norway]	Noted - however, we need a broader assessment framework here and we can also not make judgments on the acceptability of risks, as this would be policy prescriptive.
51204	41	28	41	46	For the overall feasibility and effectiveness of large-scale CDR, you should also discuss the carbon cycle response to large-scale carbon dioxide removal: the non-linearity of the climate system, the asymmetrical response of various climate parameters to CDR make large-scale CDR an unacceptably high-risk enterprise, see Keller et al. (submitted) The Effects of Carbon Dioxide Removal on the Carbon Cycle, Current Climate Change Reports [Linda Schneider, Germany]	Taken into account - removed title "overall feasibility", which actually belongs to the uncertainty paragraph. Was an editing error. Carbon cycle response is assessed in the new table with issues cross-cutting over different CDR options.
55730	41	28	41	46	overall feasibility of CDR. ee the follwiong for comprehensive and comaprative reviews of technilogies, and review of existing regulatory frameworks: , refer to Williamson, P., & Bodle, R. (2016). Update on Climate Geoengineering in Relation to the Convention on Biological Diversity: Potential Impacts and Regulatory Framework. Technical Series No.84. Secretariat of the Convention on Biological Diversity, Montreal, availableat:https://www.cbd.int/doc/publications/cbd-ts-84-en.pdf; also: Williamson, P., Watson, R.T., Mace, G., Artaxo, P., Bodle, R., Galaz, V., Parker, A., Santillo, D., Vivian, C., Cooper, D., Webbe, J., Cung, A. and E. Woods (2012). Impacts of Climate-Related Geoengineering onBiological Diversity. Part I of: Geoengineering in Relation to the Convention on Biological Diversity: Technical and Regulatory Matters. Secretariat of the Convention on Biological Diversity. Montreal, Technical Series No. 66, 152 pages avaiable at: https://www.cbd.int/doc/publications/cbd-ts-66-en.pdf [David Cooper, Canada]	Taken into account - removed title "overall feasibility", which actually belongs to the uncertainty paragraph. Was an editing error. Existing regulatory frameworks are now contained in the new table with issues cross-cutting over different CDR options.
7946	41	31	41	31	Replace "identifying" with "identify" [Christopher Bataille, Canada]	Reject - there is no noun in this sentence to go with "identify"
28574	41	32	41	32	The term "Post-R&D-Issues" is rather trivialising the huge challenges as for full large scale implementation of the CDR. It sounds as if only some additional aspects have to be solved after R&D - but quite the opposite is the case. To realize the CO2-removal-potential projected by some scenarios means to build up and to run a totally new industry. Please revise language in order to be more reflective of this. [Germany]	Taken into account - the large scales are now more emphasized in the individual technology sections. We have clarified that we are at this point talking about the state of the literature and not actual deployment.
13350	41	34	41	36	There are considerable policy challenges to the development of frameworks to underpin NETs development and deployment. Geden et al (in review), Assessing the prospects for carbon dioxide removal in the context of EU climate mitigation policymaking, WIREs Cchange consider these for the EU, as one of the strongest macro-regional advocates for climate mitigation action. [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - reference taken up in table 4.6.
28576	41	34	41	37	There is not only a policy lack for large scale CDR and a research lack for policy frameworks and governance. More research and better knowledge is needed for CDR on the whole (natural-science, engineering/technology, business/ economics, ...) . This is necessary a) to know more about effects and side-effects of CDR and b) to develop and implement the technologies (if policy and society decides to do so). Please add information relevant to these considerations. If there is a lack of relevant scientific evidence, please clarify. [Germany]	Noted - however, we are highlighting here some cross-cutting uncertainties, while section 4.6 discusses the knowledge gaps. In addition, the state of the literature on potentials, costs and side effects is separately assessed for each CDR option in the preceding text of 4.3.7.
7460	41	35	41	35	Insert after "Peters and Geden, 2016": "Honegger and Reiner 2018". Reference: Honegger, Matthias; Reiner, David (2018): The political economy of negative emissions technologies: consequences for international policy design, Climate Policy, 18, p.306-321 [Axel Michaelowa, Switzerland]	Noted - We appreciate the message of the paper that international policy for NETs currently does not exist and that the market mechanism under Article 6.4 of the Paris Agreement could be a way to facilitate this, but feel this is outside the scope of the 1.5C-relevant literature and does not rigorously argue the point that a market mechanism is the answer to the question of what international policy mechanism should support CDR.
7462	41	37	41	37	Insert after "is needed": "(Honegger and Reiner 2018)". Reference: Honegger, Matthias; Reiner, David (2018): The political economy of negative emissions technologies: consequences for international policy design, Climate Policy, 18, p.306-321 [Axel Michaelowa, Switzerland]	Noted - We appreciate the message of the paper that international policy for NETs currently does not exist and that the market mechanism under Article 6.4 of the Paris Agreement could be a way to facilitate this, but feel this is outside the scope of the 1.5C-relevant literature and does not rigorously argue the point that a market mechanism is the answer to the question of what international policy mechanism should support CDR.
12328	41	37	41	38	More accurate to say "For marine methods, including ocean fertilisation, the governance structure…" [United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, this part has been completely revised and is now - in shortened form - part of a new table.
28578	41	37	41	38	The current sentence "For Ocean Fertilisation, the governance structure in the form of the London Protocol calls for more research before considering commercial-scale deployment." is substantially wrong or at least misleading. It must be replaced by the following one in order to provide correct information: "For ocean Fertilization, the governance structure in the form of the London Protocol (the amendment of the London Protocol concerning marine geo-engineering of 2013) prohibits commercial-scale deployment. Contracting Parties are allowed to permit research projects if it can be demonstrated that no detrimental effects on the marine environment will be caused by the research project." [Germany]	Accept - has been clarified
19678	41	37	41	38	The last sentence of this paragraph does not properly capture the intent of the governance structure under the London Protocol. It would be clearer to take language directly from the London Protocol Resolutions by which the existing controls on ocean fertilization were established, i.e. the parties to both the London Convention and London Protocol agreed that "given the present state of knowledge, ocean fertilization activities other than legitimate scientific research should not be allowed." (http://www.imo.org/en/OurWork/Environment/LCLP/EmergingIssues/geoengineering/Documents/2008resolutionOF.doc) This was deliberately not an explicit call for more research into ocean fertilization, but rather a decision not to permit ocean fertilization activities unless they could be justified as legitimate scientific research (as defined in the assessment framework adopted under the second LC-LP Resolution, from 2010, (http://www.imo.org/en/OurWork/Environment/LCLP/EmergingIssues/geoengineering/Documents/OFassessmentResolution.pdf)). One possible alternative drafting for this sentence that would reflect the approach under the London Protocol more accurately would be to say "For Ocean Fertilization, the governance structure in the form of the London Protocol prohibits ocean fertilization activities other than those deemed to meet the criteria under an assessment framework for 'legitimate scientific research'." [Jennifer Morgan, Netherlands]	Accept - has been clarified

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44092	41	37	41	37	needs space at end of centance [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accept
50516	41	37	41	38	The amendment to the London Protocol sets out strict rules and regulations to make sure that any forms of ocean fertilization "constitute legitimate scientific research that is not contrary to the aims of the London Convention or Protocol". Article 8 of the LC-LP.1 (2008) states that "given the present state of knowledge, ocean fertilization activities other than legitimate scientific research should not be allowed. To this end, such other activities should be considered as contrary to the aims of the Convention and Protocol and not currently qualify for any exemption from the definition of dumping in Article III.1(b) of the Convention and Article 1.4.2 of the Protocol". No part of the amendment 'calls for more research before considering commercial-scale deployment' as is written in this paragraph. [Ina Möller, Sweden]	Accept - has been clarified
51200	41	37	41	38	This amounts to a dreadful misrepresentation of the London Protocol governance structure and its intention. The London Protocol has listed Ocean Fertilisation so as to prohibit its deployment, in particular for commercial purposes. It allows for small-scale research, a term that is clearly defined under the London Protocol. It certainly does not call for more research, and certainly not with the objective of facilitating commercial-scale deployment. [Linda Schneider, Germany]	Accept - has been clarified
52172	41	37	41	37	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Accept
63266	41	38	41	38	Add: ....of the London Protocol calls for more research before considering commercial-scale deployment. In general the considerable potential of both biotic and abiotic marine-based CDR methods have been underrepresented in governance, policy, modeling and roadmapping considerations, and could increase the feasibility of achieving the 1.5degC goal in socially and environmentally acceptable ways if demonstrated by further research and testing. [Greg Rau, United States of America]	Noted - however, we cannot pick out specific technologies at this point without appearing to be policy prescriptive
51202	41	40	41	46	You could at least discuss the ethics literature on CDR that there is, e.g. Lawford-Smith/Currie (2017) Accelerating the carbon cycle: the ethics of enhanced weathering, Biology Letters. Also, Preston 2013 Ethics and geoengineering: reviewing the moral issues raised by solar radiation management and carbon dioxide removal, Wiley Interdiscip. Rev. Clim. Change. 4, 23-37 discusses ethical issues pertaining to both SRM and CDR. The risks associated with sudden termination of SRM are also relevant for Carbon Dioxide Removal, e.g. in the case of large-scale reversals. [Linda Schneider, Germany]	Noted - however, Preston (2013) had already been discussed in the SOD (and is of course still included in the final draft). We prefer this reference and Minx et al. (2018) over the other suggested reference that is very specific to one technology.
61042	41	40	41	46	This paragraph is very academic and should be deleted. [United States of America]	Taken into account - the whole subsection is gone and has been replaced by a table with simplified language.
62194	41	40	41	46	In this paragaph it could be mentioned that large scale CDR deployment if costs stay high will be also an intergenerationnal burden, adding one sustainability issue [Antoine Bonduelle, France]	Noted - however, we could not find an evidence base for this in the literature, even though we agree that this can be an issue. It appears to be more of a topic for the dynamics of 1.5°C pathways assessed in chapter 2, however, rather than for the bottom-up technology assessment in 4.3.7.
46310	41	41	41	42	It is correct that “ethics literature on CDR is sparse”. However, one piece that is in press and will appear presently is: Shue, H. (2018). Mitigation gambles: uncertainty, urgency and the last gamble possible. Philosophical Transactions of the Royal Society A 20170105. doi:10.1098/rsta.2017.0105. [in press] [Henry Shue, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - even though we do not agree that any of the 1.5°C pathways assessed in this report trades off short-term mitigation against negative emissions later, we have included the reference to contribute to the literature on moral hazard.
61986	41	43	41	43	The IPCC is not expected to say what future work should be. [Valérie Masson-Delmotte, France]	Accept - reformulated.
1038	42	1	42	1	It is confusing to call its Solar radiation management in the heading and Radiation Modification Measures in the body [Jesse Reynolds, Netherlands]	Taken into account. We keep SRM, but M is now refer to Modification. Please see Glossary and Chapter 1 (section 1.4.1) for the explanations of the new term
12330	42	1	43	52	Solar radiation management is not in the agreed Scope; these 2 pages are not needed. (see also comments on ch.4 pages 102-108 Cross-chapter Box 4.2) [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, we have shortened section 4.3.8 and Box 10 as much as possible and focused on the most important and relevant to 1.5Cinformation
18624	42	1	43		Given space constraints in this report, it would be better not to devote two whole pages to SRM (especially since they mainly point out its difficulties and drawbacks). Similarly, Box 4.2 is extremely long. Is all this information really needed? [Andrea TILCHE, Belgium]	Taken into account, we have shortened section 4.3.8 and Box 10 as much as possible and focused on the most important and relevant to 1.5Cinformation
28580	42	1	42	23	The headline of this paragraph should be "Solar radiation management", not "Radiation modification management". The term SRM is used in the framing chapter and is also contained in the glossary of IPCC AR5. "RMM" is not a commonly used term. If the term RMM is kept in this report it should be clarified why this change is being made, and the scientific references supporting this decision should be included. But the term "SRM" is already well-established, so we would prefer to keep SRM instead of "RMM", and also kindly ask the author teams to makes sure it is being substituted in other chapters accordingly. [Germany]	Taken into account. We keep SRM, but M is now refer to Modification. Please see Glossary and Chapter 1 (section 1.4.1) for the explanations of the new term
37466	42	1	42	1	Consistent terminology is crucial. I highly recommend referring to established terms (SRM or solar geoengineering) rather than inventing new ones (without explanation) like RMM. If you are using RMM, then you need to use it consistently; It is confusing to call its Solar radiation management in the heading and Radiation Modification Measures in the body [Matthias Honegger, Germany]	Taken into account. We keep SRM, but M is now refer to Modification. Please see Glossary and Chapter 1 (section 1.4.1) for the explanations of the new term
38616	42	1	43	52	I think section 4.3.9. does too much review and not enough assessment. As it is now, recent studies are listed withouth assessing robustness, limitations, knowlede gaps etc. [Jan Fuglestvedt, Norway]	take into account, we tried to revise text in order to add more assessment there
38620	42	1	43	52	The relation between section 4.3.9. and the Box 4.2 is unclear ro me. Role/function of the section and the box should be clearer. [Jan Fuglestvedt, Norway]	taken into account. Both 4.3.8 and Cross-Chapter Box 10 were revised, we hope that current version of them is more clear
50092	42	1	43	52	What is missing in this section is a good assessment of the possible negative consequences of RMM/SAI, which are an important issue when considering the use of RMM (missing in the SPM by the way). It just discusses governance, costs and accepatbility. Material on impacts is discussed in cross-chapter box 4.2, but the key findings on this should be presented in section 4.3.9. More in general, section 4.3.9 should be a summary of the findings in box 4.2, but now it looks more like two seperate assessments. [Bert Metz, Netherlands]	Noted, but we are very limited in space and can't repeat the material.
51212	42	1	43	52	The is no apparent or stated reason for introducing new terminology here. Solar Radiation Management (SRM) is a well-established term in the literature and in international climate policy discourse, and this term is used consistently throughout the rest of the report, to avoid confusion and ambiguity, Chapter 4 should stick with the established terminology. [Linda Schneider, Germany]	Accepted, we kept SRM, but explain that M means modification
61044	42	1	42	7	Strongly suggest not introducing a new term (RMM) when SRM is accepted in the literature; they are virtually synonymous and obviously separate from CDR. Cross-reference to Section 1.4.3 (page 1-42). Need consistency throughout the report. [United States of America]	Taken into account. We keep SRM, but M is now refer to Modification. Please see Glossary and Chapter 1 (section 1.4.1) for the explanations of the new term
62812	42	1	43	52	Ethics is paramount. It is addressed under 4.3.9.3. Is it possible to elaborate on thiis isssue from the point of view of developing countries and particularly African countries. [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	taken into account partly, we can't have long discussion here, because we are very limited in space. Text was revised: "Whyte (2012) argues that the concerns, sovereignties, and experiences of Indigenous peoples may particularly be at risk. "

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61046	42	1	43	52	This section should be cross-checked with Cross-Chapter Box 4.2 to eliminate redundancy. As a general comment, the discussion of SRM and RMM here and elsewhere in the report tends to downplay the fact that these approaches do not address CO2 deposition in the ocean and changes to ocean chemistry. In fact, ocean acidification seems likely to be one of the most prominent impacts of global change on pathways consistent with a 1.5°C increase (and would be more pronounced if those pathways included SRM/RMM). This section should therefore include a salient discussion of effectiveness of SRM/RMM that makes this point explicitly. It would also be helpful if this section could include a paragraph to address how the effects of SRM/RMM would be distributed geographically. [United States of America]	Noted, this section assesses the feasibility, from an institutional, technical, economic and social-cultural viewpoint. See part B of Cross-Chapter box 10 for ocean acidification.
54036	42	3	42	7	The refrain to use the term "geoengineering" and the proposal to change the name of SRM, as well as the artificial separation of CDR and SRM emanate from proposals by propoents of geoengineering proponents to confound governments and the public about the impacts of geoengineering and SRM. IPCC must not play in the hands of geoengineers. The separation of CDR and SRM is nefarious as both were developed to be used at the scale necessary to modify the climate. CDR will have much larger and different synergistic impacts than considering each technology separate from the others. IPCC should reconsider all of these changes that plays in the hand of geoengineers. Ref: Gardiner, Steve: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1357162; ETC group et al, The Big Bad Fix, The case against climate geoengineering., 2017 http://www.etcgroup.org/content/big-bad-fix [Elenita Daño, Philippines]	Taken into account. We keep SRM, but M is now refer to Modification . But we still refrain from use geoengineering as we separate CDR from SRM. See details in section 1.4.1
54228	42	3	42	7	Eliminating the word 'geoengineering' from the report does not eliminate the fact that the report is discussing geoengineering. Furthermore, replacing the word with increasingly technical expressions contributes to intransparency and inhibits open discussion about the kind of approaches that are considered feasible and acceptable in the setting of global climate politics. It reminds very strongly of certain policies in the United States that are eliminating the word 'climate change' in public documents. Further, the argument that the AR5 report separated SRM from CDR does not justify the elimination of the geoengineering concept entirely, in particular because the AR5 report explicitly included the term and - in contrast to this report - discussed 'geoengineering', including both CDR and SRM, as separate from mitigation. If the IPCC wants to ease the political acceptability of DACS, BECCS, and afforestation, I suggest including those technologies under the mitigation section. But obscuring the fact that ocean fertilization, stratospheric aerosol injection, or any other large-scale manipulations of the global commons are deeply problematic with potentially massive political and ecological consequences is, in my view, irresponsible. [Ina Möller, Sweden]	Taken into account. We keep SRM, but M is now refer to Modification . But we still refrain from use geoengineering as we separate CDR from SRM. See details in section 1.4.1
28582	42	4	42	6	It is not clear why CDR is categorized as a mitigation measure here, while in the literature CDR is often defined as one "branch" of geoengineering" IPCC AR5 also states: “Geoengineering denotes two clusters of technologies that are quite distinct: carbon dioxide removal (CDR) and solar radiation management (SRM).”, while the IPCC AR5 Glossary defines Geoengineering as follows: Geoengineering refers to a broad set of methods and technologies that aim to deliberately alter the climate system in order to alleviate the impacts of climate change. Most, but not all, methods seek to either (1) reduce the amount of absorbed solar energy in the climate system (Solar Radiation Management) or (2) increase net carbon sinks from the atmosphere at a scale sufficiently large to alter climate (Carbon Dioxide Removal). Scale and intent are of central importance. Two key characteristics of geoengineering methods of particular concern are that they use or affect the climate system (e. g., atmosphere, land or ocean) globally or regionally and / or could have substantive unintended effects that cross national boundaries. Geoengineering is different from weather modification and ecological engineering, but the boundary can be fuzzy. Instead of "we classify CDR as mitigation" it should be pointed out that "there could be some overlap between the two definitions" with regard to CDR, as in the Fifth Assessment Report, and a short reflection should be added. Please see also our comment on the entire report explaining our reservation to categorize CDR as a mitigation technology. [Germany]	Rejected. This report refrains from using the term ‘geoengineering’ and separates solar radiation modification (SRM) from CDR (see Section 1.4.1 and Glossary for description).While CDR can be considered as a special type of mitigation, SRM does not fit either mitigation or adaptation.
40456	42	4	42	4	Geoengineering is a widely used and well known term. It should be used in the report as an overarching term to cover SRM-RMM, CDR, or both. The option of separating SRM and CDR creates confusion, does not help to promote a much needed debate on the pros and cons of geoengineering and makes the report less understandable and useful for policy makers. A simple search for the term in Google Scholar produces more than 38 thousand results. [Pedro Alfredo Borges Landaez, Venezuela]	Rejected. This report refrains from using the term ‘geoengineering’ and separates solar radiation modification (SRM) from CDR (see Section 1.4.1 and Glossary). While CDR can be considered as a special type of mitigation, SRM does not fit to mitigation/adaptation categories
5098	42	5	42	7	While in the past much of the discussion about SRM has been as an emergency response after some very significant warming or nonlinear change has occurred, I think the leading type of proposed application being thought about recently is to shave off warming that cannot be dealt with in a timely way by mitigation (including CDR) and dealt with by adaptation--so peak shaving instead of a reversal of very large warming. As such, instead of contemplating reversing a CO2 doubling or quadrupling where there can be issues about whether SRM might cause serious impacts itself, the present proposal would involve a reduction equivalent to offsetting something likethe equivalent of a 25-50% CO2 increase, so a much smaller magnitude offset that would be gradually phased up and then phased out over decades to centuries, depending on the strength of mitigation/CDR. The other point that needs to be made as part of the opening remarks is that there is the potential to apply some of the SRM approaches on a regional basis to, for example, potentially offset or moderate some of the worst impacts, such as the amplified warming in the Arctic. Just talking about global implementation of SRM really fails to present an aspect of what is possible--that is, seeking to augment or complement adaptation efforts. In that the Arctic is already changing so much and will be very transformed by further warming, it would seem a real omission to not be mentioning that there are efforts and ideas about how to moderate Arctic change, perhaps reduce warming in areas where tropical cyclones tend to intensify to unprecedented levels, even perhaps shade the Great Barrier Reef or other specific areas. I just don't think the lead in to this section is adequate for explaining what the ideas and some analyses are that are being mentioned in the scientific literature (my personal papers about this are only a part of the thinking in this area). [Michael MacCracken, United States of America]	Accepted partly, this report should be focused on 1.5C and we can't add specific details about regional geoengineering. We had some of this information in the FOD, but then had to removed it due to space limits. But, we have mentioned some of the possible effects of SRM on the regional scale (see section B of the Cross-Chapter Box 10)
5114	42	5	42	7	With respect to the traditional view that RMM cold come in as an emergency approach at some timeafter a major impact has manifested itself (such as a section of the Antarctic ice sheet collapsing and initiating large and rapid sea level rist), there is no real reason to think that RMM could stop such an occurrence one it occurred. Paleo evidence makes clear that collapse of ice sheets goes much more rapidly than thei build-up, so if one wants to reduce the likelihood of ice sheet collapse, action must be taken prior to manifestation of the effect, and this is what peak-shaving is designed to do--keep the temperature from rising enough to trigger a collapse (and why we really need to not go above 1 C and should head back down to below 0.5 C. In addition, the imposition of a large and sudden RMM offset would have very significant consequences as well, so I just don't think this type of potential application is even worth considering--it would come too late to help and cause significant harm as for things like food production there would over the years have been some adjustment to the warmer conditions. This section needs more context on what is really practical about how RMM might be applied. [Michael MacCracken, United States of America]	Noted, thank you for this information, but we need to discuss SRM in context of 1.5 C and with relation to proposed pathways

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48234	42	5			…we classify CDR as mitigation. I commented on this in the FOD review. I can accept that the authors will not change their standpoint on this classification, and am glad to see that a definition of CDR includig this perspective has now been added to Chapter 1 (section 1.4.3); that is a considerable improvement. However, no justification is given there, it is only stated that "Mitigation...also may encompass attempts to remove greenhouse gases from the atmosphere." I strongly recommend that the authors include a clear justification for this choice, and also that the statement in the RMM section be moved to the CDR section, where it really belongs. In the review paper noted in the previous comment, there is a figure that describes CDR and RMM (there called RFG), and explains how both are distinct from classical mitigation, i.e., by treating CO2 and other substances AFTER they are in the atmosphere, rather than PREVENTNG their release, which is how a large part of the community that works directly on these topics views this. It is also worth noting that studies like Boucher et al. (2012) have shown that returning CO2 levels to a previous state can contribute to partly returning the climate and other Earth systems towards the corresponding previous state, though not entirely, due to hysteresis and other effects - i.e., the results are different than the same amount of mitigatino. If the authors have a good justification for their choice, in light of this, then they should state it clearly, otherwise it is likely to be questioned, especially if our review paper is published at about the same time taking a very different (and clearly justified) standpoinit. [Mark Lawrence, Germany]	noted, please see section 1.4.1. "Mitigation refers to efforts to reduce or prevent the emission of greenhouse gases, or to enhance the absorption of gases already emitted, thus limiting the magnitude of future warming (IPCC, 2014c)." See also the glossary. The statement has been removed indeed (although we do include a very brief statement on CDR and geoengineering as those terms are often associated with SRM).
54038	42	5			CDR is not mitigation - The reference to CDR as mitigation in this Report is a deviation from the definitions adopted in the IPCC assessment reports and by the UNFCCC and has clear political implications. CDR is never equivalent to emissions reductions which is what is urgently needed in order to meet the 1.5C goal. This sentence needs to be changed, the same with references to this deviation in the rest of the report. [Elenita Daño, Philippines]	Noted. See response to comment 48234.
54040	42	5	42	7	Delete RMM and use SRM in the whole chapter and report. The change of name from SRM to RMM intends to distract the attention of the readers from the many potential impacts associated with Solar Radiation Management and geoengineering. It would be not responsible forf IPCC to play this game of geoengineers. [Elenita Daño, Philippines]	Taken into account. We keep SRM, but M is now refer to Modification
56980	42	5	42	5	No one uses "geoengineering" to apply to CRD but not SRM: "..to cover SRM and CDR, or sometimes just SRM." [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted
5698	42	6	42	6	There is no need to invent yet another acronym (RMM). If you don't want to use SRM, use albedo modification (AM) as used in the US National Academy reports (2015) or the new AGU statement on climate intervention. [Alan Robock, United States of America]	Taken into account. We keep SRM, but M is now refer to Modification
5704	42	6	42	6	What is RMM? If you are going to use a term, you have to explain what it is. What kind of radiation? What measures? You also have to make clear right at the beginning that no such measures exist. These are only theoretical schemes, and there are serious questions about whether they would work at all. [Alan Robock, United States of America]	Taken into account. We keep SRM, but M is now refer to Modification
7464	42	6	42	6	Is it necessary to coin a new term RMM, given that the term SRM is used by all relevant literature in the field? [Axel Michaelowa, Switzerland]	Taken into account. We keep SRM, but M is now refer to Modification
19682	42	6	42	6	While it is understandable that the authors might want to use an alternative collective term, the term 'Radiation Modification Measures' may not be ideal, given the lack of qualification that it is solar radiation that is being referred to, rather than ionising radiation. It may be clearer to the audience of the report, and for future cross reference, to continue to use the term solar radiation management (SRM) [Jennifer Morgan, Netherlands]	Taken into account. We keep SRM, but M is now refer to Modification
45514	42	6	42	6	We should use the term of art in the literature - SRM - not new terms because we don't like the literature. RMM refres to the irradiation of materials to modify their properties - nothing to do woth climate! [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We keep SRM, but M is now refer to Modification
56982	42	6	42	6	RMMs. Is this new term really necessary? I can see that it attempts to do away with the problem of cirrus thinning, but I am not sure that is worth the introduction of yet another new term. My strong preference, given that the report is not going to use the term geoenginering, is to use albedo modification instead of SRM and simply talk about cirrus thinning directly when necessary. (Among other things, straight after introducing RMM you find yourselves immediately saying "except modification through greenhouse gas concentrations") [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We keep SRM, but M is now refer to Modification
1040	42	9	42	9	These and other papers do not "assert," a word that is used nowhere else in this chapter. Instead, the models "indicate" or "show," words that are used elsewhere. [Jesse Reynolds, Netherlands]	Accepted, text revised
1042	42	9	42	9	The references should include this, which is the most thorough assessment of RMM's expected climatic effects: Kravitz, Ben, et al. "A multi-model assessment of regional climate disparities caused by solar geoengineering." Environmental Research Letters 9.7 (2014): 074013. [Jesse Reynolds, Netherlands]	noted, we cited several papers by Kravitz in other parts of this section and in Cross-chapter Box 10. We have not cite proposed paper because it does not change formulation of the sentence, but will add to the word count
5100	42	9	42	9	Why is the word "asserted" used here? We do not say that models "assert" that CO2 will warm the climate. To avoid being prejudicial, the word to use is "indicated" [Michael MacCracken, United States of America]	Accepted, text revised
12332	42	9	42	12	Replace "Recent papers have" with "Some have" (2014 is not very recent). What about including neutral papers which don't attempt value judgements factually report changes in various climate paramenters? eg http://onlinelibrary.wiley.com/doi/10.1029/2008JD011450/abstract http://www.atmos-chem-phys.net/10/5999/2010/acp-10-5999-2010.pdf http://onlinelibrary.wiley.com/doi/10.1002/jgrd.50856/abstract [United Kingdom (of Great Britain and Northern Ireland)]	Noted, unfortunately we are limited in space and can't include all material, we are focussing on the most recent and related to 1.5C papers
19686	42	9	42	18	At some point in this paragraph, it would be worth also including reference to the recent review of the possible implications for biodiversity of both deployment and rapid termination of solar radiation management, published by Trisos et al. (2018) (https://doi.org/10.1038/s41559-017-0431-0) [Jennifer Morgan, Netherlands]	Accepted. Trisos et al. 2018 is now cited in this paragraph: "SRM also holds risks of changing precipitation and ozone concentrations and potentially reductions in biodiversity (Pitari et al., 2014; Visioni et al., 2017a; Trisos et al., 2018)." See Cross-Chapter Box 10
37468	42	9	42	9	Assert, is not the appropriate wording; Model-based studies "indicate", "show," or "suggest" that.... [Matthias Honegger, Germany]	Accepted, text revised
41664	42	9	42	10	This sentence has multiple issues. Firstly the papers are not just recent, secondly they have found that SRM would reduce impacts not just risks, and thirdly they have not 'asserted' these potential benefits, they have concluded based on extensive model analysis. To be accurate and balanced the sentence should say that roughly a decade of modelling, examining a range of scenarios via a range of simulations, have found/concluded/reported (not asserted) that moderate use of SRM could reduce many of the impacts of climate change, including global average temperatures(Irvine et al 2016), extreme temperatures (Curry et al 2013), extremes of precipitaton (Curry et al 2013), disruptions to average precipitation (Irvine et al 2016), rate of sea level rise (Moore et al 2010) and intensity of tropical cyclones (Moore et al 2015; Jones et al 2017). For clarity and balance is important here to address the different potential impacts separately (eg extreme temps, sea level rise, storm intensity) rather than just referring en masse to "some of the risks of global climate change related to remperature rise", especially as in the next sentence some potential risks are spelled out individually. [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, some references added, text revised: "SRM could reduce some of the global risks of climate change related to temperature rise (Izrael et al., 2014; MacMartin et al., 2014), rate of sea level rise (Moore et al., 2010), sea-ice loss (Berdahl et al., 2014) and frequency of extreme storms in the North Atlantic and heatwaves in Europe (Jones et al., 2018). "
56984	42	9	42	9	asserted -- this is a strong term that casts a bit of doubt. It is only used very rarely in the report. It seems to me that the more neutral "found" would be more defensible. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text revised
61988	42	9	42	18	Please provide an exhaustive assessment of uncertainties associated with the response of climate to aerosol forcing. The wording "peak shaving" suggests more accuracy than for instance reported by the IPCC AR5 on the response of climate to aerosol forcing, including lessons learnt from past volcanic eruptions. [Valérie Masson-Delmotte, France]	Taken into account, text revised

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1044	42	10	42	10	Those papers do not indicate that the risks would be greater than the benefits. They show that these risks would exist, and to some degree, quantify them. [Jesse Reynolds, Netherlands]	Taken into account, text revised.
1046	42	10	42	10	I am unsure what is meant by the risks of cloudiness. [Jesse Reynolds, Netherlands]	Taken into account, text revised.
5096	42	10	42	11	Given that the approach to applying SRM is currently "peak shaving" and so offsetting only the equivalent of about a 25-50% increase in CO2 and then phasing it down, the likelihood is pretty high that the offset will take the climate back to within the range of natural variability around a slightly elevated baseline climate, so back to the global average temperature increase being roughly in the range of 1-1.5 C (or preferably lower peak and certainly lower for the long-term given anything above 0.5 C would likely have serious consequences for society). All of the SRM modeling studies tend to bring the climate back toward a baseline value compared to not undertaking SRM, so the real comparison to be made is mitigation (including CDR) and adaptation together and then with or without SRM. The right simulations to be making judgements about this are really still to be made, but I think the statement here is simply not justified in that it simply does not seem to be making the conclusion compared to not having the SRM offset. [After writing this, I see the notion is mentioned--I would suggest that be featured and certainly that the general discussion go on before the discussion of risks as now appears on lines 10-11.] [Michael MacCracken, United States of America]	Taken into account, text revised.
37470	42	10	42	10	So far there is no paper that would indicate that "changing precipitation, ozone, etc. would outdo the benefits". Such a claim would 1. require an assessment of multi-dimensional benefits of avoided climate impacts from SRM/RMM deployment, 2. assessment of impacts related to the listed side-effects an 3. normative judgment of how the various dimensions compare. None of the three has been done or done conclusively in the scientific literature; and 3. would notably require a level of normative judgment that would require democratic decisions rather than expert judgment. While first attempts at such comprehensive assessments are emerging (Honegger et al. 2018; forthcoming), they remain preliminary as proposals of SRM/RMM as well as political priorities (e.g. in the Agenda 2030/SDG) context evolve and greater clarity of interconnections is generated. => Rephrase to say: "but others also indicate potentially significant unintended impacts such as changing precipitation patterns, ozone, cloudiness and implications thereof and the scientific evidence is insufficient for an encompassing judgment of the relative importance of potential benefits and harms respectively." [Matthias Honegger, Germany]	Taken into account, text revised.
41666	42	10	42	11	The studies mentioned here do not find that these potential impacts would 'outdo' the benefits of SRM. Indeed, scientific studies cannot conclude this sort of thing as it's an issue of value rather than fact [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, text revised.
41668	42	10	42	10	The concept of 'changing precipitation patterns' has to be addressed with more sophistication and more accurately communicated. Modelling studies have consistently found that use of SRM, whether large so as to take temperatures back to pre-indutrial, or moderate so as to stop or reduce the rate of warming, would overall decrease the disruptions to precip patterns for most places on the planet. Focusing on the minority of areas that might experience increased precip disruptions is unbalanced. It should be mentioned, of course, but to be balanced it should be alongside something that reports the modelling finding that most areas would experience changing precip patterns without SRM [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted partly, the fact that changes in precipitation patterns will appear without SRM is considered in chapter 3. We removed corresponding sentence, but part of it is now in the Table 4.7. (listed as a specific impacts on climate variables)
4324	42	11			The Pitari 2014 and Visioni 2017 papers are about ozone loss and the effects of sulphur in the stratosphere, not sea salt in the lower troposphere. It would help to clarify this. Until we have firm evidence, it is more likely than not, that putting sea surface temperatures back to where they used to be will be beneficial with respect to precipitation and cloudiness. For example a politically popular early test would be to moderate El Niño events. If we can make mono-disperse spray to get a high nucleation fraction we could do this with about 200 spray vessels. The pro-El Niño lobby is very small. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Noted, thank you for this information, but we are very limited in space and can't include this. The Pitari and Visioni references mentioned in the table are associated with SAI, not with MCB.
9490	42	11	42	11	The cited literature does not support the claim "outdo the benefits". The literature cited points out that CO2+RMM would not yield the same climate as no radiative forcing. Evaluating whether the impacts "outdo the benefits" would require a different analysis that is not in the scope of these or any other currently existing papers. The IPCC should restrict itself to assessing literature, not making unsubstantiatable normative statements on that. (I think the only statement that can be made is that we don't know, without more research, whether the risks would outweigh the benefits.) [Douglas MacMartin, United States of America]	Taken into account, text revised.
19138	42	11	42	11	I very much doubt that the quoted references support the assertion that the "risks outdo the benefits". The quoted references point to some risks but do not make a value judgment as to whether these outdo the benefits or not . [Olivier Boucher, France]	Taken into account, text revised.
5102	42	12	42	14	To really lay out the issue, it needs to be said that none of the available approaches (i.e., mitigation, CDR, adaptation, SRM) can solve the whole problem in a timely or cost-effective way thst does not involve exceedingly long commitments--I really think this needs to be said: It is too late to do by mitigation alone, too slow to do by CDR along, not possible to adapt to everything, and SRM does not fix ocean acidification and would be needed indefinitely were it not for mitigation and CDR. Basically, the situation is that we have waited so long to act that we will need all of the approaches in order to stay below 1.5 C (as shown in this assessment, without SRM we either overshoot by a lot or the world has to make draconian cutbacks in emissions that it is not at all clear would b possible, much less politically doable. And this is for keeping the increase in the global average temperature below 1.5 C when to really prevent unacceptable consequence, the need is to be below 0.5 C--and for that, SRM really has to play an early role or the damage of being at 1 to 1.5 C will be done. So, I would urge the authors to more clearly lay out the dilemma the world is in. [Michael MacCracken, United States of America]	Taken into account partly, text revised a bit, we are talking about SRM as a supplement measure ("SRM would only be deployed as a supplement measure to large-scale carbon dioxide removal")
54042	42	13			Delete the words "deep", and delete the text in parenthes is("peak-shaving"), as the majority of proposals for SRM propose to deploy the technology over a long time. It is not possible to only deploy SRM over a short time, as this expression implies. Ref: Trisos et https://www.nature.com/articles/s41559-017-0431-0 and Pierrehumbert, R, https://thebulletin.org/trouble-geoengineers-%E2%80%9Chacking-planet%E2%80%9D10858 [Elenita Daño, Philippines]	Noted, "deep mitigation" is fixed term. A lot of recent articles proposes "peak-shaving" or "moderate" SRM. First reference (Trisos) was added, thank you
38618	42	14	42	14	A full discussion… sounds very complete and final. I suggest changing this to "a more comprehensive" [Jan Fuglestvedt, Norway]	Accepted, text revised
54044	42	14			Delete the word "full". The discussion on the matter in this report is limited and only takes into account certain perspectives and opinions. Definitely not a "full discussion" in every sense. [Elenita Daño, Philippines]	Accepted
5104	42	16	42	18	This sentence also needs to say that the analysis here pertains to globally focused RMM and is not covering at all the issue of a potential regional focus for RMM, something that does need to be covered, or at least mentioned. [Michael MacCracken, United States of America]	noted, we can't add specific details about regional SRM. We had some of this information in the FOD, but then had to removed it due to space limits. But, we have mentioned some of the possible effects of SRM on the regional scale (see section B of Cross-chapter Box 10). We also describe SRM timing and magnitude in section A od the Box 10 and say that we are focussing on global mean temperature, thus we are not discussing regional RMM

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54262	42	16	42	18	The exclusive focus on SAI as the most discussed form of SRM (or 'RMM', as it has been re-named for rather obscure reasons), further reinforces the point that what is actually problematic about SRM is SAI - also widely called solar geoengineering - and that other methods of local albedo enhancement are not considered of much importance. Why then create an entire new category called RMMs (while maintaining the titles 'Solar Radiation Management'), if what the report is discussing is actually only stratospheric aerosol injection? I strongly suggest enhancing transparency by calling it what it is, rather than making the discussion ever more technical by adding to the continuous invention of complicated terminology [Ina Möller, Sweden]	Accepted partly, we have added Table 4.7: Overview of the main characteristics of the most-studied SRM methods to this section. Some of the RMMs are also discussed in the Cross-Chapter Box 10. This section assesses the feasibility, from an institutional, technical, economic and social-cultural viewpoint. The information about MCB, CCT or GBAM is very limited in this fields
56986	42	16	42	18	As in comment on SPM page 19 lines 20-24, I think "feasibility" is not quite what this section deals with, and has a tendency to make what are useful value judgments appear as if they are pragmatic assessments. It seems to me that these paragraphs are in fact discussing limits on what might be justifiable, or desirable, much more than on what is feasible. For example, "economic feasibility" as used here seems concerned more with "would this make economic sense" than "is this economically feasible" (its not like there is a law of economics that would be in some way broken). The section on governance talks about the need for it to be equitable, which might be hard to achieve. But inequitable governance is not "infeasible"; It is simply undesirable. I would recommend making the values involved in these helful analyses explicit. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, we revised text of this section significantly. We hope that now it looks much more like a discussion of what might affect feasibility of SRM, but please note that the literature has limitations and very often agreement is low and evidence is not robust. Quantitative estimates are very difficult to make.
5700	42	17	42	17	Stratospheric Aerosol Injection (SAI) is not correct. Again, why a new acronym? Anyway, the technique most studied is not injectiof of aerosols into the stratosphere, but injection of a gas, sulfur dioxide, which then converts to aerosols over a period of weeks. [Alan Robock, United States of America]	Noted, it is not a new acronym, it is used in the literature. Please see SAI description is in the Table 4.7, where we have following :"Injection of a gas in the stratosphere, which then converts to aerosols."
5106	42	20	42	23	Two points: (1) Quite a Catch-22 for RMM--that there is not really money for research means that much of the work is speculative and so opinion, so not covered, even though the papers on other general apporaches often offer opinion in describing the significance of their research, etc.; and (2) what about covering the statements of leading professional societies (so AGU, AMS, National Academy of Sciences, Royal Society, etc.) which do represent quite authoritative professional views? [Michael MacCracken, United States of America]	Noted. Some statements of leading professional societies have been included
7466	42	20	42	21	As long as papers on SRM are peer-reviewed and not specifically marked as "commentary", they should not be excluded. [Axel Michaelowa, Switzerland]	Accepted, we cite such papers indeed. However, we cannot cite everything because of space limitations.
19140	42	20	42	20	change "much" to "some" [Olivier Boucher, France]	Accepted, text revised
41670	42	20	42	20	I'm not sure what is meant by the claim that much of the literature on SRM takes the form of opinion pieces. There are now hundreds of academic papers on all different aspects of SRM, from physical science to law to discourse analysis to engagment studies to ethics to economics. This is the intellectual foundation for analysis of the risks and potential of SRM and I suggest that this sentence should be cut as it serves no clear purpose. [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Noted, it is just to explain that we do not use Commentaries and Opinions in our assessment
45516	42	20	42	23	I would report the views and characterise them as such. Many other views have been reported (notably on feasibility) [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted, we are limited in space and, unfortunately can't include all these views
54046	42	20	42	23	This statement is sincere but should motivate IPCC to look for more independent information. Most of the information selected by the author/s have not been assessed, and as stated, even if published in journals, it is a focused selection of information, biased toward spresenting the opinions of proponents of geoengineering. [Elenita Daño, Philippines]	Noted, we are assessing balance of literature and cite mostly peer-reviewed papers. We are not selective in terms of proponents/opponents of SRM.
9492	42	21	42	23	The part of this sentence after the comma doesn't quite make sense; need to reword. [Douglas MacMartin, United States of America]	Accepted. This was deleted.
5702	42	22	42	23	assessed, also if they appear in scientific journals. I don't understand what this means. [Alan Robock, United States of America]	Accepted, text revised
7948	42	22	42	22	also if is wrong; do you mean "even if"? [Christopher Bataille, Canada]	Accepted, text revised
10586	42	22	42	23	… such viewpoints are therefore not assessed, also if they appear in scientific journals'. The meaning is not clear. [Hong Yang, Switzerland]	Accepted, text revised
12334	42	22	42	43	It's not clear what "also if they appear in scientific journals" means, can this phrase be deleted? [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, text revised
56988	42	22	42	22	also should be "even" [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text revised
61048	42	22	42	22	This sentence is unclear – do you mean "even" instead of "also"? [United States of America]	Accepted, text revised
46308	42	26	42	54	Much excellent analysis of the governance of SRM has been done by Stephen M. Gardiner, author of The Perfect Moral Storm. Here are some examples: Gardiner, S.M. (2013). Why geoengineering is not a 'global public good', and why it is ethically misleading to frame it as one. Climatic Change 121, 513 - 525. doi:10.1007/s10584-013-0764-x. Gardiner, S.M. (2014). Why 'global public good' is a treacherous term, especially for geoengineering. Climatic Change 123, 101 - 106. doi:10.1007/s10584-014-1079-2. Gardiner, S.M. (2011). Some early ethics of geoengineering the climate: A commentary on the values of the Royal Society report. Environmental Values 20, 163 -188. doi: 10.3197/096327111X12997574391689. Gardiner, S.M. (2016). Geoengineering: Ethical questions for deliberate climate manipulators. Oxford Handbook of Environmental Ethics, eds. S.M Gardiner and A. Thompson. doi: 10.1093/oxfordhb/9780199941339.013.44. [Henry Shue, United Kingdom (of Great Britain and Northern Ireland)]	Accepted partly, the first reference (Gardiner 2013) added, others - as in the form of chapters in the book, commentary, responses, access to them is not public or they are not peer-reviewed.
55104	42	26	42	26	The title 4.3.9 is missing since we are moving into RMM. But I also believe that the issue of governance and institutional feasibility should not be just limited to RMM. A similar analysis should be made to CDR, also the considequences/adverse impacts are lower. [Yamide Dagnet, United States of America]	Taken into account – The aspect of governance – dealt with in the penultimate paragraph of the CDR section – has been slightly expanded. A full assessment of governance is not possible because there is a separate section on governance issues of deep decarbonisation (and adaptation) in chapter 4 and there is no space to accommodate more text in 4.3.7
1048	42	27	42	28	According to models, low intensities of RMM bring all regions close to preindustrial conditions. That is, they *might* -- but not necessarily *would* -- have negative consequences for some groups. This assumes that all groups of people desire a climate closer to preindustrial conditions, which is an implicit assumption of this report. [Jesse Reynolds, Netherlands]	Accepted, we deleted this sentence
5108	42	27	42	28	This assertion regarding negative consequences is presented without any qualification based on model simulations for very different situations than would be used for peak-shaving, and that generally are based on comparison to the baseline state rather than the perturbed state. Taking for the moment the offsetting of CO2 doubling, it is not at all clear that any location would be worse off in terms to the temperature effect and the precipitation effects again need to be judged with respect to the perturbed state, not the baseline as that just won't be what will be experienced. I don't know of simulations done in a peak shaving type of application and evaluating the extent to which the offset brings conditions back to within the one- to two-sigma range of variability for the baseline case. I just do not see how an unqualified assertion like this can be scientifically justified. [Michael MacCracken, United States of America]	Accepted, we deleted this sentence

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5706	42	27	42	27	RMMs would be intended to result in positive consequences for some This is not correct, if they are used for military purposes. Then they would only be positive in an indirect sense for the attackers. You need to address this potential danger. [Alan Robock, United States of America]	Noted, we have no reason to assume that SRM would be used for military purposes. We are discussing unilateral action here as a potential danger
7266	42	27	42	29	This is opinion, which you just said you were going to avoid. An equally plausible scenario is that an exit strategy is decided before beginning (e.g., Tilmes et al., 2016). [Ben Kravitz, United States of America]	Accepted, we deleted this sentence
9494	42	27	42	27	Change "would" to "could". Despite the fact that social science and governance literature (such as Heyen, cited) generally assume this, but without any proof. Climate model simulations don't support this strong an assertion. (Of course, people who might benefit from climate change would be harmed by RMM, but they would also be harmed by mitigation.) (As in many other points, this also depends on the implicit comparison being made, but relative to the same CO2 concentration and higher temperature without geoengineering, then model simulations to date actually suggest that everywhere has precipitation closer to preindustrial, and nearly everywhere has temperatures closer. See Kravitz et al 2014 doi:10.1088/1748-9326/9/7/074013, and MacMartin et al 2018 (doi:10.1098/rsta.2016.0454); the latter even has maps showing how many models predict precipitation to be further from preindustrial under limited deployment in each grid cell; rarely does any point have more than 2-3 out of 12 models agreeing that precipitation would get worse). [Douglas MacMartin, United States of America]	Accepted, we deleted this sentence
28584	42	27	42	30	There are mentioned "negative consequences for others". We propose to add results from a new study, co-authored by Rutgers Distinguished Professor Alan Robock, research associate Lili Xia and postdoc Brian Zambri, published in Nature Ecology & Evolution, 30.1.2018: "Potentially dangerous consequences for biodiversity of solar geoengineering implementation and termination": https://www.sesync.org/potentially-dangerous-consequences-for-biodiversity-of-solar-geoengineering-implementation-andpotential biological impacts of geoengineering". [Germany]	Accepted. We cited this paper in the beginning of the section: "SRM also holds risks of changing precipitation and ozone concentrations and potentially reductions in biodiversity ". Corresponding sentence was deleted
37282	42	27	42	27	The text states “RMMs would be intended to result in positive consequences for some, but would have negative consequences for others.” This is both presumptive and falsely confident in excluding possible deployment scenarios in which all regional climates more closely approximate preindustrial conditions than they would in the absence of RMM (e.g., Kravitz et al. 2014). [Kravitz, Ben, et al. 2014. “A Multi-Model Assessment of Regional Climate Disparities Caused by Solar Geoengineering,” Environmental Research Letters 9: 074013; Keith and Irvine (2016)] [Joshua Horton, United States of America]	Accepted, we deleted this sentence
37472	42	27	42	28	This is incorrect. According to models, deployment of RMM to partially compensate for limited warming of e.g. 3°C (down to e.g. 1.5°C) would bring all regions closer to preindustrial conditions than the corresponding state of the climate system in the absence of RMM. That is, they *could* -- but not necessarily *would* -- have negative consequences for some groups. Some relevant publications are: MacMartin, D. G., Ricke, K. L. & D. W. Keith (2018). Solar Geoengineering as part of an overall strategy for meeting the 1.5°C Paris target. Forthcoming in Phil. Trans. Royal Soc. A. doi:10.1098/rsta.2016.0454 Jones, A., Hawcroft, M., Haywood, J., Jones, A., Guo, X., & Moore, J. (2018). Regional climate impacts of stabilizing global warming at 1.5 K using solar geoengineering. Earth’s Future. Irvine, P. J., Ridgwell A., & Lunt D. J. (2010). Assessing the regional disparities in geoengineering impacts. Geophysical Research Letters, 37(18). Ricke, K. L., M. G. Morgan, & M. R. Allen (2010). Regional climate response to solar-radiation management, Nat. Geosci., 3(8), 537–541. [Matthias Honegger, Germany]	Accepted, we deleted this sentence
38622	42	27	42	29	I find this sentence too un-nuanced. These issues are complicated in many ways and needs a much more nuanced treatment. E.g., what is meant by "positive consequences for some" ? And "addiction problem" is too sloppy for an IPCC assessment, in my view. [Jan Fuglestvedt, Norway]	Accepted, we deleted the first sentence and rephrased a sentence about addiction problem ("...be multilateral because of the risk of termination, and risks that implementation or unilateral action by one country or organisation ")
41672	42	27	42	28	This sentence is unbalanced in its framing. It speculates as to the intent of a future RMM/SRM deployer before stating as fact that SRM would have negative consequence for some people. If this paragraph wishes to start off reporting physical impacts, then it should stick with the consistent conclusion of SRM modelling studies: that moderate use of SRM would reduce many the impacts of climate change for most people on the planet, but not for all and a small minority might experience additional impacts. [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, we deleted this sentence
54090	42	27	42	40	This paragraph should also recognise that there are very substantial differences in the general approach to the governance of these technologies.See, for example: Huttunen, S., Skytén, E. and Hildén, M. 2015. Emerging policy perspectives on geoengineering: An international comparison. The Anthropocene Review 2015, Vol. 2(1) 14–32 [Mikael Hildén, Finland]	Noted, we had this message and this reference in the FOD, but then it was removed due to strong space limit. In this report we tried to focus on the most important issues, unfortunately we don't have space for the details.
2098	42	28			out of date - more recent research suggests no net losers from SRM http://www.tandfonline.com/doi/abs/10.1080/21550085.2014.926078?src=recsys&journalCode=cepe21 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted, thank you for reference, but we can't cite commentaries
5110	42	28	42	29	Regarding the "addiction problem", that too needs some context. If we stop mitigation we'll also be in a very precarious situation for a long time, and same with adaptation and same with CDR (which has yet to be proven at near sufficient scale. As noted in another comment, we need all of the approaches to play a significant role to stay below 1.5 C and also, more properly on a scientific basis of avoiding unacceptable harm, for trying to get back to no more than 0.5 C. Now, there is a clear path to ending the SRM and that is to phase up the CDR (on top of aggressive mitigation), so there is a clear and acceptable exit strategy. Given the amount of warming and associated climate change that just mitigation and CDR (assuming it can indeed be scaled up) are going to allow, the evaluation needs to be made between the signficant overshoot without the RRM (and one might choose mainly regional or global implementations) and the much lower warming and impacts of taking the risk on RMM. Making this evaluation is much more complex than the very simple statement here, which does not even mention the amount of damage that would be offset. I find the presentation here inadequate and prejudicial, not really presenting the situation in the balanced way that IPCC is charged with doing. [Michael MacCracken, United States of America]	Accepted, text revised
37284	42	28	42	28	The text states that RMMs “would result in an “addiction problem””, but this is the case only if continued net emissions growth coincides with RMM. Also, there is no reason that geoengineering must be maintained indefinitely. [David W. Keith & Douglas G. MacMartin, A temporary, moderate and responsive scenario for solar geoengineering, Nature Climate Change volume 5, pages 201–206 (2015); Parker and Irvine (in press) Earth's Future] [Joshua Horton, United States of America]	Accepted, text revised

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41674	42	28	42	29	It is demonstrably wrong to say that once SRM is started it is hard to stop. Firstly, SRM could be turned on to only a low level of cooling, from which it could be switched off without riskng the sudden and dangerous warming associated with 'termination shock' (Kosugi, T. (2013). Fail-safe solar radiation management geoengineering. Mitigation and Adaptation Strategies for Global Change, 1–26. https://doi.org/10.1007/s11027-012-9414-2; Parker, A. and Irvine, P. J. (2018), The Risks of Termination Shock From Solar Geoengineering, Earth's Future). Secondly, even SRM geoengineering that were exerting a high degree of cooling could be turned off by slowly ramping it down, avoiding sudden warming. Therefore this sentence is wrong when it categorically states that use of SRM would result in an addiction problem. To be accurate it should avoid imprecise and emotive phrases like 'addiction problem' and should stick to the evidence, saying "...and, if ever deployed to a high level of cooling, could not be switched off suddenly without resulting in rapid and substantial warming that could prove dangerous". Parker and Irvine (2018) provides a reference for this [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	taken into account, text revised, the risk of termination just mentioned here. Part B of Cross-Chapter Box 10 goes into the termination shock/effect a bit more.
57354	42	28	42	28	Avoid informal language [Hans Poertner, Germany]	Accepted, text revised
2146	42	29			addiction problem is fallacious - SRM can be ramped down, once emissions have reduced. https://keith.seas.harvard.edu/publications/temporary-moderate-and-responsive-scenario-solar-geoengineering [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, we revised text and conclude that "The severity of the termination effect has recently been debated and depends on the degree of SRM cooling "
5112	42	29	42	30	Please do say what the "evidence" is--it is all speculation about possibilities. This report somehwo seems to accept that the countries will really make an effort to stay below 1.5 or 2 C, for which there is also very little evidence this can and will be done. But back onto the single actor hypothesis, while it is possible to inject the aerosol, the reward for doing so as an individual nations is not at all clear--the changes are very broad. With the interconnected world, each nation depends on the situation in other nations and by far the most likely situation will that this will be approached as an international issue. In any case, While some regional differentiation may well be possible (and appropriate to lessen the likelihood of Arctic melting and super intensification of tropical cyclones), it is purely specuative to be talking about whether the consequences would be adverse for some nations compared to the situation of there being no RMM. What is really clear is that global warming will do very extensive damage for virtually all nations on Earth and that mitigation/CDR cannot (or are not going to) be done in time to prevent this--and only RMM can play this role, dependent of course on mitigation and CDR being done. I thik raising this unilateral action point is quite overstated. [Michael MacCracken, United States of America]	Taken into account, text revised: "There is robust evidence but medium agreement for unilateral action potentially becoming a serious SRM governance issue "
12336	42	29	42	29	What is meant by "high evidence"? [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, text revised: "There is robust evidence but medium agreement for unilateral action potentially becoming a serious SRM governance issue "
37476	42	29	42	29	Unilateral action is a possibility, that does not mean that there is "high evidence" for it to "potentially becoming a serious governance issue". Rather, "many commentators find reasons for concern regarding the possibility of unilateral deployment" [Matthias Honegger, Germany]	Taken into account, text revised: "There is robust evidence but medium agreement for unilateral action potentially becoming a serious SRM governance issue "
51214	42	29	42	40	SRM is not just "hard to stop" - sudden termination would have devastating effects (much higher warming rates than under conditions of "normal" climate change) - and termination is a significant risk when considering the possibilities of technological and/or human failure etc. A recent paper by Trisos et al. (Trisos, C.H. et al. (2018) Potentially dangerous consequences for biodiversity of solar geoengineering implementation and termination, Nature Ecology & Evolution) has made clear that sudden termination of SRM would cause rates of rapid warming that would leave many species and human communities incapable of adapting. [Linda Schneider, Germany]	Accepted, text revised, Trisos, C.H. et al. (2018) cited
12338	42	30	42	31	To what does "medium agreement" refer? Is it the 2 references already mentioned? Or does it also include the next one? If not, why not? [United Kingdom (of Great Britain and Northern Ireland)]	Noted. It is it the 2 references already mentioned and some others which we just can't add to reference because we are very limited in space and have to count each word
54048	42	30	42	31	Delete from "others argue… to the end of sentence including reference". Again, opinion of one or a few, while the majority see the governance of SRM as a major, even unsurmountable problem. [Elenita Daño, Philippines]	Taken into account, "others argue" deleted, text revised
5116	42	31	42	33	An issue that countries will also be required to consider is how serious the consequences of global warming without SRM would be likely to be--this is the context for even considering RMM. I really think that this section needs to more clearly present the situation being faced and then lay out the set of questions to be faced, not presenting this particular one as critical and not mentioning the other questions. [Michael MacCracken, United States of America]	Noted, This section assesses the feasibility of SRM from different viewpoints. The message on consequences of global warming without SRM is in others parts of the report, here we assess SRM itself.
5118	42	31	42	38	First, there is no indication that RMM will be particularly expensive compared to other options (so where did "high costs" come from?) and the whole purpose of RMM is to reduce the impacts on the global commons, so what is this focus on the high cost on the global commons. I also do not understand this notion of RMM tending to lead to greater extremes, etc.--returning to the lower global average temperature compared to the unconstrained global warming will lessen the problems indicated, not exacerbate them. Yes, with respect to an unperturbed baseline, there may be effects, but these pale in comparison to the adverse impacts associated with not invoking RMM. Were this a discussion from back in the time before GHG induced climate change and whether to do RMM or not (such as ideas in the 1960s to artificially warm the Arctic to get at its resources), the arguments here would apply, but that is not the situation we have. With warming, sea level rise, expansion of the subtropics and extremes increasing, the intent of RMM (and what model results show) is to moderate the impacts of GHG induced climate change. And it mitigation and CDR can bring the excess forcing down, then phase out RMM--no question about that--but they will not be able to do that for many decades to centuries, certainly at the pace things are going now, and in this situation RMM is, at least that we are aware of now, the only potential approach for fending off really disastrous sea level rise and other impacts. I just do not think the text here does at all well in presenting the dilemma. [Michael MacCracken, United States of America]	Noted. See response to comment 5116.
12340	42	32	42	32	to what does "address this" refer? Enhanced collaboration? [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, "address this" deleted
7268	42	33	42	33	Robock (2016) is an opinion piece, which you said you were going to avoid. [Ben Kravitz, United States of America]	Accepted, this reference will be deleted as part of the errata.
54306	42	33	42	34	SAI is substantially different from 'many other climate responses' in the sense that mitigation and adaptation efforts do not normally require multilateral goverance. Under the NDCs, every country can develop climate policies according to their own, national law. SAI and marine geoengineering are fundamentally different because they involve intentional manipulation of the global commons, which would indeed require multilateral governance. I therefore suggest deleting the clause 'like many other climate responses' [Ina Möller, Sweden]	Accepted, text revised
1050	42	34	42	34	There is no evidence to suggest that RMM would have relatively high costs, and that is consequently not a reason for governance's necessity. [Jesse Reynolds, Netherlands]	Accepted, text revised
1052	42	34	42	34	RMMs do not *require* multilateral governance. As noted here, a single state could benevolently implement them. Instead, governance must be multilateral in order to be *legitimate*. [Jesse Reynolds, Netherlands]	Accepted, text revised
37474	42	34	42	34	Delete: "high costs". There is no evidence to suggest that RMM would have relatively high costs, and that is consequently not a reason for governance's necessity. [Matthias Honegger, Germany]	Accepted, text revised
41676	42	34	42	34	RMMs do not "require" multilateral governance, but many have argued that it would be highly desirable [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text revised

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41680	42	34	42	34	This is a somewhat snarky point so please forgive me - you guys are doing a great and thankless job producing this report. But it's also an important point: how has this chapter managed to review the literature to the point where it concludes that there is a general consensus that RMMs would require multilateral governance, citing some pretty obscure papers in support of this, but it does not report that if mitigation and CDR do not prove sufficient, SRM would be the only way to stay under 1.5C??? Surely this is something that is important for readers to know?!? [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account partly, text has been revised. In the context of this report, SRM is assessed in terms of its potential to limiting warming below 1.5°C in temporary overshoot scenarios as a way to reduce elevated temperatures and associated impacts. Cross-Chapter Box CB10, Figure 1 shows how SRM could be used if mitigation and CDR do not prove sufficient. We hope that we make this message more clear
56990	42	34	42	34	Not clear what these "high costs" are -- please be specific (note that as is said a little later, the direct costs are quite low ($1bn-$10bn per annum" [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, this was deleted
2100	42	36			effect is called 'free driver' - name needs to be added, with relevant cites. https://dash.harvard.edu/bitstream/handle/1/17368469/34975192.pdf [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted partly, suggested reference (Weitzman 2015) is cited. Unfortunately we don't have space for adding 'free driver' term here
1054	42	37	42	37	It is unclear what a risk to photosynthesis means. Studies have repeatedly shown that SAI RMM would increase photosynthesis, e.g. in Xia, Lili, et al. "Stratospheric sulfate geoengineering could enhance the terrestrial photosynthesis rate." Atmospheric Chemistry and Physics 16.3 (2016): 1479-1489. [Jesse Reynolds, Netherlands]	Noted, this sentence was deleted
2148	42	37			photosynthesis a bit of a red herring, recent studies show low impacts in most regions http://onlinelibrary.wiley.com/doi/10.1002/2016GL070111/full, perhaps even +ve http://onlinelibrary.wiley.com/doi/10.1002/2015JD024202/full [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted, corresponding sentence was deleted. Some information about photosynthesis is given in section C of Cross-Chapter Box 10.
41678	42	37	42	37	What is meant by a risk to photosynthesis? This needs to be explained more clearly [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this sentence was deleted
5120	42	38	42	40	I also think that the "many uncertainties" issue is overplayed. First, the proposed RMM approaches, especially stratospheric aerosol injection, very closely mimic the natural process of volcanic aerosol injection--this is not some new phenomenon. For RMM, the injection rate would likely start off like that of small volcanic injections and be done slowly over time--in that models have done fairly well for large intjections that spread out and persist for a couple of years (i.e., Pinatubo), it is really not clear that there are serious new uncertainties. Yes, there are engineering questions about making the aerosol and we aerosol uncertainties do exist, but there could be different types of particles, etc.---the energetics of all of this and how the climate would respond are within our experience, it is just the engineering to do the energetics that needs to be worked out. And this could all be done starting slowly and doing iteratively. Likely, per Santer et al., small volcanic eruptions contributed a cooling influence during the first decade of the century and it was hardly noticed (except perhaps a bit slower rate of warming)--I just do not see what the "many uncertainties" are, especially in that with RMM the conditions would be much like present climatic conditions with which we have experience, whereas foregoing RMM and letting the climate warm to unprecedented levels as compared to the last several million years and more, which are conditions the models have not and cannot be verified on. So, again, comparative uncertainty analysis, in my view, would suggest that the models would be likely to do better in the situation with RMM versus no RMM (so only GHG induced warming). If this statement is to be made, it needs to be made clear what the basis is, and for what reason the uncertainties are thought to be larger for the situation with RMM than not. [Michael MacCracken, United States of America]	Accepted, "many" deleted, and 'surrounding deployment of' was added. Further explanations require space, but we are very limited in space
41682	42	39	42	39	Add in reference to Parker A. 2014 Governing solar geoengineering research as it leaves the laboratory. Phil. Trans. R. Soc. A 372: 20140173. http://dx.doi.org/10.1098/rsta.2014.0173 [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	accepted, added
54050	42	40			Add: Others have suggested that establishing governance of research and experiments separated from deployment is not possible, as it results to "technology entrechment" and a "slippery slope" that would pave the way to deployment. Ref: Oldham, P et al http://rsta.royalsocietypublishing.org/content/372/2031/20140065 , See Gardiner, Steve, 2014 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1357162 [Elenita Daño, Philippines]	Noted, "slippery slope" problem is mentioned in 4.3.8.3 Social acceptability and ethics
1056	42	42	42	43	The SBSTA is part of the UNFCCC system, and this makes the sentence redundant. [Jesse Reynolds, Netherlands]	accepted, clarifications added
5122	42	42	42	47	I'd suggest that the main reason they would want to join is to be finding some approach that could moderate the serious consequences that lie ahead given the inadequacies that are becoming apparent in mitigation efforts. Overshoots to 3 C and above, which is what the world is on track to have occur, especially in that most important impacts will depend on peak warming and not the ultimate level that the warming is brought back to, are going to be very, very impactful and there is, I'd suggest, going to be lots less focus on the need for further research than for moving aggressively to deploy RMM. The paragraph here seems to fail to consider the context of the rapidly worsening climate situation that all nations are facing--look to the Arctic now and the expanding aridification occurring as the subtropics push poleward. In my view, this paragraph just has to consider the context for even considering RMM, and that is not being done in the text. [Michael MacCracken, United States of America]	Noted, we are citing literature here (Lloyd and Oppenheimer, 2014). We revised text here: "Voice in SRM diplomacy, prevention of unilateral action by others and benefits from research collaboration might be reasons for states to join an international governance framework for SRM." We are very limited in space and can't expand this discussion
5732	42	42	42	42	define all the acronyms: UNFCCC 43 or the UNCBD (Honegger et al., 2013), under SBSTA (Nicholson), [and add year for last reference] [Alan Robock, United States of America]	Accepted
30630	42	42	42	47	You could also add that there is also a debate on the governance of research around SRM techniques [France]	Taken into account. Governance of research may relate to the discussion on doing SRM research: "The literature shows low agreement on whether SRM research and deployment may lead policy-makers to reduce mitigation efforts and thus imply a moral hazard" and the 'slippery slope' argument. "Some have suggested that the governance of research and field experimentation can help clarify uncertainties surrounding deployment of SRM "
54052	42	42	42	47	As mentioned in previous comments, SRM governance is considered by many scientists as an unsurmountable problem. This paragraph however presents the issue as if it was a question of options. Excepting CBD, there is no other UN body that discusses governance of geoengineering. Furthermore, civil society strongly advocates for a ban on SRM . We suggest in the begining of the sentence: "Because of its unequal impacts and because SRM would involve "winners" and "losers", SRM governance is seen by many scientists and civil society as an unsurmountable problem". Ref: Heinrich Boell Foundation and ETC group, Riding the Geostorm, 2017, http://www.etcgroup.org/sites/www.etcgroup.org/files/files/etc_hbf_geoeng_govern_usletter_sept2017_v4_1.pdf . We suggest to delete the rest of the paragraph. Alternately, we suggest that the suggested sentence above should precede the paragraph. [Elenita Daño, Philippines]	Noted, we are assessing a balance of literature which does not support the point here. We citing peer-reviewed literature, thank you for reference, but it can't be included
37414	42	43	42	43	May want to specify that the reference is to the UNFCCC SBSTA. Also, missing year (Nicholson): probably 2017? [Matthias Honegger, Germany]	Accepted, text revised. Year was missing because it had not yet been published and this is the way unpublished papers were reflected.
2102	42	44			Ricke on power blocs is not cited (until later) - an obvious ommission [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted, we are very limited in space and can't include this
51216	42	49	42	54	If SRM deployment could never be decided by democratic process, then why even take into consideration such a high-risk powerful technology that is prone to unilateral deployment and militarisation? [Linda Schneider, Germany]	Noted, it is arguable. "SRM may be compatible with democratic processes (Horton et al., 2018) or not (Szerszynski et al., 2013; Owen, 2014)."
52174	42	49	42	53	Explain the acronyms here. [Jason Donev, Canada]	Accepted

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55732	42	49	42	54	Note: (1) Bodle 2012 does not "confirm" that these organizations coiuld paly a role in governance of RMMs, rather Bodle et al 2012 note that each of these orgawnizations and otehrs has relevance with respect to the regulatory framework. (2) the CBD Conference of the Parties has adopted guidance that invites Parties to ensure in the absence of science based, global, transparent and effective control and regulatory mechanisms for that no climate-related geo-engineering activities that may affect biodiversity take place, until there is an adequate scientific basis on which to justify such activities and appropriate consideration of the associated risks for the environment and biodiversity and associated social, economic and cultural impacts, with the exception of small scale scientific research studies that would be conducted in a controlled setting in accordance with Article 3 of the Convention, and only if they are justified by the need to gather specific scientific data and are subject to a thorough prior assessment of the potential impacts on the environmen [David Cooper, Canada]	Accepted (1) - clarifications added. Noted (2) - we are very limited in space and can't write the decision of CBD in full, but we referred to this. We added the first part of the guidance: "The UNCBD gives guidance that 'that no climate-related geo-engineering activities that may affect biodiversity take place' (UNCBD, 2010). "
4544	42	51	42	53	This is a somewhat imprecise summary of CBD decision X/33. In addition to the need for an "adequate scientific basis", reference to "control and regulatory mechanisms" should possibly be made. In addition, "warning against any actions..." could probably be replaced with "recommends not to take any actions". In my view, this would be the shortest way to summarize what is otherwise a rather unwieldy COP decision. [Florian Rabitz, Lithuania]	Accepted, text revised
5124	42	52	42	53	It is not at all clear that RMM would cause any harm to biodiversity--indeed, the whole purpose of RMM is to offset the harm that ongoing global warming will be doing to biodiversity in the absence of RMM. Basically, the whole argument here (and consideration of RMM on this point) has been backwards--RMM would tend to preserve biodiversity, especially given the overshoot conditions that are looking increasingly likely. [Michael MacCracken, United States of America]	Noted, we are citing the decisions of CBD
1058	42	53	42	53	The claims of Szerszynski et al. (2013) and Owen (2014) are highly speculative. If they are mentioned, then the counterclaims made in Horton et al, "Solar Geoengineering and Democracy," Global Environmental Politics, accepted and forthcoming, should be mentioned [Jesse Reynolds, Netherlands]	accepted, Horton 2018 cited, text revised: "..and that SRM is compatible with democratic processes (Horton et al., 2018) or not (Szerszynski et al., 2013; Owen, 2014). "
5126	42	53	42	54	It is rather strange to be picking out RRM for this comment, given how the release of GHGs and limited mitigation efforts seem to be going on in spite of or perhaps it is because of democratic processes. Aside from the word "may" allowing any possible interpretation of this sentence (making it really meaningless in an assessment document), the notion that a democratic process is the universal way in which world decisions get made seems overly idealistic and certainly not how other of history's decisions that have saved the planet from potential destruction have been made, and have had to be made. Without context, I don't see how this sentence at all advances understanding and consideration of the issue. [Michael MacCracken, United States of America]	Taken into account, text revised
37286	42	53	42	53	The text cites Szerszynski et al. 2013 and Owen 2014 arguing that RMM may be incompatible with democracy, but this view is strongly contested, e.g., Horton et al., 2018. Arguments for incompatibility are based on specific, implicit assumptions about technology and politics, and claims to this effect do not stand up to critical scrutiny. [Joshua B. Horton et al., "Solar Geoengineering and Democracy," Global Environmental Politics (forthcoming)] [Joshua Horton, United States of America]	accepted, Horton 2018 cited, text revised: "..and that SRM is compatible with democratic processes (Horton et al., 2018) or not (Szerszynski et al., 2013; Owen, 2014). "
37482	42	53	42	53	Add counterarguments made in Horton et al., 2018 Reference: Horton et al, "Solar Geoengineering and Democracy," Global Environmental Politics, forthcoming [Matthias Honegger, Germany]	accepted, Horton 2018 cited, text revised: "..and that SRM is compatible with democratic processes (Horton et al., 2018) or not (Szerszynski et al., 2013; Owen, 2014). "
54054	42	53			Add after "can justify such activities" and the impacts on biodiversity and related livelihoods are taken into consideration [Elenita Daño, Philippines]	Noted, we are very limited in space and can't include this additional information. But, it is assumed, of course that if CBD would allow for SRM then impacts on biodiversity and related livelihoods are taken into consideration
30632	43	1	43	18	This section leaves the impression that costs and technical constraints do not constitute a major barrier to implementation notwithstanding the acceptability or issues around governance. [France]	Noted, we are assessing SRM feasibility from different points of view. While SRM is likely to be technically and economically feasible, "the combined uncertainties surrounding the various SRM approaches, including technological maturity, physical understanding, potential impacts, and challenges of governance, constrain the ability to implement SRM in the near future."
34250	43	1	43	13	When discussing economic feasibility of SRM, it states that cost effectiveness may be high. It is important to note the cost effectiveness of SRM compared to mitigation technologies depends heavily on the time horizon over which annualized costs are calculated. With many mitigation technologies the upfront costs are high but decrease following deployment, whereas SRM would require continual application to maintain effectiveness. Therefore SRM annual costs may be in perpetuity or until additional mitigation action was taken, at additional cost. The timescale on which to assess annual costs is therefore critical - the annualized cost to deploy mitigation technologies up to 2050 may be higher than to deploy SRM, but if a longer timescale is used - to 2100 or beyond - annualized costs for mitigation may be lower than SRM in perpetuity. It would be worth looking into the literature on this, or at least noting this issue. [Joe Thwaites, United States of America]	Noted, some of the cited papers calculate SRM cost up to 2100 and came up with conclusion that it is cheaper then mitigation even in such timescales. Here we can't have a discussion you proposed because o space limitations, so we just mention technical annual cost which appears in the literature: "There is high agreement that cost of SAI (not taking into account indirect and social costs, research and development costs and monitoring expenses) may be in the range of 1–10 billion USD yr–1 for injection of 1–5 MtS to achieve cooling of 1–2 W m–2 ".
51218	43	1	43	13	But indirect and social costs, and costs from damages inflicted, must be part of the picture! Otherwise the account makes for an incomplete and skewed picture of the real risks and costs of this technology. [Linda Schneider, Germany]	Taken into account partly, we say: "The overall economic feasibility of SRM also depends on externalities and social costs (Moreno-Cruz and Keith, 2013; Mackerron, 2014), climate sensitivity (Kosugi, 2013), option value (Arino et al., 2016), presence of climate tipping points (Eric Bickel, 2013) and damage costs as a function of the level of SRM (Bahn et al., 2015; Heutel et al., 2018)." But we are assessing existing literature in this field and provide with information which is possible to find there
55106	43	1	43	8	In this section, as per the title, we are expecting some assesmment of the econoic feasibility, but the section only talk about the technicality. [Yamide Dagnet, United States of America]	Noted, as was mentioned in the text "The overall economic feasibility of SRM also depends on externalities and social costs (Moreno-Cruz and Keith, 2013; Mackerron, 2014), climate sensitivity (Kosugi, 2013), option value (Arino et al., 2016), presence of climate tipping points (Eric Bickel, 2013) and damage costs as a function of the level of SRM (Bahn et al., 2015; Heutel et al., 2018)."
1060	43	2	43	2	It is unclear what "real world" means. There have been costing studies, some of which are cited here. These studies refer to our real world. [Jesse Reynolds, Netherlands]	Accepted, text revised, changed to "..and may be unreliable in the absence of testing or deployment. "
37288	43	2	43	2	An exception is the study by McClellan et al. (2012), which provides rather detailed estimates for delivering 1–5 million metric tonnes (Mt) of albedo modification material to altitudes of 18–30 km. [McClellan, J., Keith, D.W., Apt, J., 2012. Cost analysis of stratospheric albedo modification delivery systems. Environ. Res. Lett. 7, 034019.] [Joshua Horton, United States of America]	Taken into account. Sentence has been reworded: "The literature on engineering cost of SRM is limited and may be unreliable in the absence of testing or deployment"

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37484	43	2	43	2	What would "real world costing studies" mean exactly? There have been costing studies, some of which are cited here. These studies refer to our real world. If you mean to say "such studies can prove unreliable in the absence of testing at scale or small-scale deployment" I would agree and suggest to add reference to (Honegger and Reiner, 2018). Reference: Honegger, M. & Reiner, D. (2017). The political economy of negative emissions technologies: consequences for international policy design. Climate Policy, 18 (3), 306-321. [Matthias Honegger, Germany]	Accepted, text revised, changed to "..and may be unreliable in the absence of testing or deployment. " Proposed reference is mostly about NETs, but not SRM, so we do not include this
5128	43	3	43	7	Note that the cost estimates done have not really been for a peak-shaving effort, which would hopefully be smaller than the effort costed here. The part of the sentence suggesting that "side-effects are low are neglected" is a very strange way of putting what has been left out, which are the avoidance of very large impact costs that would occur and grow for a very long time (e.g., in the case of sea level rise) were RMM not done. I do accept that it might well be hard convincing people of the benefits of RMM that would result because the impacts would not be occurring and so might be seen as hypothetical instead of real (sort of like the benefits or the fencing around the observatory of the Empire State Building, which involve not having the losses that would occur were there no fencing). I would just suggest that the phrasing of this sentence is quite strange given the impacts that would be avoided by going forward with RMM. Without such consideration, the presentation here seems rather one-sided. [Michael MacCracken, United States of America]	noted, yes, we presented estimates done not for the peak-shaving effort, but indicate for how much cooling (1–2 W m–2) these values are. There are no studies with cost estimates for the peak-shaving scenario
61990	43	3	43	3	Avoid acronyms (e.g. SAI) used only a few times and not introduced [Valérie Masson-Delmotte, France]	Taken into account. SAI was introduced in Table 4.7
61050	43	4	43	7	What is the equivalent USD/tCO2e cost-effectiveness to achieve a similar effect on radiative forcing that could be compared to standard mitigation measures? [United States of America]	Noted, this section is about SRM and its feasibility, we can't provide here with information reviewer asked for because it is beyond the scope of this report
2104	43	5			cite hunt's work http://rsta.royalsocietypublishing.org/content/370/1974/4263 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	taken into account, Davidson et al. 2012 is cited in the paragraph below: "For SAI, there is high agreement that aircrafts after some modifications could inject millions of tons of SO2 in the lower stratosphere (~20 km; (Davidson et al., 2012; McClellan et al., 2012; Irvine et al., 2016)."
2106	43	5			such studies generally do not price for redundancy/overcapcity - this ommission is not noted or calculated. Costs of providing security (eg fighter escorts, base defence) are also not priced. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted
5130	43	7	43	10	Is this not the case across virtually all consideration of the climate change issue? Why pick these out for RMM when they apply more generally, and I would suggest would be likely to be much more serious for the situation of not invoking RMM. I just do not understand this evaluation of RMM outside the context of the overall situation being faced and think a much more comprehensive persentation of the situation (dilemma) that we face is needed. [Michael MacCracken, United States of America]	Noted, we can't evaluate SRM impacts in comparison with climate change effects itself (although this would be useful), almost all studies assess SRM as an option itself when talking about negative impacts
19690	43	7	43	7	…cost effectiveness may be high IF [rather than when] side effects are low or neglected' - once again this is simply one assumed condition rather than definitive outcome. [Jennifer Morgan, Netherlands]	accepted, text revised
37290	43	7	43	7	Externalities and social costs are accounted for in the integrated assessment models by postulating that the damage costs are an increasing function of the level of RMM (Bahn et al. (2015), Goes et al. (2011), Gramstad and Tjøtta (2010), Heutel et.al. (2015)). Studies agree that the uncertainty in the RMM side-effects defines whether RMM passes the cost-benefit test. Yet, RMM may prove highly advantageous when climate tipping points are accounted for (Bickel (2013)). [Bahn, O., Chesney, M., Gheyssens, J., Knutti, R., Pana, A.C., 2015. Is there room for geoengineering in the optimal climate policy mix? Environmental Science & Policy 48, 67– 76. Eric Bickel, J., 2013. Climate engineering and climate tipping-point scenarios. Environment Systems & Decisions 33, 152?167. Gramstad, K., Tjøtta, S., 2010. Climate engineering: cost benefit and beyond (MPRA Paper). University Library of Munich, Germany. Goes, M., 2011. The economics (or lack thereof) of aerosol geoengineering. Climatic Change. Heutel, G., Cruz, J.M., Shayegh, S., 2015. Solar Geoengineering, Uncertainty, and the Price of Carbon. National Bureau of Economic Research, Working Paper Series 21355.] [Joshua Horton, United States of America]	accepted, text revised, two of proposed reference (Bahn et al. 2015; Bickel 2013) added
53920	43	7	43	7	Before "The overall economic feasibility of RMMs also depends on...", a sentence stressing the losses caused by RMM by reducing PV-based electricity production, which begins to be a highly relevant component of the (intra-day and overall) electricity mix in many countries should be inserted. [Valentino Piana, Italy]	Noted, we discussing SRM as a peak-shaving measure. The effect mentioned by reviewer will be low in this scenario
31542	43	9	43	9	There are important studies using IAMs to assess the economic values of SRM. Therefore, we recommend inserting "except for Kosugi, (2013) and Arino et al., (2016)" just after "integrated assessment models". Also the two studies need to be added to Reference. Kosugi, T. (2013). Fail-safe solar radiation management geoengineering. Mitig Adapt Strategies Glob Change 18, 1141–1166. doi:10.1007/s11027-012-9414-2 Arino, Y., Akimoto, K., Sano, F., Homma, T., Oda, J., and Tomoda, T. (2016). Estimating option values of solar radiation management assuming that climate sensitivity is uncertain. Proceedings of the National Academy of Sciences, 113(21), 5886–5891. doi:10.1073/pnas.1520795113 [Japan]	Noted, references added. "The overall economic feasibility of SRM also depends on externalities and social costs (Moreno-Cruz and Keith, 2013; Mackerron, 2014), climate sensitivity (Kosugi, 2013), option value (Arino et al., 2016), presence of climate tipping points (Eric Bickel, 2013) and damage costs as a function of the level of SRM (Bahn et al., 2015; Heutel et al., 2018)."
37478	43	9	43	9	Important reference regarding non-deployment costs: Parker and Irvine, 2018 Reference: Parker, A., & Irvine, P. (2018). The risk of a termination shock from solar geoengineering. Forthcoming in Earth's Future. [Matthias Honegger, Germany]	Take into account, it is cited in the Cross-Chapter Box 10 part B
5132	43	11	43	13	What is needed is a comprehensive analysis of the overall situation, considering the relative benefits and costs for different degrees of all possible approaches along with the associated impacts, including long-term implications. Clearly, this is a very difficult challenge whether RMM is included or not, and picking out RMM for this statement seems to me inappropriate, especially given the time scales involved and what future generations will make of our actions (should they just be based on economics; is the sutainability question just economics; and so on). It does not seem to me that making this point just for RMMs really makes clear the overall context for the decisions that need to be made, and this just has to be done better here. [Michael MacCracken, United States of America]	Noted, but we based our assessment on existing studies
2108	43	15			outdated. Condensing plumes are now favoured https://link.springer.com/chapter/10.1007/978-1-4614-5770-1_3 - http://eprints.uni-kiel.de/41466/ [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, but most of the references mentioned SO2 as a precursor

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5134	43	15	43	18	The estimate of an possible amount is based on thinking about an emergency response type of application, which seems far less plausible and useful than a peak-shaving application that might start by injecting just enough to offset the cumulative warming influence for one year at a time and gradually building up. It just seems to me that inadequate context is given of possible approaches for using RMM and the whole section just has to be redone, providing more context. [Michael MacCracken, United States of America]	Noted, figure 1 of the Cross-Chapter Box 10 how that we are talking about peak-shaving application. This report only considers limited SRM in the context of mitigation pathways to 1.5°C. The sentence which was commented by reviewer was shorten: "For SAI, there is high agreement that aircrafts after some modifications could inject millions of tons of SO2 in the lower stratosphere (~20 km; (Davidson et al., 2012; McClellan et al., 2012; Irvine et al., 2016)". Is s fact which is not depended on the type of application, this is just aircraft capability
7760	43	15	43	16	extra parenthesis and missing space. [I have omitted many other orthographic corrections on the assumption that this report will be copy-edited.) [Amory Lovins, United States of America]	Noted
7950	43	16	43	16	Replace "highagreement that aircrafts" with "high agreement that aircraft" [Christopher Bataille, Canada]	Accepted.
28586	43	16	43	16	What exactly is meant by "aircrafts COULD inject...". Is this really a proven concept considering all aspects of infrastructure, finance, governance & management - on the long run? Or a hypothesis? Please specify and provide references for your statements. [Germany]	Accepted, we added "after some modifications", references here: (Davidson et al., 2012; Irvine et al., 2016; McClellan et al., 2012).
5734	43	16	43	18	There is highagreement that aircrafts could inject the millions of tons of SO2 needed in the lower stratosphere (~20 km or 60 hPa) (Davidson et al., 2012; Irvine et al., 2016; McClellan et al., 2012). This contradicts the comments on lines 2-3 that there are no real-world studies. We learned at the Climate Engineering Conference in Berlin in Oct. 2017 that it will not be possible to refit existing aircraft (not "aircrafts") with new wings or engines, and a whole new class of planes will have to be invented. Although these papers speculations agree, they are probably wrong. [Alan Robock, United States of America]	Taken into account. We based our research on existing peer-reviewed literature on this field. But we revised text and added "after some modifications": "For SAI, there is high agreement that aircrafts after some modifications could inject millions of tons of SO2 in the lower stratosphere (~20 km; (Davidson et al., 2012; McClellan et al., 2012; Irvine et al., 2016)."
52176	43	16	43	16	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Noted.
38624	43	17	43	17	needed for what? [Jan Fuglestvedt, Norway]	Accepted, word deleted
47158	43	17	43	17	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted
40366	43	21			Geoethics is very important to be added at this point [Jonathan Gómez Cantero, Spain]	noted, it is not very clear what reviewer mean by geoethics
40394	43	21	43	35	In this part of the chapter, when any reference is made to the rights of non-human species, the concept of «interspecies justice» should also be included, in order to emphasize the necessity of a balance along the continuous changing relations between human and non-human actors. [Erick Pajares, Peru]	Noted, we are very limited in space and can't include such details
48326	43	21	43	28	Another relevant reference about justice is Gardiner (2011). Paragraph (lines 21-28) should include it: "4.3.9.3 Social acceptability and ethics Key ethical questions discussed in the research literature include those of international responsibilities for implementation, financing, and compensation for negative effects, the procedural justice questions of who is involved in decisions, privatisation and patenting, informed consent by affected publics, intergenerational ethics (because RMMs require sustained action in order to avoid termination hazards), the rights of non human species, Indigenous peoples and women, and the so-called 'moral hazard' that RMMs could reduce mitigation and adaptation efforts (Buck et al., 2014; Burns, 2011; Gardiner, 2011; Morrow, 2014; Whyte, 2012; Wong, 2014) (Suarez and van Aalst, 2017)." The full citation is: Gardiner, S. M. (2011). Climate justice, in The Oxford handbook of climate change and society, eds. J. Drzyek, R. Norgaard and D. Schlosberg (Oxford: Oxford University Press), 309-322. [Miriam Solera Ureña, Germany]	Noted, we are very limited in space and can't include all references. Moreover proposed reference is not recent - 2011. We tried to focus on literature after AR5 (2013).
61052	43	21	43	35	Not clear why ethics concerns only apply to RMM. Shouldn't they be considered for all CDR? [United States of America]	Rejected – the CDR section is in 4.3.7 and already includes an assessment of the CDR-relevant ethics literature.
61054	43	21	43	52	This section could be condensed. [United States of America]	noted, but we also have got comments about inclusion of new material here, which will expand section
2112	43	22	43	27	sentence is so large it is in danger of collapsing into a black hole. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, revised
5136	43	22	43	29	This quite long list leaves out the key ethical question of the value of avoiding the very serious prospective impacts of climate change and the ethical questions around not taking action as opposed to taking action. Is the world going to stand by and allow some regions to become virtually uninhabitable without trying to avoid that situation, to allow many island nations and low lying areas to be inundated with increasing rates of sea level rise without having taken actions to try to limit the rate of sea level rise, and so on? I think such questions will far override the questions and issues raised in the current phrasing. Are we really going to let some of the arguments listed in the text prevent us from taking actions that would moderate the impacts (or moderate many impacts, not all, for many people, perhaps not all)? This seems to me a much more important question (although given how the US Congress is functioning right now, it may be that the focus will indeed be on the issues raised in the text rather than the more survival based issues that I suggest merit top-level attention). For a scientific assessment, it seems to me it must raise the really crucial issues. [Michael MacCracken, United States of America]	Noted, although questions listed by reviewer seems to be important they do not mentioned in the literature which we have to assess
33112	43	22	43	28	add references to human rights. By respecting procedural and substantive rights (as per the Paris Agreement preamble) the risks of moral hazard are reduced. For example in the case of wpomen's participation see: Mary Robinson Foundation – Climate Justice (2015c) Women's participation: An enabler of Climate Justice. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-_Womens-Participation-An-Enabler-of-Climate-Justice_2015.pdf [Tara Shine, Ireland]	Noted, thank you for the reference but it is not in peer-reviewed journal, so we will not include this, also because of space limitations. Corresponding sentence was revised: "Unequal representation and deliberate exclusion are plausible in decision-making on SRM, given diverging regional interests and the anticipated low resource requirements to deploy SRM (Ricke et al., 2013). Whyte (2012) argues that the concerns, sovereignties, and experiences of Indigenous peoples may particularly be at risk. "
1062	43	23	43	23	For compensation for negative effects, see Reynolds, Jesse L. "An Economic Analysis of Liability and Compensation for Harm from Large-Scale Field Research in Solar Climate Engineering." Climate Law 5.2-4 (2015): 182-209. [Jesse Reynolds, Netherlands]	Accepted, we added the citation to list that begins with Buck. But we do not have space to discuss the nuances from the article.
1064	43	24	43	24	For patenting and privatization, see Reynolds et al., "Intellectual property policies for solar geoengineering," WIREs Climate Change, accepted and forthcoming. [Jesse Reynolds, Netherlands]	Accepted, we added the citation to list that begins with Buck. But we do not have space to discuss the nuances from the article.
2114	43	26			reads like a social justice virtue signalling exercise. No known evidence that SRM will disproprotionately harm women, or even indigenous peoples. Far more likely to REDUCE harms, by controlling climate change. For clarity, a lack of procedural representation does not equate to an increased likelihood of harm. http://www.tandfonline.com/doi/abs/10.1080/21550085.2014.926078?src=recsys&journalCode=cepe21 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, "the rights of non-human species, Indigenous peoples and women" removed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7270	43	26	43	26	Kahan et al. (2012, 2015) have shown the opposite of a moral hazard problem. [Ben Kravitz, United States of America]	Taken into account, text revised: 4.3.8.3: "The literature shows low agreement on whether SRM research and deployment may lead policy-makers to reduce mitigation efforts and thus imply a moral hazard (Linnér and Wibeck, 2015)". We cannot include more references because of space limitations.
9498	43	26	43	26	Unclear to me why "indigenous peoples and women" aren't part of "affected publics". Does that mean that "affected publics" only include men and those whose ancestors came from a different continent? [Douglas MacMartin, United States of America]	Taken into account, text revised: "Unequal representation and deliberate exclusion are plausible in decision-making on SRM, given diverging regional interests and the anticipated low resource requirements to deploy SRM (Ricke et al., 2013). Whyte (2012) argues that the concerns, sovereignties, and experiences of Indigenous peoples may particularly be at risk. "
37292	43	26	43	26	Literature review on the interaction of RMM with mitigation is missing. The combination of mitigation and RMM is projected to achieve a larger reduction in negative impacts of climate change than either approach separately (Wigley 2006). [Wigley, T.M.L., 2006. A Combined Mitigation/Geoengineering Approach to Climate Stabilization. Science 314, 452?454. https://doi.org/10.1126/science.1131728] [Joshua Horton, United States of America]	Noted, this reference argues that SRM should be assessed as a supplement to mitigation. We underline this in the beginning of 4.3.8: "Literature only supports SRM as a supplement to deep mitigation, for example in overshoot scenarios (Smith and Rasch, 2013; MacMartin et al., 2018). "
2110	43	27			Lockley and Coffman distinguish moral hazard (malfesance) from morale hazard (recklessness). This has been overlooked. http://journals.sagepub.com/doi/abs/10.1177/1461452916659830 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, we added the citation to list that begins with Buck. But we do not have space to discuss the nuances from the article.
47944	43	28	43	28	Kindly check: Suarez and van Aalst, 2017 not available in the reference list. [Sarah Connors, France]	accepted, reference added
54056	43	28	43	35	Delete whole sentece that says that literature show "low agreement" on moral hazard. This is a unsubstantiated statement based on a poor and biased selection of literature reiewed. Also, delete the the whole sentece that refers to "empirical evidence" and individuals, because it is even more limited. As this is a paragraph of SOCIAL ACCEPTABILITY, please include "Civil society and indigenous peoples´organizations have clearly rejected all forms of geoengineering, both SRM adn CDD" Ref: Geoengineering Monitor http://www.geoengineeringmonitor.org/ ; Heinrich Boell Foundation, Biofuelwatch, ETC Group http://www.etcgroup.org/content/big-bad-fix [Elenita Daño, Philippines]	Noted, some papers have shown the opposite to the moral hazard problem. There are some paper in peer-reviewed journals which do not prove this, so agreement is low. Proposed reference is a grey literature which is not from a peer-reviewed journal, so we should not include this. Proposed sentence "...Civil society and indigenous peoples" is not supported by peer-reviewed literature
56992	43	28	42	31	I wonder if it might be helpful specifically to link this discussion to the earlier discussion of moral hazard in CDR? [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted, section 4.3.7. just mentioned moral hazard in the Table 4.6. There is no need to refer there, because 4.3.8.3 has more comprehensive discussion.
5138	43	29	43	35	Again, context is needed. There is no indication that policymakers are committing to enough action now (or in the near future) to prevent a catastrophic overshoot of the goal that they set. It is just simply not the case that enough is being done now to save what can be saved of the environment that the world depends on. Are we to really forego an approach that has the real possibility of helping for at least a bit of time because the policymakers and nations will do even less and so presumably shorten the time for catastrophic effects from five to four decades, say. It is my general unwillingness to put all my hopes into what mitigation can do for us that I am urging a much more balanced consideration of the potential role of RMM (plus my view that the decision to set the temperature increases ceiling--and by assumption it seems the long term equilirbium level--at 1.5 to 2 C is simply ill-informed in terms of its scientific implications and was politically rather than scientifically based). It seems to me that this slippery slope argument just fails to take account of the blinders on the part of at least some of the most important decision makers (the US Government being one, having been too slow to come to the table even before Trump got up and left) for the past several decades and there is no no alternative to considering an option we would all like to have avoided, but are now left with a situation where RMM is essential in order to essentially lose the global environmental conditions on which global society depends (which a 2-3 C rise would almost certainly cause for a large fraction in the world). [Michael MacCracken, United States of America]	Taken into account partly. The report is saying :There is agreement in the literature reviewed by Chapter 2 that staying below 1.5°C would entail significantly greater transformation in terms of energy systems, lifestyles and investments patterns compared to 2°C-consistent pathways. Yet there is limited evidence and low agreement regarding the magnitudes and costs of the investments (Sections 2.5.1, 2.5.2 and 4.4.5). " I the section 4.3.8. we are doing an assessment of literature, available for SRM and such issues as moral hazard and slippery slope are discussed there, so we can't ignore them. But we mentioned possible benefits of SRM too: "SRM could reduce some of the global risks of climate change related to temperature rise (Izrael et al., 2014; MacMartin et al., 2014), rate of sea level rise (Moore et al., 2010), sea-ice loss (Berdahl et al., 2014) and frequency of extreme storms in the North Atlantic and heatwaves in Europe (Jones et al., 2018). "
39248	43	29	43	29	Linked to RMM pssoibly resulting in reduced mitigtation action, note this pattern of reduced mitigation efforts and RE investment is already visible in countries which are embracing CCS as integral to policy (United Kingdom 2017). [Lindsey Cook, Germany]	noted, interesting fact, but where to find reference for this?
1066	43	33	43	34	Corner and Pidgeon 2014 did not ask whether considering RMM would cause people to change their GHG emissions. They asked whether they agreed with a concern that considering RMM would cause a decrease in *total* GHG emissions. The difference is subtle but important. People often have different views of others' behavior than of their own. [Jesse Reynolds, Netherlands]	Accepted, text here was revised
37488	43	33	43	34	Inaccurate reference for this; Corner and Pidgeon 2014 find that people are concerned about the possibility that considering RMM would cause a decrease in total GHG emissions reductions efforts. They did not seek evidence that would fit this sentence. [Matthias Honegger, Germany]	accepted, text here was revised
19142	43	34	43	35	This is only half of the message of the paper. We theorize the “slippery slope” and “moral hazard” arguments but also show that a rational SRM research ban would require special conditions of time-inconsistent preferences and low prudence. The overall conclusion is that it generally makes sense (economically-speaking) to perform the research. [Olivier Boucher, France]	taken into account, we have added new references and reworded the text. But we can't have a long discussion here because space limits
2116	43	35			speculative, include counterpoint. Slippery-slopes are often fallacious - see this kids' resource for an explanation http://www.softschools.com/examples/grammar/slippery_slope_examples/391/ [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted, it is established term, very often mentioned in the literature
37490	43	35	43	35	add: though others also find a indications of the opposite effect (Bellamy and Healy, 2018) Bellamy, R., & Healey, P. (2018). ‘Slippery slope’or ‘uphill struggle’? Broadening out expert scenarios of climate engineering research and development. Environmental Science & Policy, 83, 1-10. [Matthias Honegger, Germany]	accepted, text revised, reference added
41684	43	35	43	35	The idea that SRM research would lead to a 'slippery slope' to deployment is challenged by Parker A. 2014 Governing solar geoengineering research as it leaves the laboratory. Phil. Trans. R. Soc. A 372: 20140173. http://dx.doi.org/10.1098/rsta.2014.0173 [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	accepted, text revised, reference added
1068	43	37	43	40	Ricke et al 2013 did not show that there are strategic incentives to form exclusive coalitions. Instead, this was an *assumption* of their paper. Therefore, unequal representation and deliberate exclusion are not necessarily to be expected. [Jesse Reynolds, Netherlands]	accepted, we revised text here a bit: "Unequal representation and deliberate exclusion are plausible in decision-making on SRM, given diverging regional interests and the anticipated low resource requirements to deploy SRM (Ricke et al., 2013)."
1070	43	37	43	38	Lack of transparency is largely independent of the coalition size. A large coalition can have opaque decision making, and a small one can be transparent. [Jesse Reynolds, Netherlands]	accepted, text revised
2118	43	37	43	40	highly theoretical - in reality, much more likely that potentially-disadvantaged states would have many levers to influence power bloc policy. Pro-consensus norms are likely to arise, as a result of the extreme low cost of intervention (free driver) creating an escalation risk for any state breaking consensus norms - echoing nuclear-MAD [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, we are assessing existing literature. Text has been revised to: "Unequal representation and deliberate exclusion are plausible in decision-making on SRM, given diverging regional interests and the anticipated low resource requirements to deploy SRM (Ricke et al., 2013)."

Comment No	From Page	From Line	To Page	To Line	Comment	Response
3776	43	37	43	41	These lines hint at the possibility that there are individuals, groups, even countries, for whom a rise in temperature has beneficial effects. Unfortunately, the report never discusses the potential benefits of temperature rising (such as access to alternative trade routes and resources, higher costs for economic competitors, etc.) – neither here nor in the many other subsections where this would be appropriate, given the importance attached (p.11 l. 4) to political and social acceptability and other conditions for feasibility. [Marcel Wissenburg, Netherlands]	Noted, benefits of temperature rising is beyond of the topic of this section, here we assessing the feasibility, from an institutional, technological, economic and social-cultural viewpoint, focusing on Stratospheric Aerosol Injection (SAI).
9496	43	37	43	37	to be expected seems a bit strong considering the complete lack of evidence available today. How about "plausible". [Douglas MacMartin, United States of America]	accepted, text revised
5140	43	37	43	40	This discussion seems to infer that a few parties could do something that would only help them, which is simply not at all clear. In addition, given that all major powers have a global economic footprint (at least), the idea that one would act to leave the rest of the world behind seems overly proviincial. If the rate of seal level rise can be slowed, this would benefit all--no one gains from sea level rise, especially rapid sea level rise. I don't think any country really gains from an increase in the global average temperature or from an expansion of the subtropics. I just don't think that a good case has been made for why a country would try to act on its own even if this would be possible, and this also goes for individuals. [Michael MacCracken, United States of America]	noted, but we are assessing existing literature in this field. Text has been revised to: "Unequal representation and deliberate exclusion are plausible in decision-making on SRM, given diverging regional interests and the anticipated low resource requirements to deploy SRM (Ricke et al., 2013)."
37294	43	37	43	37	The cited paper does not draw this conclusion: "Lack of transparency, (...unequal representation and deliberate exclusion are) to be expected in decision-making on RMMs". [Joshua Horton, United States of America]	accepted, text revised
37492	43	37	43	40	Wording is way (!) too strong here. Rephrase "The possibility of lack of transparency, unequal representation and deliberate exclusion are a possibility and concern. Explanation: The incentives are a function of regional effects of SRM/RMM and geopolitics; the former are in addition a function of the deployment scenario; there is no concensus on what is a likely deployment scenario, therefore there is no strong indication of what types of strategic incentives could arise. Ricke et al 2013 did not show that there are strategic incentives to form exclusive coalitions. Instead, this was an *assumption* of their paper. Therefore, unequal representation and deliberate exclusion are not necessarily to be expected. [Matthias Honegger, Germany]	taken into account partly, text was revised here, "to be expected" was replaced by "are plausible".
51220	43	37	43	41	If "[l]ack of transparency, unequal representation and deliberate exclusion are to be expected in decision-making on [SRM]", then the IPCC should draw the appropriate consequences from this analysis and exclude SRM as an irresponsible and unjustifiable option. [Linda Schneider, Germany]	noted, we can't exclude this because it exists as a potential measure in the scientific literature and IPCC have to do an open and transparent assessment and excluding any measure for such reasons would be prescriptive. We did revise text here.
5142	43	40	43	41	If there is a group that would be expected to most want the climate to stay at its preindustrial state, it would seem to be the Indigenous Peoples, who traditionally have gathered their food and focused their cultures on living with the natural (and so given the Holocene has been thousands of years long and pretty stable), so preindustrial climate. Indeed, uncontrolled climate change puts all of their culture and Traditional Knolwedge and experience and skills not only at risk, but out of existence, disrupting the value of elder wisdom and more. Yes, taking one action to offset another might well be seen as going against their culture, but it is what is needed. At least in North America, the American Indians used fire to mold the landscape to promote their needs--the notion that they would simply sit by and let whatever happens happen without taking actions they could does not seem to me to be less consistent with their culture than sitting still and dying as the climate shifts over them. I, for one, would welcome their involvement, even to the extent of casting out of the decision making process that who were the creaters of the problem we face. [Michael MacCracken, United States of America]	noted
37494	43	41	43	41	Again, too definitive for a single reference to a speculative paper: "may particularly be at risk" [Matthias Honegger, Germany]	accepted, text revised
7342	43	43	43	52	This paragraph largely ignores recent development with small N studies, including Wibeck et al. (2017) (http://doi.org/10.1007/s10584-017-2067-0) and Asayama et al. (2017) (http://dx.doi.org/10.1016/j.geoforum.2017.01.012). Asayama et al. (2017) mostly echo the findings of Bellamy et al. (2017), but an assessment should be based on multiple lines of evidence (even for small N studies). [Masahiro Sugiyama, Japan]	Accepted, we added Wibeck et al. Asayama et al was added to Cross-Chapter Box 10
5144	43	43	43	52	What is not clear from the studies in this area that I have seen is that the dilemma that society faces has been laid out fully and without starting with a description of RMM. Basically, what I think needs considerable social science effort on is to explain the situation with respect to emissions and climate change, to indicate how little mitigation to date has acheived and the great degree to which the world's economy (and so everyone's well being) is dependent on fossil fuels, how much must be done to transition even if we try and the costs and time for this and what will happen to the climate because of this, to then indicate how far there is to go before CDR can bring the problem under control, how the real need (based on paleo evidence) is to be at a global warming of only 0.5 C or less, and how far we are from this situation given the mitigation, CDR and adaptation options open to us. And then get to RMM and it having the potential, if researched and applied wisely, to shave peak warming down a bit using approaches that really are imitations of how Nature has cooled the planet in the past and done so with few side effects. And then ask if they really want to forego RMM or not and what the consequences and cost of each approach would be. Certainly, there will be a natural aversion to taking an additional action to try to offset the original action, but then perhaps a good analog is the landing of the plane in the Hudson River--does one not try to account for the failings of technology by responding (similarly with fire trucks to fires, etc.) or does one just let the world run over one without trying? Again, I just think the presentation of RMM in this section has seriously failed in presenting the context for the situation that we face and simply must do better. [Michael MacCracken, United States of America]	Taken into account, text has been revised significantly (in this section and in the cross-chapter Box 10) in order to present SRM and its potential in the more clear way.
37486	43	43	43	43	Add reference to (Tingley and Wagner, 2018) Tingley, D., & Wagner, G. (2017). Solar geoengineering and the chemtrails conspiracy on social media. Palgrave Communications, 3(1), 12. [Matthias Honegger, Germany]	rejected, we are very limited in space and can't a references which do not add much to assessment. This ref. would only support existing sentence and references.
40458	43	43	43	44	“There is some evidence that the public is confused and concerned about RMMs, with those in developing countries unaware of the issue ...” This is not accurate; there has been a lot of criticism to solar radiation management and radiation management measures coming from developing countries. (e.g. Bravo. 2013. “The Political Ecology of Geoengineering”. Letras Verdes. Revista Latinoamericana de Estudios Socioambientales, 14:358-63. https://doi.org/https://doi.org/10.17141/letrasverdes.14.2013.1009. and reference therein) [Pedro Alfredo Borges Landaez, Venezuela]	Accepted, "with those in developing countries unaware of the issue" removed
54058	43	43	43	44	Delete the whole first sentence in this para, incl reference. Again, limited narrow and biased reference. Public is not confused about SRM. Public is generally against SRM and geoengineering. A sentence in this sense can be added instead. [Elenita Daño, Philippines]	Noted. We are assessing published literature and cannot ignore what it says. Text revised to "The general public can be characterised as ignorant and worried about SRM (Carr et al., 2013; Parkhill et al., 2013; Wibeck et al., 2017). "
37480	43	44	43	44	Add at the end of the sentence: ",and the literature is limited to a small number of countries" [Matthias Honegger, Germany]	Rejected, no space for extra words. We have following text here: "An emerging literature discusses public perception of SRM, showing a lack of knowledge and unstable opinions (Scheer and Renn, 2014)"

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3952	44		81		The absence of the role of power and political economy is notable across the Chapter (see comment above), and is relevant in sections 4.4 (deserving of its own sub-section?) and 4.5. [Emily Tyler, South Africa]	Noted. Literature on the political economy is identified as a knowledge gap, particularly for adaptation. For mitigation, there was no literature, to our knowledge, on political economy of 1.5C, while there was lots that was only loosely related to 1.5C. Based on available literature some references have been made especially around adaptation options and in the ES, but for the remainder, the literature did not allow for a policy-relevant assessment.
6134	44	1			Section 4.4. has quite a different structure compared to the other sections of chapter 4 and large parts of the text is very generic. There is limited use of/referencing to section 4.4. in the subsequent section. [Anne Olhoff, Denmark]	Noted. See revisions in 4.4
10590	44	1	45	27	4.4 Implementing 1 far-reaching and rapid change. There are many short paragraphs with no clear connections and information flows. E.g., .' Public awareness and access to climate information is loosely linked to climate action, but can inform perceptions of climate risk and the capacity to respond (Lee et al., 2015). Where education and climate services inform women, they support an important component of an enabling environment for ambitious climate responses (Azeiteiro et al., 2017; Lutz and Muttarak, 2017; Wamsler, 2017).' It is not clear what is the key message here. [Hong Yang, Switzerland]	Noted. The section has been substantially revised and shortened with the intention of making Section 4.4.1 -4.4.6 flow better.
14112	44	1			Please review the use, or the omission, of the likelihood language in this chapter in order to improve coherence and confidence on statements. Especially when statements are suggesting causalities, sinergies and trade-offs. In many cases for this chapter it was difficult to analyze the relevance and coherence of the statements due to the lacking of likelihood languaje [Meimalin Moreno, Venezuela]	Noted. New synergies and trade-offs section introduced in 4.5.4
18626	44	1			Section 4.4. has quite a different structure compared to the other sections of chapter 4 and large parts of the text is very generic. There is limited use of/referencing to section 4.4. in the subsequent section. [Andrea TILCHE, Belgium]	Noted. See revisions in 4.4
32866	44	1	80	49	• Section 4.4. despite being devoted to implementing far-reaching and rapid change and looking at institutional capacities ignores the need for innovation and accelerating science and research capacities to support transformation. For a comment and a concrete proposal on this matter: Tàbara, J.D., Jäger, J., Mangalagiu D. & Grasso, M. 2018. Defining Transformative Climate Science in the context of high-end climate change. Regional Environmental Change. http://doi: 10.1007/s10113-018-1288-8 . In particular fostering distributed climate scientific and research assessment capacities and climate science innovations and cooperation, is especially needed in low-income countries, to help assess transformative solutions and supporting situated robust transformations. In Chp 4 the need for developing different kinds of science is only partially addressed with regard the topic of 'attribution science' in box 4.4., with regard to one sector –that of a possible 'urban science' or in terms of the effect of having increased computer capacity to support a Business-as-usual curiosity-driven / conventional science. But not as truly developing a fresh and integrated approach based on specific principles, new tools and methods (including ABM with heterogenous agents) and new forms of science interactions both internally and with regard to the science-policy interface-specifically accelerated global warming. [J. David Tabara, Spain]	Taken into account. Section 4.4.4 is devoted entirely to innovation, including innovation capabilities, and section 4.4.2 to institutional capacity. See also revisions to 4.4.5.2. The need for a different kind of science is not something that is widespread in the literature, as far as we could see.
57802	44	1	83	32	This section fails to recognize the well established capacity of national government to commit to the early retirement of capital. This failure is replciated by the assumptions in the IAMS. See for example, U.S. Energy Information Administration, 2018: Almost all power plants that retired in the past decade were powered by fossil fuels. https://www.eia.gov/todayinenergy/detail.php?id=34452 The EIA reports that "Nearly all of the utility-scale power plants in the United States that were retired from 2008 through 2017 were fueled by fossil fuels" and further reports that TThe U.S. has witnessed the retirement of 110 GW in electrical generating capacity since 2008. According to EIA, the factors influential in these retirements "include changes in regional electricity use, federal or state policies that affect plant operation, and state policies that require or encourage the use of certain fuels such as renewables." In addition, the EIA reports that "improving technologies also play a part in plant retirement decisions." [Hunter Cutting, United States of America]	Accept. More attention is now given to stranded assets and the potential government's role to address it (see 4.3 as well as 4.4.5).
61056	44	1	80	49	Section 4.4 seems to be extremely broad and general, and lacks focus. It would benefit from (1) significant streamlining and (2) a focus on what is relevant to 1.5°C pathways, rather than simply related to climate change in general. [United States of America]	Noted. See revisions to 4.4. This is constrained by the availability of underlying literature that is 1.5C-relevant.
61058	44	1	45	27	This section could be significantly shortened, for example by deleting the paragraphs at lines 15-36 and page 44 (line 52) to page 45 (line 8), and combining the last paragraph with the paragraph beginning at line 42 on page 4-44. [United States of America]	Accepted. The text has been significantly shortened.
46924	44	7	44	7	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
936	44	15	44	15	This coherencetypically' should be 'This coherence typically' [Robert Shapiro, United States of America]	Accepted
4546	44	15	44	28	The entire para is quite unclear and could possibly be streamlined. [Florian Rabitz, Lithuania]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
7952	44	15	44	15	Separate "coherencetypically" [Christopher Bataille, Canada]	Accepted
10100	44	15	44	28	It would be appropriate to note at this level that much of the literature assessed for this section is not 1.5c-specific but nevertheless is believed to be relevant to informing the transition to a 1.5c world. [Saudi Arabia]	Accepted. Text revised to include this perspective.
13352	44	15	44	15	coherencetypically needs space [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Accepted
30634	44	15	44	15	Typo: space missing between coherence and typically [France]	Accepted
31722	44	15	44	15	coherencetypically should be "coherence typically" [Michael SUTHERLAND, Trinidad and Tobago]	Accepted
32266	44	15			typo: coherencetypically [Jamaica]	Accepted
34628	44	15			Please change coherencetypically to coherence typically [Mexico]	Accepted
52178	44	15	44	15	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Accepted
55858	44	15	44	15	Space between coherence and typically [Debora Ley, Guatemala]	Accepted
56130	44	15	44	15	Insert a space between "coherencetypically" to get "coherence" "typically". [Emilie ALBEROLA, France]	Accepted
8372	44	17	44	19	The data involved here are not correct. It is suggested to verify them. The two consecutive sentences are not logically related, with the case being about Shenzhen and the data being about China. The word "decarbonisation" is not appropriate, which is suggested to be reworded as "Low carbon development". [China]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
58354	44	17	44	17	Suggest to add: "Better alignment across governance levels, as well as alignment of policy effects across sectors, is important to maximise the effectiveness of climate policies (OECD-IEA-NEA-ITF, 2015). [Andrew Prag, France]	Accepted. Text revised.
194	44	18	44	18	Coal comsumption increased by 2.0% in 2013 and recreaded by 2.0% in 2015 if applied recent China statistics. Data source? http://data.stats.gov.cn/easyquery.htm?cn=C01. [Mingshah Su, China]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
57356	44	22	44	23	Unclear sentence, specify "narrow alignment" [Hans Poertner, Germany]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
28588	44	24	44	27	This sentence is unclear and incoherent and that does not allow for grasping its key message. "not overly expensive to monitor governments" suggests a potentially sensitive content of the sentence, which the reader currently cannot understand. Please revise and clarify. [Germany]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.

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55108	44	30	44	55	This part is interesting but should include concrete examples. Also, there should be a sentence highlighting the need to create space to discuss this. [Yamide Dagnet, United States of America]	Noted. Text revised and significantly shortened. The need for discursive institutions is discussed under 4.1 and 4.3.
61060	44	33	44	36	Revise to read: "… required to build the capacity across scales of decisions required for the challenging and complex transitions …" [United States of America]	Noted. Text revised so as to reword this sentence.
62196	44	36	41	36	Locus or loci is a term used in genetics. The metaphor is maybe too difficult for this text... [Antoine Bonduelle, France]	Accepted
62200	44	36	44	36	The table is not balanced between new production technologies, efficient technologies, and behaviour . The latter should have more space in the table, including shared rooms in housing, for example. [Antoine Bonduelle, France]	Noted. The Table is taken on content described in Chapter 1, and now appears in section 4.5.1. Behaviour change is featured in section 4.4.3, but does not include the specific example due to policy prescriptiveness.
48230	44	40	44	40	Please integrate the two references (Cole, 2015a; Jordan et al. 2015), which have been published before the Paris Agreement, with these two analyses of the number of new laws on climate change before and after PA and of the interaction between the national level and the global negotiations: M. Nachmany et al., 2017; Lázaro-Touza L., 2018. The full quotes, in bibliography, are the following: M. Nachmany et al. (2017), 'Climate change laws of the world database', Grantham Research Institute on Climate Change and the Environment and Sabin Centre for Climate Change Law. Lázaro-Touza L., Climate change and COP23: urgency, exams, rules and the Talanoa spirit, Elcano Royal Institute, 2018. [Valentino Piana, Italy]	Noted, but regrettably it is too late to include grey literature.
14108	44	42	44	43	I suggest to eliminate the clarification within the parenthesis, in order to get a sentence a little more polite. Especially because in chapter 5 there are deeper discussions on this issue [Meimalin Moreno, Venezuela]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
45518	44	42	44	50	Isnt this Ch 5 material? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
8374	44	48	44	50	The phrase "everyday development failures" is hard to understand and is ambiguous, hence not suitable for use in an IPCC assessment report. At the same time, the statement does not mention the financial and technical support from developed countries, which is suggested to be supplemented. [China]	Accepted. It is a direct citation, but nonetheless the text revised (and significantly shortened) so as to exclude this sentence.
33114	44	49	44	50	see also: Robinson, M. & Shine, T. (submitted) Achieving a climate justice pathway to 1.5oC. Nature Climate Change. Mary Robinson Foundation – Climate Justice (2015a) Zero Carbon Zero Poverty the Climate Justice Way: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Available online at https://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Noted, but regrettably it is too late to include grey literature. This recommendation was made in the last round of comments and considered for inclusion the, but rejected based on content and emphasis on peer reviewed literature.
47946	44	49	44	49	Kindly check: Pelling et al., 2017 is not available in the reference list. [Sarah Connors, France]	Noted. Added to reference list.
14110	44	52	44	53	it is not clear the likelihood for this statement: "The potential for rapid and widespread climate responses is enhanced by mutually enforcing market instruments, regulations and standards and strategic investment, targeting different barriers to change (Grubb et al., 2014) - a point Campiglio (2016) and Winkler and Dubash (2015) reiterate in the specific contex of carbon pricing" [Meimalin Moreno, Venezuela]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence. The citations do appear in 4.1.
13186	44	54	44	55	Delete the text "- a point Campiglio (2016) and Winkler and Dubash (2015) reiterate in the specific contex of carbon pricing". [Eleni Kaditi, Austria]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence. The citations do appear in 4.1.
32268	44	54			typo: should be 'context' [Jamaica]	Accepted
34630	44	54			Please change contex to context [Mexico]	Accepted
52180	44	55	44	55	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Accepted. Editorial.
56132	44	55	44	55	Insert a space after the dot and before "support". [Emilie ALBEROLA, France]	Accepted. Editorial.
47948	45	2	45	2	Kindly check: Abeygunawardena et al., 2003 is not available in the reference list. [Sarah Connors, France]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
33230	45	7	45	8	one of the only reference to women in the chapter - needs to be reinforced by the literature. A specific example of the power of focusing services at women : Mary Robinson Foundation – Climate Justice (2015c) Women's participation: An enabler of Climate Justice. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-_Womens-Participation-An-Enabler-of-Climate-Justice_2015.pdf UN Women & the Mary Robinson Foundation – Climate Justice (2016). The Full View second edition. Ensuring a comprehensive approach to achieve the goal of gender balance in the UNFCCC process. Available online at https://www.mrfcj.org/wp-content/uploads/2016/11/MRFCJ-Full-View-Second-Edition.pdf [Tara Shine, Ireland]	Rejected. Too late to include grey literature. See chapter 5 for detailed discussion on gender. This chapter was criticised for covering chapter 5 content.
28590	45	9	45	9	The entire phrase is very deterministic and prescriptive. Please delete "rather than resist", or rephrase entirely. In its current formulation this sentence seems very uncritical and seems to imply that mega-trends financialisation and globalisation should under no circumstances be questioned or critically reflected - this seems problematic. [Germany]	Accepted. This text has been removed.
39250	45	11	45	22	These are critical points to highlight in the SPM - concerning major reforms in the global finalcial system, role of bold political leadership, and removing FF subsidies. [Lindsey Cook, Germany]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence, but this comment has been conveyed to authors of SPM.
3778	45	15	45	16	These lines hint at the possibility that there are individuals, groups, even countries, for whom a rise in temperature has beneficial effects. Unfortunately, the report never discusses the potential benefits of temperature rising (such as access to alternative trade routes and resources, higher costs for economic competitors, etc.) – neither here nor in the many other subsections where this would be appropriate, given the importance attached (p.11 l. 4) to political and social acceptability and other conditions for feasibility. [Marcel Wissenburg, Netherlands]	Noted. This is a global assessment and country effects (such as more competitiveness are not factored in. Chapter 3 is clear that the impacts are overwhelmingly negative at the global scale.
10102	45	15	45	22	Bold political leadership that lacks realism would equally not help innovations and right direction for future investment. In particular, identifying and selecting winners where there are many uncertainties about the scalability and potentials is not realistic neither announcing phasing out of fossil-fuel powered vehicles without ensuring the affordability, sustainability, and reliability of the proposed alternatives. [Saudi Arabia]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
54092	45	15	45	22	This reasoning should be expanded by an explicit recognition of the necessity of a Schumpeterian 'creative destruction' and that the 'destruction' and path breaking will require policies that face sereious difficulties in challenging existing paths and removing direct or implicit subsidies for current paths. See Kivimaa, P., Kern, F., 2016. Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. Research Policy 45, 205–217. https://doi.org/10.1016/j.respol.2015.09.008 [Mikael Hildén, Finland]	Noted. This point has been reflected in 4.1, but this useful reference has been added here.

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54424	45	15	45	15	Consider opening this paragraph with: 'The environmental and climate policy preferences of leaders in government influence policy outputs and outcomes (Carter and Jacobs 2014; Knill et al. 2010; Jensen and Spoon 2011).' Knill, C., Debus, M., and Heichel, S., 2010. Do parties matter in internationalised policy areas? The impact of political parties on environmental policy outputs in 18 OECD countries, 1970-2000. European Journal of Political Research, 49 (3), 301–336. Jensen, C.B. and Spoon, J.-J., 2011. Testing the 'Party Matters' Thesis: Explaining Progress towards Kyoto Protocol Targets. Political Studies, 59 (1), 99–115.Carter, N. and Jacobs, M., 2014. Explaining Radical Policy Change: The Case of Climate Change and Energy Policy Under the British Labour Government 2006–10. Public Administration, 92 (1), 125–141. [Conor Little, Ireland]	Noted. Text amended and this paragraph no longer exists.
61062	45	15	45	15	Current framing is a bit too broad. Should acknowledge that the success and cost effectiveness of such measures depends on the level of certainty of market and technological trends that is not always available. For instance, unilateral "political" leadership in identifying "sun set" and "sun rise" sectors and technologies in the context of significant uncertainty could have the unintended effect of inefficient capital allocation over the short, medium, and long-run, thereby slowing transitions to more cost-efficient, lower emissions technologies. [United States of America]	Accepted. Text amended and now much shorter and narrower. Sunset etc. has been removed.
19652	45	18	45	22	Removing perverse subsidies and identifying 'sun-rise' and 'sun-set' sectors and technologies in policy targets (see Section 4.2.2), such as the scheduled phasing out of fossil-fuel powered vehicles in a number of countries and cities, for example, can guide innovation and industrial policy while assisting the smooth reallocation of assets. These emphasis on smooth and schedule change is in contradiction with the rapid and disruptive change we need to increase the probability of reaching 1.5C in the scenarios included in the report as well as taming down the sense of urgency also emphasised in the report. Please revise language accordingly for consistency. [Jennifer Morgan, Netherlands]	Noted. This section has been shortened and no longer includes this point. Elsewhere (4.1, 4.2.2) text has been revised to indicate that rapid change can be incremental or discontinuous or disruptive.
28592	45	18	45	25	Please verify "perverse" - it seems a poor choice of words here and also in line 25. [Germany]	Noted. Text revised to exclude this word.
13188	45	19	45	20	Delete the text "such as the scheduled phasing out of fossil-fuel powered vehicles in a number of countries and cities, for example,". [Eleni Kaditi, Austria]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
47950	45	22	45	22	Kindly check: Carter and Jacobs, 2014 is not available in the reference list. [Sarah Connors, France]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
54418	45	22	45	22	Carter and Jacobs (2014) is cited but is not included in the list of references. Carter, N. and Jacobs, M., 2014. Explaining Radical Policy Change: The Case of Climate Change and Energy Policy Under the British Labour Government 2006–10. Public Administration, 92 (1), 125–141. [Conor Little, Ireland]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
33116	45	24	45	27	expalin locally relevant rights frameopwkrs - human rights are universal. [Tara Shine, Ireland]	Accepted. Text revised (and significantly shortened) so as to exclude this sentence.
62788	45	30			I think the nation state level and the level of supra-national country clubs are missing here. Should not NDCs and mid-century strategy be discussed here as important new elements of national climate governance processes? [Elmar KRIEGLER, Germany]	Reject. Super-national discussed in subsection 4.4.1.2 while national is described in sub-section 4.4.1.4
32872	45	32	50	24	: In general, this section does not provide a clear picture or simply omits to provide a useful mapping about 'Who' are the different agents relevant for climate governance, of their roles, power/knowledge interactions and their differentiated responsibilities. For instance, and specifically, this section talks about multi-level governance but underestimates or simply completely ignores the role played by large multinational corporations as key actors influencing local, national and international (economy) governance (as we all see, multi-national corporations fund political campaigns and influence the election of public representative including presidents of large nations which then can have a true impact on global climate policy…). [J. David Tabara, Spain]	Accepted, role of large multinational corporations is mentioned.
57906	45	32	45	39	Discussions on multi-governance may be supported with an emphasis on cities, including through the recent publication "Fuhr, H., Hickmann, T., Kern, K., The role of cities in multi-level climate governance: local climate policies and the 1.5°C target, Current Opinion in Environmental Sustainability, Vol. 30, pp 1-6, 2018." [Siir KILKIS, Turkey]	Accepted, inserted in 4.4.1.4
28594	45	33	45	33	Please modify: it should read: 'and to increase resilience and adaption' [Germany]	Noted, but text has been deleted
61064	45	34	45	39	This section could be shortened or deleted. [United States of America]	Rejected, this session introduce the definition of Governance to include also informal institutions.
33118	45	42	45	54	add references to the institutional changes needed to uphold and repsect human rights in the delivery of climate action e.g. Mary Robinson Foundation – Climate Justice (2015b). Zero Carbon Zero Poverty the Climate Justice Way: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Available online at https://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Rejected, thought this is a very important point, this is not relevant in this section. Ch 5 is dealing with justice and in that chapter 'uphold and respect human rights in the delivery of climate action' shall be mentioned.
61066	45	42	46	28	Section 4.4.1.1 could be significantly condensed. [United States of America]	Accepted, text has ben cut to shorten the section.
47160	45	50	45	50	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted
57358	45	51	45	51	Why is there a need for "cultural transformations"? All cultures, specific cultural elements? What does "cultural transformation" actually mean? And is it desirable for everybody? [Hans Poertner, Germany]	Accepted, "cultural transformations" deleted.
47162	45	54	45	54	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted
47164	46	1	49	5	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted.
54426	46	8	46	8	Consider adding this citation: Jänicke, M. and Quitzow, R., 2017. Multi-level Reinforcement in European Climate and Energy Governance: Mobilizing economic interests at the sub-national levels. Environmental Policy and Governance, 27 (2), 122–136. [Conor Little, Ireland]	Accepted, citation added
46926	46	15	46	15	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted
33120	46	17	46	19	There is a larger gender and climate change literature to draw on to emphasise and flesh out this point. [Tara Shine, Ireland]	Rejected, already 3 articles are quoted, no need to flesh it out here as this point is dealt with in Ch. 5

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3906	46	23	46	28	This paragraph appears out of place in sub-section 4.4.1.1 It also promotes a simplified and binary view (either top down or bottom up) of the policy process. The post-positivist policy literature (for example Farley, J., Baker, D., Batker, D., Koliba, C., Matteson, R., Mills, R., & Pittman, J. (2007). Opening the policy window for ecological economics: Katrina as a focusing event. Ecological Economics, 63, 344–354. DOI 10.1016/j.ecolecon.2006.07.029) suggests additional ways of conceiving policy change which are more responsive and systemic than a top-down / bottom-up frame. Policymaking for complex systems is then based on policy action within a complex systemic frame, emphasising flexibility, nudging, creation of positivive path dependencies and advocacy coalitions to render long term policy solutions 'sticky' and therefore resistent to watering down or abandonment over time. (See Steinberg, P. (2009) Institutional Resilience amid political change: the case of biodiversity conservation. Global Environmental Politics, 9,3, 61-81; Dombkins. D. (2014) Realising complex policy: using a system-of-systems approach to develop and implement policy. Journal of policy and complex systems, 1,1, 22-60; Levin, K, Cashore, B, Bernstein, S, Auld, G. (2012) 'Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. Policy Sciences, 45, 2, 123-152. [Emily Tyler, South Africa]	Accepted sub-section deleted
32868	46	23	46	28	• Section 4.4.1, p.46, lines 23-28, and table 4.6: consider the suitability of using the expression 'top-down' and 'bottom-up'. Although such expression is widely used, in scientifically terms, it is rather confusing or simply vague unless the criteria used to define what or who lies at the 'top' and what/who lies at the bottom in different contexts is clearly specified. On the one hand, this hierarchical and closed vision of societies is often based on a rather obsolete framing which views social systems as pyramidal constructs with some powerful people at the 'top' controlling (or able to control) the lives of those at the 'bottom' in a rather hermetic way. On the other hand, it is also based on an over-emphasized view of the role and supposed capacity of policymakers, individuals and government actors to steer societal change to their own will; instead of social and collective action being mediated through their organisations [J. David Tabara, Spain]	Accepted sub-section deleted
32870	46	23	46	28	The 'bottom-up' / 'top-down' opposition seem in contrast with the fact that such description also ignores the role of multinational corporations –and transnational networks- in local decision making (e.g. in which part of the 'top' are such multinational corporations with respect with other 'top' local policy makers?). Very rarely what is depicted as successful 'bottom-up' actions occur in isolation but are the result of complex transnational networks who support cooperation and learning –and which lie and the core of the understanding on how local transformations operate in practice. For these reasons, an more nuanced and robust interpretation which looks at social systems as complex and increasingly interconnected networks with different dimensions of power, knowledge and influence in different realms of social action is required. In fact, this more nuanced approach is already well taken in other parts of the report - although perhaps not sufficiently elaborated, given that such new forms of organising collective action may be at the core of the actions that need to be promoted to achieve a 1.5 ºC world as it is the case with Carbon Clubs. [J. David Tabara, Spain]	Accepted sub-section deleted
51526	46	23	46	28	The problem with the bottom up approach lies with the centralised governance structure that are not transparent and accountable to the people and developed at a national scale without any sub-national level feedback and accoutability. It cannot be effetive for lomg term implementation plan and programme. It can, at best, facilitate short term policy and legislative provisions and can be influenced by electoral cycles. But, for long term implementation, climate actions need decentralised governance at sub national level where communities form the core of the bottom up approach and FPIC, community governance rights, community resource rights, consultation and participation should all the be important components of that approach. In electoral democracies, the elected representatives (often nominated ones also) from communities should be part of that decentralised governance. [Souparna Lahiri, India]	Accepted sub-section deleted
7954	46	26	46	26	Replace "top/down" with "top-down" [Christopher Bataille, Canada]	Rejected because section deleted
35530	46	26	46	27	The top-down can respond to electoral cycles only in functioning democracies with regular elections - so, not applicable to the whole world! [Ashok Sreenivas, India]	Rejected because section deleted
42822	46	31	48	5	There should be more in this section about the Kigali Amendment to the Montreal Protocol as a means to highlight that a successful international agreement is possible. Further, the Montreal Protocol, as a start-and-strengthen treaty, lends itself to facilitating common but differentiated responsibilities through the fact that developed countries act first—because they have the technologies and financial means with which to begin enacting the treaty—that allows developing countries to follow, usually benefiting from the trial-and-error stages of technology development that may have plagued the developed countries. [Kristin Campbell, United States of America]	Accepted Kigali Amendment mentioned as suggested with relevant source
43070	46	31	48	5	There should be more in this section about the Kigali Amendment to the Montreal Protocol as a means to highlight that a successful international agreement is possible. Further, the Montreal Protocol, as a start-and-strengthen treaty, lends itself to facilitating common but differentiated responsibilities through the fact that developed countries act first—because they have the technologies and financial means with which to begin enacting the treaty—that allows developing countries to follow, usually benefiting from the trial-and-error stages of technology development that may have plagued the developed countries. [Durwood Zaelke, United States of America]	Accepted Kigali Amendment mentioned as suggested with relevant source
61068	46	31	48	33	There is an abrupt transition from international governance to community and local governance. Given that the overall section focuses on multi-level governance, some intervening discussion of national and sub-national (e.g., provincial or regional, not just community/municipal) considerations would make sense. Also, the box on watershed management (page 4-50) is a good example of why governance is needed across hydrological and not merely political units, and could be anchored in such a discussion of sub-national governance in the text itself. [United States of America]	Accepted, text added as suggested
62790	46	31			This is an informative discussion, but why does it stop before Paris? I think the key mechanisms of the Paris agreement and their new governance structure should be discussed here: linking bottom-up (NDCs, MCS) with global goals e.g. via global stocktake. Discussion of how fairness considerations are taken up (e.g. as part of the NDCs countries need to state why they think their action is fair) would also be interesting. [Elmar KRIEGLER, Germany]	Noted, good comment the role of NDCs and fairness in discussed in Cross Chapter Box 11 on NDCs, sentence added to link the session to the box
51528	46	31	51	20	Climate action does need multiple level governance from international to local at community level. There is broad agreement on this architecture. But, at the same time, we need to development international agreements, Conventions and treaties in a way that recognise and respect that multilevel governance and do not succumb to the political position of national sovereignty. The national governants are accountable to the international community through the international agreements - binding or non binding - that they ratify or sign. Where as at the national/country level, the governments not always are that accountable and transparent across the sub antional level especially at the local level. Therefore, multilevel governance mechanism needs appropriate policy legislation for implementing a bottom up approach which is accountable and transparent at the local and community level and that the communities are consulted and they can participate in decision making. How the communities see the need and support for such governance and decision making process has come out very clearly in the Community Conservation Resilience Initiative assessment reports - a project of Global Forest Coalition supported by funds from the Government of Germany - those can ve accessed at http://globalforestcoalition.org/resources/supporting-community-conservation/ [Souparna Lahiri, India]	Accepted. The concept is already present in the SOD text, some text from the comment has been added to make this more evident

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55110	46	31	47	24	I suggest adding more references on how the Paris Agreement is providing that legally bindingness to secure trust. This was highighted in Dagnet et Al. 2016 (Dagnet, Y., D. Waskow, C. Elliott, E. Northrop, J. Thwaites, K. Mogelgaard, M. Krnjaic, K. Levin, and H. McGray. 2016. "Staying on Track from Paris: Advancing the Key Elements of the Paris Agreement." Working Paper. Washington, DC: World Resources Institute. Available online at http//www.wri.org/ontrackfromparis). The paper shows that the Paris Agreement Provides transparency and accountability for countries' commitments. The Paris Agreement requires countries to be transparent about the actions they are taking. All countries are legally bound to prepare, communicate, and maintain their NDCs on mitigation every five years and pursue domestic measures to achieve them. The Agreement also includes strong, legally binding provisions on how to measure, report, and verify emissions reductions. Countries will be required to use the reporting guidelines that are applicable to all, but that also take account of differing capacities and allow some flexibility. All countries will submit information verified through a technical review process. Finally, the Paris Agreement provides for the establishment of a compliance mechanism in the form of an expert committee "to facilitate implementation and promote compliance with the provisions of this Agreement," underscoring the seriousness with which all countries have entered into the Paris Agreement. These provisions build confidence and trust among governments and stakeholders regarding the delivery of each country's respective commitments, while holding countries accountable for their actions. Trust and confidence will help support cooperation, and greater accountability will reduce freeriding. Together, they will support the collective action required to achieve the Agreement's temperature, resilience and net-zero emission goals. The statement in page 47 line 19 till 24 is supported and illustrated in that paper as well. [Yamide Dagnet, United States of America]	Accepted, reference added and short sentence
8376	46	32	46	34	"Supranational authorities and treaties can help strengthen policy implementation, providing a guide to transition in periods between election cycles to ensure a medium and long-term vision is being considered and followed". We do not think that there is a concept of "Supranational authorities" as written in this sentence. It is suggested to delete it or give it a detailed explanation. [China]	Accepted. Supranational Authorities is deleted
61070	46	34	46	36	Insert "climate" just before "governance" and remove the parenthetical "(e.g., UNFCCC, Paris Agreement, Montreal Protocol)". Rationale: The addition of "climate" clarifies scope of governance being described, and deletion of the parenthetical broadens the relevance by avoiding the exclusion of other significant entities. [United States of America]	Accepted. Changed as suggested
8378	46	40	46	47	The current formulation of this paragraph does not meet the understanding of the issue of adaptation mechanisms by most countries, which is suggested to be deleted. [China]	Noted - original text has been expanded and strengthened
54428	46	40	46	40	Words missing here. [Conor Little, Ireland]	Rejected, not clear want indicated
34632	46	45			Please add "the" best [Mexico]	Rejected
8380	46	54	47	13	The expression in this paragraph does not relate to achieving 1.5?. The statement of the Kyoto Protocol and the principle of common but differentiated responsibility in this paragraph is not objective nor consistent with our understanding of the fundamental principle of the Convention, which is suggested to be deleted. [China]	Partly accepted, The paragraph is relevant to 1.5C as it describes international governance option for 1.5C, the reference to CBDR has been deleted
36128	46	54	47	24	These two paras talk about binding top down commitments vs. non-binding bottom up pledges. More recent citataions to be added on evaluations of Paris Agreement. [India]	Accepted, a reference on the evaluations of Paris Agreement. Added Jaime Nieto, Óscar Carpintero, Luis J. Miguel, Less than 2°C? An Economic-Environmental Evaluation of the Paris Agreement, Ecological Economics, Volume 146, 2018, Pages 69-84, https://doi.org/10.1016/j.ecolecon.2017.10.007.
61072	46	54	47	47	This section (through line 47 on page 47) is not essential to the report and should be deleted. [United States of America]	Rejected, these sections are very relevant to 1.5 C governance, in any case the text has been revised and shortened.
4548	46	55	47	2	binding limits allocated by principles of historical responsibility and equity, or on carbon prices, emissions quotas or pledges and review of policies and measures: the text gives the impression that those are mutually exclusive policy options [Florian Rabitz, Lithuania]	Accepted, added that also a combination of options is possible
13190	47	1	47	1	Delete the text "on carbon prices,". [Eleni Kaditi, Austria]	Rejected, carbon price is a relevant policy instrument
61992	47	1	47	45	Avoid a policy prescriptive style (e.g. the approach of the Paris Agreement "must be strengthened") or speculating on the future ("the Paris Agreement enables a more regular, tightening of NDCs". [Valérie Masson-Delmotte, France]	Accepted
1660	47	3	47	3	Referece (Wang L, Chen W, Zhang H, Ma D, 2017. Dynamic Equity Carbon permit allocation scheme to limit global warming to 2 degrees. Mitigation and Adaptation Strategies for Global Change, 22?4??609~628) expains a new apporach for budget allocation could also be cited here. [Wenying Chen, China]	Rejected, not relevant here
4550	47	3	47	24	I would suggest not to turn those two paras into a discussion on whether the KP has been a success or failure. The phrase "diametrically opposed approach of no binding commitments ... in the Paris Agreement" is somewhat imprecise, considering how the PA contains both binding and non-binding components. Loaded language such as "doomed" should probably not be used here. [Florian Rabitz, Lithuania]	Accepted, text modified.
7468	47	3	47	4	Given that there is a lot of literature that sees the Kyoto Protocol regime a success, the sentence should be reworded as follows: "Some literature criticizes the Kyoto Protocol (KP) regime for the inability to agree …" [Axel Michaelowa, Switzerland]	Accepted, text changed
13192	47	3	47	13	Delete the text "Literature about the failure of the system and actors that produced the Kyoto Protocol(KP) gives two important insights from a 1.5°C perspective: the inability to agree on rules to allocate emissions quotas under the UNFCCC principle of Common but Differentiated Responsibility (Gupta, 2014; Méjean et al., 2015; Shukla, 2005; Winkler et al., 2013) and a climate-centric vision of a climate regime (Shukla, 2005; Winkler et al., 2011), separated from development issues which drove identity and resistance among developing nations (Roberts and Parks, 2006). For the former, a burden sharing approach led to an adversarial process among nations to decide who shall be allocated 'how much' of the remainder of the emissions budget (Giménez-Gómez et al., 2016; Ohndorf et al., 2015; Roser et al., 2015). Industry group lobbying was fundamental in reducing the capacity of some key major emitting nations to move adequately on the issue of climate change (Dunlap and McCright, 2011; Geels, 2014; Levy and Egan, 2003; Newell and Paterson, 1998) as government-led approaches were derided as cumbersome and ineffective.". [Eleni Kaditi, Austria]	Rejected, text has been amended but there is no reason for deleting it.
32128	47	3	47	24	Language in this section on the Kyoto Protocol, the Copenhagen Accord, the Cancun Agreements, and the Paris Agreement is biased and unbalanced. It should keep to the balanced assessment based on reviewing the literature. This section takes as a starting point that the Kyoto Protocol is a "failure", that it is "doomed", and that its approach is "diametrically opposed" to an approach of no binding commitments in the Copenhagen Accord, the Cancun Agreements, and finally the Paris Agreement. This is a very opininated assessment, not based on evidence in literature and needs to be reworded. [Jamaica]	Accepted, text modified.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
36494	47	3	47	24	Language in this section on the Kyoto Protocol, the Copenhagen Accord, the Cancun Agreements, and the Paris Agreement is biased and unbalanced. It should keep to the balanced assessment based on reviewing the literature. This section takes as a starting point that the Kyoto Protocol is a "failure", that it is "doomed", and that its approach is "diametrically opposed" to an approach of no binding commitments in the Copenhagen Accord, the Cancun Agreements, and finally the Paris Agreement. This is a very opininated assessment, not based on evidence in literature and needs to be reworded. [Snaliah Mahal, Saint Lucia]	Accepted, text modified.
61074	47	3	47	8	Common but differentiated responsibilities has no relationship to the allocation of emissions quotas. There is no basis for concluding that from the text of the UNFCCC. This reference should be removed. [United States of America]	Accepted. UNFCCC CBDR removed
56864	47	8	47	8	on the limits of a climate-centric system which excludes other values such as development see Caney (2012) 'Just Emissions', Philosophy and Public Affairs vol.40 no.4, 255-300. [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Accepted reference added
56866	47	8	47	10	on the challenges facing a purely 'burden sharing' approach see Simon Caney (2014) 'Two Kinds of Climate Justice: Avoiding Harm and Sharing Burdens', Journal of Political Philosophy, vol.22 no.2 (2014), 125-149. [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Accepted reference added
33976	47	10	47	13	Please consider to expand the current wording to elaborate on impacts of different societal actors engagement, both in support and on the other side to circumvent the Paris agreement. [Norway]	Noted (partly accepted):unfortunately space limitation do not allow to expand on this good comment that we fully share,, an additional paper has been added which reinforce the statement you are making: Michaelowa, A., 2013. The politics of climate change in Germany: ambition versus lobby power.
5646	47	11	47	13	It is important to mention the impact of industry lobbying, greenwashing and other strategies societal actors engage in to circumvent the agreements of Paris. This is a good beginning but could be expanded. How these intentional circumventions interact with the more subconscious psychologies of denial would be also desirable to comment on. [Marion Grau, Norway]	Noted (partly accepted): unfortunately space limitation do not allow to expand on this good comment that we fully share,, an additional paper has been added which reinforce the statement you are making: Michaelowa, A., 2013. The politics of climate change in Germany: ambition versus lobby power
54430	47	12	47	12	Consider citing: Michaelowa, A., 2013. The politics of climate change in Germany: ambition versus lobby power. Wiley Interdisciplinary Reviews: Climate Change, 4 (4), 315–320. [Conor Little, Ireland]	Accepted reference added
7470	47	15	47	24	The paragraph is biased, criticising the Kyoto Protocol while praising the Paris Agreement bottom up system (which may fail miserably due to many problematic characteristics of a bottom-up approach). Please reword as follows: "Given the political unwillingness to continue with the top-down approach of the Kyoto Protocol, the Paris Agreement is built on a bottom-up pledge and review system. Whether this works better, remains to be seen. Effective monitoring and timely reporting on national contributions (including on adaptation), international scrutiny and persistent efforts of civil society to encourage greater and faster action in national and international contexts may contribute to a success (Allan and Halden ...)" [Axel Michaelowa, Switzerland]	Accepted, paragraph rephrased is partly the sentence suggested
28596	47	16	47	16	Doomed does not seem be an appropriate term to evaluate the Kyoto Protocol. Please amend. [Germany]	Accepted, "doomed deleted"
28598	47	16	47	17	Please differentiate between the binding/non-binding character of the Copenhagen Accord/Cancun Agreement on the one hand, and the Paris Agreement on the other hand. In the Paris Agreement, parties have committed to take action to achieve their NDCs. [Germany]	Accepted, differentiation added
51278	47	17	47	17	1.5C needs to be replaced with "1.5 oC". [Muhammad Latif, Pakistan]	Accepted
62792	47	17	47	17	This would be an impossible goal and it is not necessary. Only carbon neutrality and a constant rate of SLCPs needs to be reached. [Elmar KRIEGLER, Germany]	Accepted, modified
8382	47	19	47	24	“Paris Agreement must be strengthened under conditions that enable effective monitoring and timely reporting on national contributions (including on adaptation), international scrutiny and persistent efforts of civil society to encourage greater and faster action in national and international contexts”. We think that the current wording is a prejudgment of the negotiation process of the Convention, which does not comply with the principle that an IPCC assessment report should be policy neutral. It is suggested to be deleted. [China]	Accepted, rephrased to make it policy neutral
47108	47	20	47	20	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted, rephrased.
28600	47	21	47	21	contribution should be substituted with "action", otherwise the term could be mistaken with the NDCs. [Germany]	Accepted, word changed
39	47	23	47	24	Please also cite here Herrala and Goel (2016), which makes this point explicitly. [Risto Herrala, United States of America]	Rejected, citation not added
7956	47	26	47	26	Add "succeeded" after "Cancun" [Christopher Bataille, Canada]	Accepted
1872	47	30	47	33	The word 'tightening' is a bit odd. How about this text ' The Paris Agreement allows countries to set their own ambitions to address climate change and to update these every five years in a new NDC'. The rest of the sentence can stay (incl ist references [Willem Pieter Pauw, Germany]	Accepted, text added as suggested
28602	47	30	47	32	Please expand on the "ambition mechanism" of the Paris Agreement (Global Stocktake) and its potential to close the mitigation gap. [Germany]	Noted (partly accepted): unfortunately space limitation do not allow to expand on the ambitious mechanism, Global Stocktake added and m
1874	47	33	47	40	the purpose of this text is not clear to me. Van Asselt et al (2015): assessment and review (…) write about MRV for NDCs, and could be a useful resource here? [Willem Pieter Pauw, Germany]	Accepted added: Assessment and Review under a 2015 Climate Change Agreement Asselt, Harro van Pauw, Pieter Sælen, Håkon Responsible organisation Nordic Council of Ministers, Nordic Council of Ministers Secretariat, Den nordiske arbejdsgruppe for global klimaforhandlinger (NOAK); however this is Grey Literature
7472	47	35	47	39	Please reword "For example … institutions" as follows: "Through market mechanisms under its Art. 6 (6.2 and 6.4), the Paris Agreement allows to harness the lowest cost mitigation options worldwide and thus may incite policymakers to enhance mitigation ambition." [Axel Michaelowa, Switzerland]	Accepted
13194	47	35	47	39	Delete the text "convergence toward a uniform carbon price and the progressive integration of different regional mechanisms (Bodansky et al., 2014; Metcalf and Weisbach, 2012) under Article 6.3 (ITMOS) and the JCM (Articles 6.4 and 6.7), and speeding up climate action as part of ‘climate regime complex’ (Keohane and Victor, 2011) of loosely interrelated global governance institutions.". [Eleni Kaditi, Austria]	Accepted, text deleted as requested
40460	47	35	47	36	“…For example, convergence toward a uniform carbon price and the progressive integration of different regional mechanisms” I suggest to use less contentious issues as examples; it could be understood as taking side in a debate that belongs to the parties. In any case, uncertainty levels should be stated. [Pedro Alfredo Borges Landaez, Venezuela]	Rejected this is the example suggested by the literature and there is no uncertainty levels associated with this concept.
1266	47	37	47	37	under Article 6.3 (ITMOS) and the JCM (Articles 6.4 and 6.7) should be repharased "under Article 6.2 (ITMOs such as the Joint Crediting Mechanism) and the Articles 6.4 mechanism". Since the JCM is under Article 6.2. [YUJI MIZUNO, Japan]	Noted but section deleted
28604	47	37	47	37	Please double check the references to the Paris Agreement. [Germany]	Noted but section deleted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
50602	47	37	47	37	One should write this line as follows : "2012) under Article 6.2 and 6.3 (ITMOS) and the new crediting mechanism proposed in the Paris Agreement (Articles 6.4 and 6.7)" - Justification : it is important to add 6.2 because it is the first alinea in Article 6 which designs the so called ITMOS; the removal of the wording "JCM" is justified by the fact that the latter (Joint Crediting Mechanism) is a creation of the Japanese Administration which implementation has started. The new crediting mechanism under Article 6.4 is not yet designed and is under scrutinity in the ongoing negotiaiton of the Paris Agreement Rule Book. [Jean-Yves CANEILL, France]	Noted but section deleted
28606	47	39	47	40	Meaning of the sentence is not clear. [Germany]	Accepted, sentence revised
55112	47	39	47	40	The Paris Agreement also use the concept of "flexibility for developing countries who need it" - this is also a way to operationalize the CBDR-RC principle. This should be noted, since it support a the notion of improvement overtime, while acknowledging countries' differing stage of development and capabilities. Dagnet et al 2016 also look into this. [Yamide Dagnet, United States of America]	Accepted text added
16520	47	44	47	45	The Paris Agreement does not call for stronger adaptation commitments from States. It recognises the importance of adaptation and the need for greater adaptation action and cooperation to enhance such action. It encourages Parties to voluntarily report on their adaptation priorities, plans and actions, but it does not call for commitments. [Australia]	Accepted suggested text added
3780	47	49	47	49	Not only trust and reciprocity but also their opposites. That there are individuals, groups, even countries, for whom a rise in temperature has overall or even exclusively positive effects. Unfortunately, the report never discusses the potential benefits of temperature rising (such as access to alternative trade routes and resources, higher costs for economic competitors, etc.) – neither here nor in the many other subsections where this would be appropriate, given the importance attached (p.11 l. 4) to political and social acceptability and other conditions for feasibility. [Marcel Wissenburg, Netherlands]	Rejected, not relevant here
37750	47	49	47	54	This is very (social science) technical language. Please rephrase so it is understandable for non (social science) technical experts [Michiel Schaeffer, Netherlands]	Accepted, text modified.
13972	47	51	47	52	Seminal suggestions are made, for example to depart from the Nash-based vision of games with actors acting individually in the pursuit of their self-interest to a Berge Please avoid terms that need to be explanned, with Nash-based or Berge-based. based vision of games" [Natalie MAHOWALD, United States of America]	Accepted, text modified.
47952	47	54	47	54	Kindly check: Axelrod, 1984 is not available in the reference list. [Sarah Connors, France]	Accepted, (Axelrod and Hamilton, 1981) added in the reference list
2398	48				In section 4.4.1.3 it is not clear how the growth in informality will impacts on governance response options. [Debra Roberts, South Africa]	Accepted, informal settlement added
7958	48	1	48	5	Period instead of comma in first line, whole "paragraph" is confusing and should be simplified. [Christopher Bataille, Canada]	Accepted, text modified.
2458	48	3	48	4	The reference to Hagen et al., 2017 (Hagen, A.; L. Kähler and K. Eisenack (2017) Transnational Environmental Agreements with Heterogeneous Actors, in S. Ça?atay (ed.) Economics of International Environmental Agreements: a Critical Approach, Routledge.) is at the right place in the text now but the reference is missing in the reference list at the end of the chapter. [Achim Hagen, Germany]	Accepted
47954	48	3	48	3	Kindly check: Year for Hagen et al., 2017 in reference list is not matching. [Sarah Connors, France]	Rejected, 2017 is correct, this is (Hagen, A.; L. Kähler and K. Eisenack (2017) Transnational Environmental Agreements with Heterogeneous Actors, in S. Ça?atay (ed.) Economics of International Environmental Agreements: a Critical Approach, Routledge.
13974	48	8	20	48	Should civil society group be mentioned more than currently? In the intro to this section you say: "(Ciplet et al., 2015) argue that civil society is likely to be the only reliable motor for driving institutions to change at the pace required." And then civil society groups are mentioned once more, but that is it. If some people think they are main driving forces, assessing the literature about whether this can be sufficiently important would seem appropriate? If the literature doesn't exist, perhaps identifying that gap is important? I see in the next secgtion you talk about motivating people: maybe linking down to that section? [Natalie MAHOWALD, United States of America]	Accepted: Civil Society added in the text
33122	48	8	48	31	add references to the right to particiation and other procedural rights in ensuring community engagement. [Tara Shine, Ireland]	Accepted, suggested text added
36130	48	8	48	31	More focus required on - A key challenge for local govenrnace is meeting local concerns with global objectives. [India]	Accepted, suggested text added
40462	48	8	48	8	(4.4.1.3 Community and local governance) While the importance of communities and local governance is undeniable, the risk of effectiveness and efficiency loss by uncoordinated or even conflicting actions or programs by local initiatives need to be addressed here. The role of national governments is vital to achieve the necessary coordination in the highly diverse, multiscale and complex network of local actors towards successful adaptation and mitigation planning. [Pedro Alfredo Borges Landaez, Venezuela]	Noted but text deleted
61076	48	8	50	24	These sections (4.4.1.3 and 4.4.1.4) should be significantly condensed. [United States of America]	Accepted, sections have been shortened
57360	48	9			Unclear whether this section is about cities, or which scale of governance, since the terms “community and local governance” are not clear. Can one generalise rural and urban areas, as well as islands, in the way it seems in this section? Moreover, “community” implies people, but this section only talks about formalised governance actors. [Hans Poertner, Germany]	Accepted title modified to subnational governance, islands added
28608	48	11	48	11	The sentence seems problematic. What are "real concerns" - which standards determine what is real. Also: it is implied that national governments are somehow less willing to address citizens real concerns. Please rephrase. [Germany]	Accepted, sentence deleted
51280	48	13	48	13	1.5C needs to be replaced with "1.5 oC". [Muhammad Latif, Pakistan]	Noted
61994	48	24	48	31	Avoid prescriptive tone ("work remains in aligning efforts of cities") [Valérie Masson-Delmotte, France]	Accepted, language changed
28610	48	26	48	31	1) Translating the collective commitment to reach the UNFCCC goals into local climate action demands various efforts particularly by national governments. National urban policies to enhance local climate action deserve more attention. . A recent publication by SEI highlights this potential (focus on low-carbon urbanization): http://newclimateeconomy.report/workingpapers/workingpaper/building-thriving-low-carbon-cities-an-overview-of-policy-options-for-national-governments/ 2) Scientific evidence is needed regarding the impact of peer learning and transnational municipal networks such as C40, GCoM, ICLEI (cf. IPCC AR 5, mitigation, chapter 12) [Germany]	Accepted, both 1) and 2)
7474	48	31	48	31	Insert after "Bulkeley, 2005": However, Michaelowa and Michaelowa (2017) empirically find a low effectiveness of the design of over 100 such initiatives with regard to mitigation". Reference: Michaelowa, Katharina; Michaelowa, Axel (2017): Transnational Climate Governance Initiatives: Designed for Effective Climate Change Mitigation?, in: International Interactions, 43, p. 129-155 [Axel Michaelowa, Switzerland]	Accepted
18628	48	34	50	24	Given that this is a dedicated section on multi-level governance, some attention should be paid to the issue of additionality: e.g. is action by cities/regions/NSAs additional to that of the 'host' country's NDC? Some studies have attempted to quantify this - as synthesised in the non-state action section of the UNEP Emissions Gap Report. [Andrea TILCHE, Belgium]	rejected, unfortunately no space available to discuss additionality

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32972	48	34	4	52	Regarding the section 4.4.1.4 "Interactions and processes for multi-level governance" and the section 4.4.2 " Enhancing Institutional Capacities" it might be interesting to mentioned the importance of centre of government institutions (understood as the institution, or the group of institutions, which provides support to the head of government, including technical and political coordination of governmental actions, planning, monitoring and communication) within governance structures to enhace climate action. In such a policy arena, which involves multiple interests and different levels of political and financial power, strong political and technical coordination might be a useful tool to move such an agenda forward. In this sense, the centre of government institutions might play an important role to promote and enhance climate action. [Brazil]	Noted, it is more relevant for 4.4.2 to discuss this point
1562	48	35	48	38	… It is unclear how multiple actors with varied motivations and agendas will come together to undertake action towards enabling a 1.5°C transition. There is growing evidence on some aspects of climate governance: a study on 29 European countries showed that the rapid adoption and diffusion of adaptation policymaking is largely driven by internal factors, at the national and sub-national levels. This statement captures the essential core of the problem of section 4.4 about implementing far reaching change. The amount of literature that suggests that a problem such as climate change to address at such a world scale is very little. Even a study of 29 European counries show that internal factors could be even more important than the urgency of a climate change problem. Just as likely for other jurisdictions, the climate problem may not be an urgent issue to address at all if other problems, such as poverty, may be more pressing. Multi-level governance is needed theoretically, but real examples are difficult to find and certainly not at world -scale that would be needed, as assessed by the pathways in Chapter 2. [Arthur Lee, United States of America]	accepted - the text on multilevel governance has been expanded, along with greater consideration of its challenges (as well as opportunities). The quotes sentence in question has also been altered./
29310	48	35	48	43	the format of citation may need to adjust [Yuanyuan Huang, France]	noted
61078	48	35	48	38	It is unclear how multiple actors with varied motivations and agendas will come together to undertake action towards enabling a 1.5°C transition. There is growing evidence on some aspects of climate governance: a study on 29 European countries showed that the rapid adoption and diffusion of adaptation policymaking is largely driven by internal factors, at the national and sub-national levels. This statement captures the essential core of the problem of section 4.4 about implementing far reaching change. The amount of literature that suggests that a problem such as climate change to address at such a world scale is very little. Even a study of 29 European countries show that internal factors could be even more important than the urgency of a climate change problem. Just as likely for other jurisdictions, the climate problem may not be an urgent issue to address at all if other problems, such as poverty, may be more pressing. Multi-level governance is needed theoretically, but real examples are difficult to find and certainly not at world-scale that would be needed, as assessed by the pathways in Chapter 2. [United States of America]	accepted - the text on multilevel governance has been expanded, along with greater consideration of its challenges (as well as opportunities). The quotes sentence in question has also been altered./
55860	48	39	48	39	Space between closing parenthesis and in [Debora Ley, Guatemala]	Accepted
47110	48	45	48	45	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted
47956	48	48	48	48	Kindly check: Ford and Berrang-ford, 2016 is not available in the reference list. [Sarah Connors, France]	Accepted.
7960	48	50	48	51	A bunch of national policies (?) are referred to in CAPS, implying they are quotes of specific policies or laws. If they are they should be referenced, if not should they be in lower case? [Christopher Bataille, Canada]	Accepted now in lower case
1876	48	51	48	53	NDCs are not so much about formulation of adaptation policies; plans and strategies, but more about their communication. The statement also needs to be further specified, e.g. by stating that a majority of developing countries used their NDC to communicate adaptation actions and strategies (see fig 8 on page 24 in Mbeva & Pauw (2016): self-differentiation of countries' responsibilities https://www.die-gdi.de/uploads/media/DP_4.2016.pdf). What developing countries communicate on adaptation in their NDCs is usually based on existing policies and strategies. See the NDC Explorer: https://klimalog.die-gdi.de/ndc/#NDCExplorer/graph?INDC??climatechangeadaptation???cat38 [Willem Pieter Pauw, Germany]	Noted - text added in the NDC box and elsewhere to clarify the role of NDCs in adaptation
47958	48	52	48	52	Kindly check: year for Magnan et al., 2015 from reference list [Sarah Connors, France]	Accepted - ref checked
57900	49	1	49	24	The statements on multilevel governance will benefit from a recent publication "Fuhr, H., Hickmann, T., Kern, K., The role of cities in multi-level climate governance: local climate policies and the 1.5°C target, Current Opinion in Environmental Sustainability, Vol. 30, pp 1-6, 2018." The paper focuses on the crucial role of local governments in the multi-level climate governance system and underlines the necessity for a massive upscaling of local climate policies. [Siir KILKIS, Turkey]	Accepted
46928	49	3	49	3	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted
33124	49	6	49	11	add references to the right to participation - see for example Mary Robinson Foundation – Climate Justice (2015c) Women's participation: An enabler of Climate Justice. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-_Womens-Participation-An-Enabler-of-Climate-Justice_2015.pdf AND Mary Robinson Foundation – Climate Justice (2015c) Women's participation: An enabler of Climate Justice. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-_Womens-Participation-An-Enabler-of-Climate-Justice_2015.pdf [Tara Shine, Ireland]	Noted, the concept is already included no need for additional references
34634	49	9			Please separate byNightingale [Mexico]	accepted
47166	49	10	49	10	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested alternative '...Party submits information…' [Sarah Connors, France]	Accepted
1564	49	15	49	54	Box 4.1 illustrates a good example of multi-level governance. However, the scale of this covenant of mayors is limited and may not yet succeed to compel or incentivize the business sectors across all of Italy to take large-scale actions, as compared to one local Chamber of Commerce in the province. [Arthur Lee, United States of America]	Rejected: The Covenant of Mayors is a major initiative with over 7700 Local Authorities in Europe and globally extended. This is a single case studies that show cooperation between local authorities and the business sector and can easily be replicated.
7476	49	15	49	54	Why is Foggia chosen as an example? Has it performed well? Unless there is robust information on the performance of the activities in Foggia, it would be better to choose another region or delete the box. [Axel Michaelowa, Switzerland]	Rejected: The Foggia case is well documented in a peer reviewed paper, reference added
61080	49	15	49	54	Box 4.1 illustrates a good example of multi-level governance. However, the scale of this covenant of mayors is limited and may not yet succeed to compel or incentivize the business sectors across all of Italy to take large-scale actions, as compared to one local Chamber of Commerce in the province. [United States of America]	Rejected: The Covenant of Mayors is a major initiative with over 7700 Local Authorities in Europe and globally extended. This is a single case studies that show cooperation between local authorities and the business sector and can easily be replicated.
61082	49	15	49	54	Box 4.1 is partially redundant with section 4.4.1.3. The text beginning at line 31 could be deleted. [United States of America]	Rejected: the section starting at line 31 is the specific local case study to illustrate with a concrete example the concept of multi-level governance
30636	49	17	49	17	Typo: major [France]	Noted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
57904	49	19	49	20	The statement "Many cities have adopted more ambitious GHG emission reduction targets than countries (Kona et al., 2018)" may be supported with the findings that ""Covenant signatories commit to ambitious GHG emission reduction targets by 2020 with an overall commitment of 27%, almost 7 percentage points higher than the minimum target." The statement takes place in "Kona A., Melica G., Bertoldi P., Rivas Calvete S., Koffi B., Iancu A., Zancanella P., Janssens-Maenhout G. Dallemand J.F., Covenant of Mayors in figures: 8-year assessment, EUR 28723 EN, Publications Office of the European Union, Luxembourg, 2017." [Siir KILKIS, Turkey]	Accepted: text and reference added
57902	49	27	49	29	The statement for the Covenant of Mayors on "Results from the 315 monitoring inventories submitted shows an already achieved 23% reduction in emissions (compared to an average year 2005) with more than half of the cities under a CTC schema" may be supported with an additional reference, namely "Kona A., Melica G., Bertoldi P., Rivas Calvete S., Koffi B., Iancu A., Zancanella P., Janssens-Maenhout G. Dallemand J.F., Covenant of Mayors in figures: 8-year assessment, EUR 28723 EN, Publications Office of the European Union, Luxembourg, 2017." In addition to one of the main findings for the 315 monitoring inventories, the same report indicates that "Covenant signatories commit to ambitious GHG emission reduction targets by 2020: overall commitment of 27%, almost 7 percentage points higher than the minimum target" (page 46 in the concluding remarks). [Siir KILKIS, Turkey]	Accepted: reference added
35532	49	34	49	34	Are municipal emissions counted similar to nation-states - i.e. based on what is emitted from within their boundaries, rather than emissions related to the consumption taking place within cities? [Ashok Sreenivas, India]	Accepted: Reference added which explain how emissions are counted, mainly based on consumption taking place in the city boundary.
61996	49	46	49	46	This sentence looks prescriptive. What are the lessons learnt from this box? [Valérie Masson-Delmotte, France]	Accepted: language changed and short sentence on lesson learned added
47960	49	48	49	48	Kindly check: Rosenzweig et al., 2015 is not available in the reference list. [Sarah Connors, France]	Accepted, reference is now available in the reference list.
57362	50	2	50	4	This important explanation should come at the beginning of the section [Hans Poertner, Germany]	Noted - in the new text additional explanation is given on the definition of governance
7100	50	8	50	8	Government means the Executive branch of the State in most of Latin America, it would be valuable to include and provide specificity by refering also to parliaments or national assembly (Legislative branch) that enact or reform legislation, approve national budgets and provide oversight to goverments commitments. All of these parliamentary insttitutions can assist in developing national adaptive capacities, for example by assigning budget lines to science and technology, or requiring investments in weather monitoring stations. This difference, subtle but important (parliamentary vs presidential systems) has not been widely recognized in the literature. [Jose Di Bella, Canada]	Accepted - text added on the interplay between local and national governance
7102	50	19	50	19	Maybe add national legislatures through bills and reforms [Jose Di Bella, Canada]	Noted - text added to further explain the role of different governance levels
7104	50	20	50	20	Another key consideration should address private sector urban developers, in developing countries and at city level, these type of firms have enourmous influence and work with local government in determining and shaping public infrastructure plans, zoning plans, urban expansion locations, and often coordinate other local and city level decisions in regard to housing projects. These are often influential actors, worth mentioning as examples of influencing or potentially facilitating or hindering adaptation planning. [Jose Di Bella, Canada]	Accepted - text added on the role played by different governance levels, with examples of policy instruments they can use
9438	50	29	51	20	Some impacts are presented with no reference to +1.5C? [Russian Federation]	Taken into account, the introduction of Section 4.4 indicates the selection of case studies, including the selection of topics in which further efforts will be required at 1.5C
10104	50	31	51	22	Box 4.2: It is unclear what is the significance of this box to 1.5c.Watershed management examples as well as other management practices would be applied regardless of the level of climate change ambition. [Saudi Arabia]	Taken into account, there was a regional and global selection of case studies and areas in which further efforts will be required at 1.5C.
61084	50	31	51	20	Box 4.2 could be condensed by focusing on one example in greater detail and mentioning others in passing. [United States of America]	Noted - the purpose of the case study is to show a variety of examples on how multi-level governance works and can be further implemented
61998	50	31	51	20	Why have these examples been selected, how consistent are they with the "1.5°C hotspots" identified in chapter 3, and what are the links with the transformations needed for 1.5°C? [Valérie Masson-Delmotte, France]	Taken into account, there was a regional and global selection of case studies and areas in which further efforts will be required at 1.5C. This also responds to the impacts on freshwater availability (3.4.2).
32270	50	48			revise statement: '"…these goals were achieved this year…" (specify the year instead) [Jamaica]	Accepted - the year, 2017 has been included.
938	50	51	50	51	basin and formed' delete 'and' [Robert Shapiro, United States of America]	Accepted - text is corrected
32274	50	51	51	8	This case study needs to be revised [Jamaica]	Noted - the three case studies have been revised
32272	50	52	50	53	revise sentence [Jamaica]	Accepted - sentence has been corrected
35392	51	2	51	3	reduction f and water rights - don't clear what is mean "f" [Andrey Kalugin, Russian Federation]	Accepted - spelling has been corrected.
940	51	3	51	3	f and water rights' delete 'f' [Robert Shapiro, United States of America]	Accepted - spelling has been corrected.
7962	51	3	51	3	What is intended after Tessler et al 2015? "f and water rights"? [Christopher Bataille, Canada]	Accepted - spelling has been corrected.
46414	51	3	51	3	…f… is extra in text. [Ijaz Ahmad, Pakistan]	Accepted - spelling has been corrected.
10346	51	12	51	12	There are 19 countries sharing the Danube Basin instead of 15. Please see http://www.icpdr.org/main/danube-basin 'With more than 800,000 square kilometres or 10 percent of Continental Europe, the Danube River Basin extends into the territories of 19 countries.' [Hungary]	Accepted - correction has been included.
470	51	24	52	25	This is an unimportant section and is well written. However, more in the way of examples of government/polcy making capacity building would be very useful here in my view. In particular, reference should be made to the UK Committee on Climate Change and its role in objectively informing national climate policy, setting carbon budgets, and critically appraising national policies and proposal on climate change. The CCC model is one that, in the context of NDCs and the ratchet mechanism, could be an exemplar for other nations in developing evidence-based decarbonsiation pathways and targets. [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The focus of this section is on institutions. Policies and instruments are dealt with in sections 4.4.3 to 4.4.5
57364	51	25			Missing links/references to previous section, which already discusses institutional contexts, scales, and examples. Also suggest more links to findings in AR5. [Hans Poertner, Germany]	Noted. The earlier section (section 4.4.1) discusses governance across all types of institutions while this section mostly focuses on enhancing the capacity of these institutions. Reference to section 4.4.1 is made in the text.
54140	51	26	51	31	There should really be a linkage to what the Parties themselves have identified as needs in terms of capacity building for governance in their own NDCs. See: http://www.climatelawgovernance.org/wp-content/uploads/2017/09/CLGI-Research-Announcement-Countries-stress-the-importance-of-legal-and-institutional-reforms-and-capacity-building.pdf [Ayman Bel Hassan Cherkaoui, Morocco]	Rejected. This section is about strengthening institutions for transition to 1.5c world and not specific to NDCs implementation. The references cited (Lustick et al., 2011; North, 1990) cover the comment's issue by explaining that institutional capacity is context-dependent and has to take into account regional and local dimensions.
14224	51	28	51	28	We recommend the word 'changes' to be replaced with the world 'imrpovements' to improve clarity and readability [United Republic of Tanzania]	Rejected. The world "changes" is preferred for being more general and neutral plus also implying "improvements'.
33128	51	29	51	55	Box - this box needs to consider the gender differentiated aspects of local and traditional knowledge systems [Tara Shine, Ireland]	Taken into account - gender aspects, in general, are discussed in greater detail in Ch. 5.
47168	51	33	51	33	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Taken into account. Editorials corrected.
54498	51	33	51	40	what ia meant by 'institutional architecture' here. How is to be made more inclusive? Does adaptation require a fundamental reorganization of this architecture? [Thomas Thornton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The institutional architecture for 1.5c would address both mitigation and adaptation

Comment No	From Page	From Line	To Page	To Line	Comment	Response
47112	51	35	51	35	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Taken into account. Editorials made
32276	51	36			should be: '...engage in informal…' [Jamaica]	Editorial corrected. Thanks.
7134	51	39	51	39	A better term instead of "these people", would be these populations, groups or communities. [Jose Di Bella, Canada]	Taken into account. Editorials made
46930	51	39	51	39	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Taken into account. Editorials made
18630	51	42	51	44	This is not a scientific statement. [Andrea TILCHE, Belgium]	Noted.
33126	51	46	51	47	Human rights should be added to the list of dimensions. [Tara Shine, Ireland]	Taken into account. Human rights aspects are governance component, which is addressed in section 4.4.1
36132	51	50	52	25	This section may also include content on institutions for policy design and implementation, like What are the institutional requirements at the national level for implementing climate policies? What are the concrete examples from other countries? [India]	Accepted. That is relevant but the section allowed space will not permit assessment at a very detailed level
49978	51	50	52	25	Should this section discusses any advance on issuing regulations on climate change response in many countries? As a direction of the countries commitment to fight againts climate change. For example,National Determined Contribution (NDC) that should be submitted to the UNFCCC (already mentioned in p 88 line 43-45). Another example, In Indonesia there is also collaborative works among government and academia on defining adaptation (Although, Box 4.4 already there as an example). [Perdinan Perdinan, Indonesia]	Accepted. That is relevant but the allowed space for the section will not permit detailed discussion and examples of regulations on climate change response at country level.
3908	51	55	52	3	This paragraph (together with the one two below on page 52 (13-20) does not address instances (in the majority in the developing world) where these things are not in place, and are unlikely to be in place in the timeframes required for 1.5 degree climate action implementation. Whilst this is a challenging observation, it should be noted, as it informs where effort is focused. Work on policymaking and management within complex systems provides some alternative ways forward, although these are in their infancy and would benefit from more research. (There is very little in this literature that speaks directly to climate mitigation policy specifically. See Tyler and Cohen 2017 for an early application to South African climate mitigation policy (Tyler, E. and Cohen, B. (2017). International Journal of Design and Nature Ecodynamics. Vol 12, 1, 124-132). [Emily Tyler, South Africa]	Accepted. The paragraph is revised to emphasize the need in developing countries for these institutions. Thanks for the reference but policy enablers are addressed in section 4.4.5
61086	52	1	52	20	The link to achieving the SDGs is relevant here and could be briefly mentioned, with a tie-in to Chapter 5. [United States of America]	Accepted. Revised sentences and added references to sustainable development and relevant sections of chapter 5, e.g. 5.5.1
62002	52	1	53	30	Why have these examples been selected, how consistent are they with the "1.5°C hotspots" identified in chapter 3, and what are the links with the transformations needed for 1.5°C? What are the lessons learnt from these examples? [Valérie Masson-Delmotte, France]	Taken into account - Each case study was selected based on socio-ecological systems identified in Chapter 3 ensuring a regional balance throughout the case studies presented in the Chapter. The case studies present cases that highlight the role of indigenous knowledge and as case studies, are not exhaustive.
47170	52	2	52	3	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Taken into account. Editorial corrected
39252	52	5	52	8	Important point to highlight in the SPM [Lindsey Cook, Germany]	Noted.
9588	52	8		9	The recommendation here is to draw on diverse knowledge sources including Indigenous and local knowledge. It is an important recommendation to make, but equally important is ensuring that decision making, research, and adaptation action involves Indigenous peoples from the start, the the co-production of knowledge and action. It must be made very clear that non-Indigenous stakeholders can not simply use Indigenous knowledge to check a box, but rather that Indigenous peoples have full control over the governance and management of their knowledge and are brought on as equal partners in decisions, discussions, and action. [Joanna Petrasek MacDonald, Canada]	Taken into account. That is indeed implied by the term institutional networking and s reflected in examples in Boxes 4.3 and 4.4
28612	52	16	52	16	Suggestion: replace "proper land-use planning ….capacities" (vague) with "effective land-use planning" (in our view the crucial point: enforcement) [Germany]	Accepted. Sentence revised accordingly
32278	52	19	52	20	mention is made of Huambo (Angola), but to what end? That case study is a bit vague and could be developed more. [Jamaica]	Accepted. Sentence is fixed
16522	52	22	52	25	It is unclear what point this paragraph is trying to make. It doesn't seem likely that any enhanced capacity of decision-making institutions in developing countries resulting from the Paris Agreement could be reflected in the Articles of the Agreement. Suggest revising. [Australia]	Accepted. Sentence revised
35534	52	22	52	22	It is an optimistic claim that the Paris Agreement process has enhanced decision making capabilities within countries! This should either be reworded or substantiated better. [Ashok Sreenivas, India]	Accepted. Sentence revised
61088	52	22	52	25	There is no basis for the assertion that these provisions of the Paris Agreement have already enhanced capacity in many developing countries. Parties are still negotiating different aspects of how the Agreement will be implemented, including with respect to Article 11 and 15 and there has not yet been implementation of these articles in a concrete sense (for Article 15, e.g., it is still unclear what the scope of the mechanism will be and what functions it will perform). This paragraph should be deleted. [United States of America]	Accepted. Paragraph revised
61090	52	22	52	25	The statement "… the Paris Agreement process has enhanced the capacity of decision-making institutions in many developing countries to support effective implementation. These efforts are particularly reflected in Article 11 of the Paris Agreement on capacity-building ..." is inaccurate. Nothing has yet been done to implement Article 11, so the authors cannot say that the Agreement has enhanced the capacity of developing countries' decision-making institutions to support implementation of 1.5°C-relevant strategies by referencing Article 11. Suggest striking this paragraph entirely. [United States of America]	Accepted. Paragraph revised
62000	52	22	52	35	The Paris Agreement process has enhanced the capacity… to support implementation. Has this been assessed? What are the corresponding publications? [Valérie Masson-Delmotte, France]	Accepted. Paragraph revised
55114	52	23	52	25	This sentence should refer to the creation of the Paris Committee on Capacity Building (mentioned in Art 11); the creation of of the Capacity Building Initiative on Transparency (CBIT) under Art 13, which aims at strengthening the institutional framework for enahnced MRV system. Dagnet et al. 2016 provides full detailson these refernces. But in the paper "How to Strengthen the institutional Architecture for Capacity Building to Support the Post-2020 Climate Regime" (https://www.wri.org/sites/default/files/How_to_Strengthen_the_Institutional_Architecture_for_Capacity_Building_to_Support_the_Post-2020_Climate_Regime.pdf) . In this paper, authors highlight that capacity of individuals must not only be built and sustained, but there must also be an increased focus on building the capacity of the organizations and institutional arrangements that support them. This fundamentally requires a move away from the ad hoc, short-term project focus of many of the capacity-building activities currently undertaken by the Convention's thematic bodies and operating entities. This will require innovative approaches to building and sustaining capacity, including online training; regional and international cooperation; leveraging the expertise of NGOs, the private sector, research institutes and academia; developing crosscutting networks of centers of excellence and partnerships with institutions that have the specific expertise; and mainstreaming or integrating climate policies with socioeconomic and development strategies. [Yamide Dagnet, United States of America]	Accepted. Sentence is revised taking into accounts the suggestions in the comment. Thanks for the reference but working papers are not acceptable for citations according to IPCC guidelines

Comment No	From Page	From Line	To Page	To Line	Comment	Response
3782	52	29	52	48	Indigenous knowledge systems are valuable for the hypotheses they can help generate on (the effects of) climate change in a given ecosystem given the local indigenous land use– but are these traditional ways of life not inherently inefficient (e.g. in their use of local resources, the level of welfare & the number of people sustained by the local land use system) as compared to modern life, and therefore an obstacle rather than helpful for global sustainability and climate control? What is their contribution to mitigating climate change for context other than the simple indigenous life? It I BTW ironic that the Maya are chosen as an example here – given that their earlier civilization perished due to environmental mismanagement. [Marcel Wissenburg, Netherlands]	Rejected - not supported by the peer reviewed literature (there is a well developed literature from diverse contexts illustrating that IK can underpin sustainability and adaptation. In many cases 'modernization' has reduced this knowledge create unsustainable trajectories, contrary to the comment).
14114	52	29	53	30	This box seems that there are particular cases where some indigenous peoples will be affected by climate change. However, it is possible to use literature in a more appropriate way, showing that actually all indigenous peoples will be affected by climate change, since all indigenous peoples have a very close relationship with and dependence on nature and this makes them very vulnerable to climate change and to other antropogenic (mostly the western) impacts. For more detailed references please see this link http://www.un.org/en/events/indigenousday/pdf/Backgrounder_ClimateChange_FINAL.pdf or consult these references: - Arctic Climate Impact Assessment. Cambridge University Press, 2005. Available online at http://amap.no/acia/. - Henriksen, John B. Report on Indigenous and Local Communities highly vulnerable to Climate Change inter alia of the Arctic, Small Island States and High Altitudes, with a focus on causes and solutions. Convention on Biological Diversity, 2007. UN Document symbol: UNEP/CDB/WG8J/5/INF/. - Maynard, Nancy C (ed). Final Report Native People-Native Homelands Workshop on Climate Change U.S. Global Change Research Program, Albuquerque, New Mexico, 1998. Available online at http://www.usgcrp.gov/usgcrp/Library/nationalassessment/native.pdf. -Report of Intergovernmental Panel on Climate Change, Working Group 2: Climate Change Impacts, Adaptation and Vulnerability, 2007. Available online at http://www.ipcc.ch/ipccreports/ar4-wg2.htm. -Salick, Jan and Anja Byg. Indigenous Peoples and Climate Change. Tyndall Centre for Climate Change Research. Oxford: May 2007. Available online at http://www.tyndall.ac.uk/publications/Indigenouspeoples.pdf [Meimalin Moreno, Venezuela]	Taken into account, there was a regional and global selection of case studies and areas in which further efforts will be required at 1.5C.
33978	52	29	53	30	Box 4.3: This comment is first and foremost to Box 4.3 but also generally for the entire report. It is good and important that indigenous peoples are mentioned here. It is positive that on page 52, line 35- 37, it is mentioned that there is a challenge on how to address and include indigenous populations in the adaptation process. But this is not only relevant to the research community but also relevant to how indigenous people is involved in decision making processes. Please consider to mention this in Box 4.3. The pressure on ethnic and cultural identity through climate change and how indigenous peoples are especially vulnerable is evident and it is important to avoid marginalization. Therefore, they need to be active partners in working with climate change strategies. This can be done in various ways. In line 45-48 on page 52 this is mentioned in regards of the Maya people, which is good. But please also consider to include information regarding the peoples of the Arctic North. [Norway]	Accepted – the text on indigenous peoples has been modified and expanded in multiple locations.
61092	52	29	53	30	Box 4.3 could also address the important role of Indigenous communities in land use management and forest conservation (which relates to climate mitigation), for example in the Amazon basin but also in other forested regions. [United States of America]	Taken into account, as case studies, they highlight some areas were IK is used, but are not exhaustive. We try to include in the text the inclusion of IK as an enabler for the different systems and options discussed in Section 4.3.
63268	52	29	53	30	On the other hand, indigenous, conventional knowledge has repeatedly failed to save civilizations (J. Diamond. 2004. Collapse: How Societies Choose to Fail or Succeed. Viking, New York) , or as A. Einstein famously said: "We can't solve problems by using the same kind of thinking we used when we created them". [Greg Rau, United States of America]	Rejected - in many cases challenges have been caused not by Indigenous peoples themselves but disruptions to local cultures and knowledge systems caused by modernization and colonization. Thus Einstein's quote is not relevant here. There are indeed examples of how IK has led to unsustainable practices (and is doing so already as illustrated in the text with the McCubbin et al ref) but this box focuses on areas where there is evidence that focusing on IK will build adaptive capacity.
53570	52	35	52	37	In response to the statement in Box 4.3 : Indigenous knowledge and community adaptation, that 'A challenge for the research community is to address how to engage indigenous populations and their knowledge systems to improve and support climate science and adaptation.' Please see artcile in Anthropocene, 2017 'A hybrid-epistemological approach to climate change research: Linking scientific and smallholder knowledge systems in the Ecuadorian Andes' Link: https://www.sciencedirect.com/science/article/pii/S2213305417300024 [Sumetee Pahwa Gajjar, India]	Accepted - text revised (reference added in)
53572	52	35	52	37	An additional reference for the same Box 4.3 29 Box 4.3: Indigenous knowledge and community adaptation | M. Burnham, M. Zhao, B. Zhang "Making sense of climate change: hybrid epistemologies, socio-natural assemblages and smallholder knowledge" Area, 48 (2015), pp. 18-26, 10.1111/area.12150 [Sumetee Pahwa Gajjar, India]	Accepted - text revised (reference added in)
51282	52	50	52	50	Indigenous needs to be replaced with "indigenous". [Muhammad Latif, Pakistan]	Editorial - the word indigenous is not capitalised throughout the chapter and report.
51284	52	55	52	55	Indigenous needs to be replaced with "indigenous". [Muhammad Latif, Pakistan]	Editorial - the word indigenous is not capitalised throughout the chapter and report.
36502	53	12	53	13	Supporting material elsewhere that allows us to broaden this to include SIDS from the Caribbean [Snaliah Mahal, Saint Lucia]	Accepted - text revised (reference to SIDS also made)
46416	53	12	53	12	Statement may be started as "The 1.5 oC". [Ijaz Ahmad, Pakistan]	Taken into account - Word consistent with what is used elsewhere in the report
36504	53	13	53	14	This statement seeks to erode the vulnerable nature of SIDS, including the Pacific which has already been declared. International Climate Change instruments speak of SIDS in terms of "special circumstances" and "particularly vulnerable". Being a resilient people as far as circumstances will allow, does not translate to not being vulnerable. [Snaliah Mahal, Saint Lucia]	Accepted - text revised (note of overall high vulnerability emphasized alongside cultural resilience)
54500	53	22	53	25	There is a concern that Indigenous knowledge will dissipate [Thomas Thornton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - text revised (wording altered)
54502	53	22	53	25	The above comment 'There is concern that Indigenous knowledge will dissipate' is not well phrased. The knowledge will not dissipate so much as change. But knowledge systems rarely just dissipate. [Thomas Thornton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - text revised (wording altered)
46932	53	30	53	30	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted - text has been revised
61094	53	36	54	11	Box 4.4 relates a nice community example but it is not written in a way that makes the scalability or replicability of the experience obvious. It could be deleted if necessary to reduce the chapter length. [United States of America]	Noted. The case studies were selected to demonstrate a range of regional examples and implementation challenges and successes at multiple scales. Issues of scalability are discussed elsewhere across Chapter 4.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
8262	54	15	54	30	This section should present a review of the state of MRV in the carbon credit markets, especially in voluntary offsetting markets. Suggested litterature could include the following: - Bumpus, A. G., & Liverman, D. M. (2008). "Accumulation by decarbonization and the governance of carbon offsets". Economic Geography, 84(2), 127–155 - Danielsen, F., Skutsch, M., Burgess, N. D., Jensen, P. M., Andrianandrasana, H., Karky, B., et al. (2011). "At the heart of REDD+: A role for local people in monitoring forests?". Conservation Letters, 4(2), 158–167 - Lovell, H. (2010). "Governing the carbon offset market". Wiley Interdisciplinary Reviews: Climate Change, 1(3), 353–362 - Merger, E., & Pistorius, T. (2011). "Effectiveness and legitimacy of forest carbon standards in the OTC voluntary carbon market". Carbon Balance and Management, 6 - Palmer Fry, B. (2011). "Community forest monitoring in REDD+: The 'M'in MRV?". Environmental Science & Policy, 14(2), 181–187 [Kelsey Perlman, France]	Noted. The space allowed will not permit that level of assessment of MRV in existing carbon markets.
31010	54	16	54	30	I would like some more explainatio on the monitoring procedure, in particular for the two mechanisms of Article 14 of the Paris Agreement. [alberto fichera, Italy]	Taken into account. References are added to provide more explanations.
32132	54	16	54	30	This paragraph on MRV institutions does not include an analysis of the need for comparability. [Jamaica]	Rejected. The need for comparability is reflected on lines 28-30 of the paragraph. See key phrase "assess progress on implementation across and within nations"
36134	54	16	54	30	Add - Enhancement of transparency is linked to the capacity of deveoping countries to adopt stringent reporting measures, which is further contingent on the support extended to them by the developed countries. Hence, a mutual trust and collaboration is needed for a progressive action [India]	Taken into account. The link of transparency to capacity building is already reflected in Article 13 through the creation of the Capacity Building Initiative on Transparency
36498	54	16	54	30	This paragraph on MRV institutions does not include an analysis of the need for comparability. [Snaliah Mahal, Saint Lucia]	Rejected. The need for comparability is reflected on lines 28-30 of the paragraph. See key phrase "assess progress on implementation across and within nations"
55116	54	16	54	30	Suggest to add a bit more: need to leverage existing institutions (statistics, university to improve the collection, use, management and storage of data; and also refere to the last sentence of Box 4.9 - importance of better ex-ante and ex-post policy design and management to monitor effort, performance and foster evidenced based policy reforms. I suggest referencing he paper Dagnet, Y., M. T. Rocha, T. Fei, C. Elliott, and M. Krnjaic. 2017. "Mapping the Linkages between the Transparency Framework and Other Provisions of the Paris Agreement." Working Paper. Washington, DC: Project for Advancing Climate Action Transparency (PACT). Available online at http://www.wri.org/publication/pact-linkages-transparencyframework/. This paper shows the mutually reinforcing monitoring reporting and review processes created under the Paris Agreement, especially around Art 13 (Enhanced transparency framework), Art 14 (the global stocktake) and Art 15 (the mechanism to facilitate implementation and promote compliance). [Yamide Dagnet, United States of America]	Taken into account. This already reflected in the first three sentences of the paragraph. Some more text is added to further emphasize the importance of these institutions. Unfortunately, the reference does not meet IPCC literature guidelines and may not be cited.
62794	54	16			Maybe more can be said on the benefit of better transparency and accounting, e.g. concerning NDCs, for the implementation of the PA. [Elmar KRIEGLER, Germany]	Taken into account. Some text added to better explain the paragraph. Further details on the benefit of the Paris transparency framework are constrained by the scope and the space allocated to the section.
61096	54	22	54	26	The Paris Agreement requires monitoring and reporting, and such a system would be integral to monitor efforts to achieve 1.5°C of temperature just as it would be to monitor efforts to achieve any temperature level. Therefore suggest the following sentence be deleted. "Scaling up these efforts to be consistent with 1.5°C would put significant pressure on the need to develop, enhance, and streamline local, national, and international climate change reporting and monitoring methodologies and institutional capacity in relation to mitigation, adaptation, finance, and GHGs inventories (Ford et al., 2015a; Lesnikowski et al., 2015; Schoenefeld et al., 2016)." [United States of America]	Noted. The sentence is meant to further emphasize the critical Importance as well as the challenges of developing such institutions
16524	54	26	54	30	There is a reference to two mechanisms: progression and global stock take. It seems that it should refer to one mechanism: global stocktake, which then enables an assessment of collective progress towards achieving the purpose of the Agreement and its long-term goals. [Australia]	Accepted. Sentence revised
18632	54	26	54	27	This sentence is not an accurate description of the Paris ambition mechanism for a number of reasons. In particular the terms "progression" and "scaling up" are not mentioned in Article 14, and the term "mechanism" can be misinterpreted. It would be more appropriate to mention that provision of information to the global stocktake (Art 14) is one reason why the good functioning of the enhance transparency framework (Art 13) is important. [Andrea TILCHE, Belgium]	Accepted. Sentence revised
61098	54	26	54	30	The Paris Agreement does not contain a progression "mechanism." Suggest that the text be amended to read "In addition, the Paris Agreement in its Article 14 has established the global stock take, to "take stock of the implementation of [the] Agreement to assess the collective progress towards achieving the purpose of this Agreement and its long-term goals" (UNFCCC, 2015c)." [United States of America]	Accepted. Sentence revised
33130	54	33	54	55	This section needs to look at equity of access to climate finance. See work by IIED on access to climate finance at the local level. https://www.iied.org/six-steps-local-climate-finance [Tara Shine, Ireland]	Noted. This section focuses on availability, enhancement, and challenges related to financial institutions rather than the detail of their operations including equity of access to financial resources. See section 4.4.5 for some of the operational aspects
35536	54	33	54	33	Accountability of international financial institutions has been a concern and there is sufficient literature available about it. Including such literature and bringing in the accountability angle of financial institutions would be useful. [Ashok Sreenivas, India]	Taken into account. The detailed aspects of institutions are dealt with in other sections including 4.4.1 on governance and 4.4.5 on finance
42824	54	33	54	55	Within the Montreal Protocol, the Multilateral Fund (MLF) serves to finance the transition away from restricted refrigerants in a bid to aid developing countries with the transition, which allows for a smoother transition and greater likelihood of success. [Kristin Campbell, United States of America]	Noted.
43072	54	33	54	47	Within the Montreal Protocol, the Multilateral Fund (MLF) serves to finance the transition away from restricted refrigerants in a bid to aid developing countries with the transition, which allows for a smoother transition and greater likelihood of success. [Durwood Zaelke, United States of America]	Noted.
61100	54	33	54	55	The discussion of capacity building in financial institutions could be written more crisply to bring out the key points and distinguish it from the climate finance discussion in 4.4.6; alternatively, these sections could be merged. [United States of America]	Taken into account. The finance paragraphs are revised significantly taking on board the comment.
3910	54	34	54	47	The gobal financial systems are underinvesting generally, not only with regard to climate mitigation. This broader systemic context could be usefully acknowledged here. The OECD report 'Investing in Climate, Investing in Growth' 2017 identifies this broader infrastructure financing gap. [Emily Tyler, South Africa]	Noted. Our interest here in climate related finance, not the global financial system
28614	54	34	54	35	volume and patterns of climate investments need to be transformed: the formulation is misleading. The volume has to be transformed, but it is not clear how the patterns of climate investments should be changed. Probably it is meant that the patterns of general investment behaviour needs to be changed to shift investments towards sustainable projects, as stated in IPCC AR5 SPM.5: "Substantial reductions in emissions would require large changes in investment patterns." Please rephrase accordingly. [Germany]	Accepted. Sentence revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
53148	54	34	54	55	The section gives the impression that public and private finance must be viewed as separate silos. One of the main roles of public finance, given its limited capital base, is to mobilize private sector investment through co-finance, but also enabling factors, such as policy development. The section could do a better job a citing the importance of enabling conditions for private investment. See: Westphal, M.I., and J. Thwaites. 2016. "Transformational Climate Finance: An Exploration of Low Carbon Energy." Working Paper. Washington, DC: World Resources Institute. Available online at http://www.wri.org/publication/transformational-climate-finance. Green, A. and M. I. Westphal. 2017. "Designing and Testing a Methodology to Estimate Private Climate Finance Mobilization from Policy and Other Causal Factors." Working Paper. Washington, DC: World Resources Institute. Available online at http://www.wri.org/publication/designing-testing-methodology-estimate-private-climate-financemobilization-policy-other-causal-factors. [Westphal Michael, United States of America]	Taken into account. Paragraph revised taking the comment on board. The reference could not be cited because IPCC literature guidelines will not allow for citing working papers.
62198	54	34	54	47	Financial institution will have the task to finance both the new infrastructure and to refinance the stranded assets. This could be mentioned here because in the context of 1,5°C the situation of debt incurred by existing carbon intensive assets (in electricity, transport, industry...) could be very common. [Antoine Bonduelle, France]	Accepted. Paragraph revised with the comment taken on board.
28616	54	35	54	37	These numbers are not entirely clear: the necessary amount would be additional to which baseline? In addition, as the AR5 is based on numbers predating the year 2014, it may be helpful to complement this by more recent estimates (if available), especially given the drastic cost reductions in renewables and storage technologies over the last years. [Germany]	Taken into account. Sentence revised to state the reference year. Updated investment numbers for 1.5c are not yet available in the reviewed literature (see section 4.4.6)
34636	54	36			Please separate "efficiencymeasures" [Mexico]	Rejected. The objective here is on assessing financial institutions not the details of financial needs for low-emissions energy and energy efficiency options. Details on these options are discussed in other sections, e.g. 4.3 as well as in chapter 2.
56364	54	36	54	36	Typo [Nuno Bento, Portugal]	Editorial done. Thank you.
28618	54	37	54	38	Without further explanation, this demand is too general and unclear. There are many examples of financial institutions that work quite well and implement innovative measures to shift investments from brown to green. Moreover, the term "financial institutions" includes such a wide range of different financial providers, that general statements are necessarily problematic. If the question of how financial institutions can contribute to the 1.5°C goal should be dealt with, it would be necessary to differentiate. [Germany]	Taken into account. Paragraph revised taking on board some of the issues outlined in the comment
61102	54	37	54	38	The citation for this statement deals with China alone, but the conclusion drawn is global in scope. Suggest removing the statement or revising to more accurately reflect the evidence base. [United States of America]	Accepted. paragraph revised. More references added to substantiate the text
28620	54	39	54	40	While mobilizing investments is an important requirement, the task ahead does also imply shifting investments from current, carbon intensive production and infrastructure to low carbon portfolios. Please consider to rephrase along the following lines: "Both public and private financial institutions would be required to mobilize, shift and incentivise investors to shift investment in order to meet the scale of resources needed for a 1.5C pathways". [Germany]	Taken into account. Paragraph revised. The term "mobilization" include incentivizing investors to shift investments.
28622	54	40	54	42	The formulation of the sentence is not very comprehensive. Moreover, the risks mentioned are just one aspect of several barriers to the upscaling of climate finance. It could be worth elaborating more in detail on the obstacles. Please revise. [Germany]	Accepted. Paragraph revised taking on board the comment
7478	54	42	54	43	Carbon markets are not a private financial institution; they build on public regulation. Please thus reword as follows: "Carbon markets, which have played an important role under the Kyoto Protocol, could face risks of carbon price volatility and insufficient political will to acquire carbon credits". [Axel Michaelowa, Switzerland]	Accepted. Paragraph revised
28624	54	42	54	43	Carbon markets are not private financial institutions. Please revise. [Germany]	Accepted. Paragraph revised
40464	54	42	54	42	Carbon markets are neither financial institutions nor necessarily private. It would be useful to choose more appropriate and less controverted examples of private funding to discuss the issue. [Pedro Alfredo Borges Landaez, Venezuela]	Accepted. Paragraph revised taking on board the comment
56366	54	42	54	42	Suggested additional up-to-date reference for the risks of technology up-scaling: Wilson, C. (2012). Up-scaling, formative phases, and learning in the historical diffusion of energy technologies. Energy Policy, 50, 81-94. [Nuno Bento, Portugal]	Taken into account. Reference cited
28626	54	43	54	45	The range of public financial institutions is quite broad and this statement is too general, as it does not hold true for all public financial institutions. Please add qualifiers here, or elaborate further. [Germany]	Accepted. paragraph revised. Text elaborated and more references added to substantiate the text
7480	54	45	54	45	Please replace "Hoch 2017" by "Bodnar et al. 2018". Reference: Bodnar, Paul; Ott, Caroline; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily; Wagner, Gernot (2018): Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation, Climate Policy, 18:3, p. 368-382, [Axel Michaelowa, Switzerland]	Taken into account. Reference added
8242	54	45	54	45	Please replace "Hoch, 2017" by "Bodnar et al., 2018". Reference: Bodnar, Paul; Ott, Caroline; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily F.; Wagner, Gernot (2018): Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation, Climate Policy, 18:3, p. 368-382. [Angela Geck, Germany]	Taken into account. Reference added
18634	54	45	54	46	It is debatable whether creation of new financial institutions would solve the problems identified. [Andrea TILCHE, Belgium]	Noted.
28628	54	45	54	46	The suggestion of Hoch (2017) is very specific and might be one of several ways to address the challenge (b.t.w. it is not very clear which challenge exactly is meant). It is questionable whether this proposition should be highlighted without mentioning all the others (and again, it could be useful to elaborate more in detail on this issue). [Germany]	Accepted. The sentence is revised indicating that Hock (2017) is just an example. More text and references are added to substantiate the paragraph
37428	54	45	54	45	Replace "Hoch 2017" is "Bodnar et al. 2018". – full reference: Bodnar, Paul; Ott, Caroline; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily; Wagner, Gernot (2018): Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation, Climate Policy, 18:3, p. 368-382, [Matthias Honegger, Germany]	Taken into account. Reference added
1878	54	49	54	55	This section is still underdeveloped. I would add that bilateral and multilateral financial institutions are increasingly investing in adaptation, but that the low private-sector awareness on adaptation means it is more difficult to prepare projects together (see Pauw, 2017: https://link.springer.com/content/pdf/10.1007%2Fs10784-016-9342-9.pdf However, the visible level of private adaptation activity may understate the actual level of activity. Activities to improve the management of climate risks may occur as part of standard risk management or planning processes without being explicitly labelled as adaptation. There is little incentive for companies to identify and publicise the work they are doing on adaptation (Agrawala, S. et al. (2011), "Private Sector Engagement in Adaptation to Climate Change: Approaches to Managing Climate Risks", OECD Environment Working Papers, No. 39, OECD Publishing. http://dx.doi.org/10.1787/5kg221jkf1g7-en [Willem Pieter Pauw, Germany]	Rejected. The role of multilateral financial institutions was moved to be discussed in section 4.4.5
28630	54	49	54	53	It is not very clear, why the reference of Linnerooth-Bayer and Hochrainer-Stigler (2015) is cited here. The authors discuss financial instruments for adaptation in general, while this section should deal exclusively with financial institutions. This part could be better shifted to the subchapter on adaptation finance (4.5.3.3). [Germany]	Rejected. The focus is on financial institutions for adaptation not financing adaptation which is the subject of 4.5.3.3

Comment No	From Page	From Line	To Page	To Line	Comment	Response
33980	54	49	54	53	We appreciate the inclusion of the impact of financial instruments in pushing the reduction of emissions. This is well stated. [Norway]	Noted. Thank you.
61104	54	49	54	55	This paragraph does not adequately discuss the role of formal institutions in adaptation finance, similar to the previous paragraph. It talks only about microfinance institutions, and summarizes a set of financial instruments. [United States of America]	Noted. An in-depth discussion of role of formal institutions in adaptation finance is provided in 4.4.5
28632	54	51	54	52	The sentence without further elaboration is not very helpful. In most cases benefits come at a cost, but what are these costs and why is it problematic? [Germany]	Accepted. Paragraph revised
14226	54	52	54	54	We suggest the word 'including' to be replaced with the words 'such as' in order to avoid the repitition of the word including and improve the flow of the sentence [United Republic of Tanzania]	Taken into account. Editorials made. Thanks
28634	54	53	54	55	It is not clear, what is the intention of this last sentence. Do you want to mention the important role of micro-finance institutions for adaptation finance? Micro-finance is always at the local level. Perhaps, you want to stress more that in comparison to mitigation finance, the actors that have to be reached are different (in many cases individuals and not huge companies) and, thus, other types of financial institutions become important. [Germany]	Noted. The objective here is give example of financial institutions for adaptation at the local level
12342	55		56		Seems to place too much emphasis on information provision and communication (e.g. see Bernaur and McGrath, 2016, Simple Re-framing Unlikely to Boost Public Support for Climate Policy or alternate papers for consideration of effect sizes). [United Kingdom (of Great Britain and Northern Ireland)]	Noted. Section 4.4.3.2 discusses many different strategies for changing behaviour, among which (but not only) information provision and communication
12344	55		56		Table 4.6 – it should identify these are examples of behaviours (there are plenty of others). [United Kingdom (of Great Britain and Northern Ireland)]	Accepted, changed accordingly.
12346	55		65		The content is very heavily focused on awareness, information, communications and other behavioural nudges. Focus should also be given to social practices and social practice theory. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. The section discusses many other factors influencing behaviour, including moral considerations, feelings, and habits, and discusses various strategies of behaviour change in section 4.4.3.1, not only information and communication.
12348	55		65		Don't appear to grapple with the publication bias issue, which is potentially prominent in behavioural research. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. Following IPCC guidelines, we assess peer reviewed papers only.
12350	55		65		Surprised there was no mention of business/organisational behavioural change, indirect and direct rebound effect, habit discontinuity and spillover effects (cf single-action bias). [United Kingdom (of Great Britain and Northern Ireland)]	Noted. (in)consistencies across behaviours are discussed in the last paragraph of section 4.4.3.2; organisational behaviour in included in Table 4.8, and elsewhere (eg section 4.4.3.2) - similar factors appear to be related to individual and organisational behaviour (change)
57366	55	5	55	7	Too general comment. The different dimensions of social capital can have very different effects (incl. negative ones) for adaptation and mitigation and are highly context-dependent. [Hans Poertner, Germany]	Noted.
40	55	29	55	29	spelling error [Risto Herrala, United States of America]	Editorial
7220	55	29	65	46	It is not clear what differentiates 'Ability to engage in climate action' and 'Motivation to engage in climate action', and the section 'Habits and Mental Shortcuts' draws almost exclusively upon economic literature without considering literature from other relevant disciplines (i.e. social psychology). Indeed, what is meant by 'habits' and 'mental shortcuts' in this context? Considering this section 'discusses how to enable and encourage behavioral and lifestyle changes that strengthen implementation of 1.5C pathways', a more structured assessment of enabling conditions and constraints at individual, group and cultural/societal scales would be helpful. This could be presented succinctly in a table, and should draw further from insights provided by psychology and human geography. The second part of this section could then, in a more structured way, examine strategies that enhance climate action and the social acceptability of climate responses (adaptation/mitigation), grouped by themes (i.e. economic incentives, values, justice, political ideology). These could also be tabulated to reduce word length. [Petra Tschakert, Australia]	Accepted. Ability reflects capability to change, while motivation reflects reasons for action - this is now clarified in the text. Habit imply that people do not weigh costs and benefits of actions, while mental shortcuts reflect the use of heuristics and biases in decision making. The text has been clarified. Discussing enabling conditions and constraints at different levels would lead to much repetition, and difficulties to meet word count. The strategies are grouped by theme, following a different categorisation, including assessing the role of values, fairness, economic incentives. political ideology, type of policy, trust
7482	55	29	55	29	Section 4.4.3 should also discuss how new emissions increasing consumption goods/services (e.g. space tourism, mining of cybercurrencies, electricity use of the internet of things ...) could be prevented through dedicated policies. [Axel Michaelowa, Switzerland]	Noted. The options included in table 4.8 imply reducing consumption of goods and services, which include preventing increases in consumption
12352	55	29	55	29	Missing space, should read "Enabling lifestyle and behavioural change." [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
29312	55	29	55	29	need comma "andbehavioural" [Yuanyuan Huang, France]	Editorial
34638	55	29			Please separate "andbehavioural" [Mexico]	Editorial
44094	55	29	55	29	needs space in heading [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
45524	55	29	55	29	This section is 1.5 relavrnt rath than 1,5 targeted. What does it leave for Ch 5 of the WG III report [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted. 4.4.3 only summarises main points due to space limitations. Ch 5 of AR6 can provide a more comprehensive and in depth overview of the literature
32874	55	29	65	49	The role played by water systems is not sufficiently elaborated in this section (and in the overall report) and water is only partially addressed and framed when talking about 'irrigation efficiency' (with not even a subsection on its own) or as 'sustainable urban water and environmental services'. The management of water systems –both freshwater and marine one-, understood in a systemic and integrated perspective, and in particularly their multiple management options –or even its implications and feasibility of CDR options-, can play a critical role in transformations processes in many sectors, at multiple levels of action and both with regard to mitigation and adaptation, including in securing the long-term sustainability of biophysical systems. This is especially critical in draught-prone areas but also has implications for many other domains including global trade (e.g. virtual water coming to Europe from draught-shaken areas like South Africa in the form of citric fruits). [J. David Tabara, Spain]	Taken into account. It does not have its own section as we did our assessment at the system level in section 4.3. However, it has a place in options in sections 4.3.2 and 4.3.3 as well as in chapter 5.
50068	55	29	65	46	This section on influencing behaviour and lifestyle is very important, because this aspect is crucial in 1.5 degree strategies, much more than in 2 degree strategies. Is is extra relevant for the report, because the IAM literature in chapter 2 is hardly covering this issue. The problem with the section is that it does not lead to conclusions that are relevant for policy makers. It refers to a large number of publications, without presenting useful messages, while such messages are in fact presnet. When I read through the section I find the folowing policy relevant messages (see also my comments on the SPM on page 22, line 41): (1) so far behaviour oriented policy has not been apllied widely and stringently and therefore effects have been limited; (2) behaviour can be influenced by disseminating knowledge on climate change and the relevant technologies and practices to limit it , but account must be taken of values, ideology and worldviews in designing optimal information campaigns; (3) emphasising individual and social benefits can make policies to influence behaviour more effective;(4) people are more likely to change behaviour if they are given the opportunity to make commitments, if they feel they are part of a community effort and if they feel the burden of taking action is fairly shared with business and government; (5) voluntary changes that involve rewards are more effective than imposed changes that restrict choice. Condense the section and reorganise, so that the various messages emerge form seperate parts of the text. [Bert Metz, Netherlands]	Accepted. Policy relevant conclusions have been highlighted
52182	55	29	55	29	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
56368	55	29	55	29	Typo [Nuno Bento, Portugal]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
53870	55	29	58	17	In chapter 4.4.3, I miss a section discussing structural drivers of behaviour (for example urban structure, time use, culture, economic structures). For example, the social practice approach (ref below) highlights the need to change underlying social, economic and political structures to make behaviour change possible, as Shove (2010, ref below) notes: "governments sustain unsustainable economic institutions and ways of life, and the extent to which they have a hand in structuring options and possibilities." Suggested refs: Shove, E. (2010). Beyond the ABC: climate change policy and theories of social change. Environment and Planning A, 42(6), 1273–1285. http://doi.org/10.1068/a42282 and Shove, E., Watson, M., & Spurling, N. (2015). Conceptualizing connections: Energy demand, infrastructures and social practices. European Journal of Social Theory, 18(3), 274–287. http://doi.org/10.1177/1368431015579964 [Grandin Jakob, Norway]	Noted. We indicated in the start of section 4.4.3.1 that structural drivers are discussed in other sub-sections of 4.4.
12354	55	31	55	33	With three separate references to climate change, modified as variously as global and anthropogenic, this is a cluttered and confusing sentence. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted, the sentence has been modified
39254	55	31	55	32	Important point to highlight in the SPM [Lindsey Cook, Germany]	Noted. The significant role of behaviour change in 1.5C pathways is included in the SPM
61106	55	34	55	36	Are the authors implying that IAMs don't include behavior change at all, or that their representation is limited? This sentence should be more concrete. What do IAMs include? What is missing? Many of the changes described in Table 4.6 are included in IAMs. [United States of America]	Accepted, sentence has been modified and now reads: This section assesses the potential of behaviour change, as the IAMs applied in Chapter 2 do not provide a comprehensive assessment of this potential (Geels et al., 2016a)
3912	55	38	55	38	Space missing between '1.5C' and 'pathways' [Emily Tyler, South Africa]	Editorial
7106	55	38	55	38	Spaces are needed between words [Jose Di Bella, Canada]	Editorial
12356	55	38			Missing space, should read "… relevant for 1.5°C pathways." [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
39256	55	38	55	41	Please elaborate, for example, DRAWDOWN (Hawken 2017) stated educating girls and family planning were the 6th and 7th most effective long term mitigation actions. This approach is useful, and less threatening when outlined, to those fear discussions on population [Lindsey Cook, Germany]	Noted. We changed the title of the Table to clarify that the Table and paragraph aims to provide an overview of behaviours that contribute to climate change mitigation or help to adapt to climate change, and not to indicate the effects of different policies. Effects of climate change mitigation and adaptation policies are discussed in section 4.4.3.2
32876	55	38	55	39	Section 4.4.3, p. 55, lines 38-39 and table 4.6: the text talks about 'reductions in populations growth can reduce overall carbon demand an mitigate climate change' -and the topic of population growth is also addressed in section 4.1, p9 lines 49 and p.10, lines 51-52. However, the table 4.6 does not capture the role of population control policies –consider then if it should- including the rapid reduction of fertility rates derived from promoting widespread female education –a policy which precisely would meet and could provide short/medium terms very positive effects both in climate and SDG goals. The issue of population and its relationship with the different actions and technologies may also be needed to be portrayed in more integrated and concrete/quantified manner, e.g. with a simple IPAT model (Impact = Population * Affluence/GHG reduction * Technology) to identify which kinds of technologies could be embraced by how many people and their relative reductions in GHG according to different scenarios. In my view, the information in table 4.6, albeit interesting, seems quite vague and unrelated to any quantification provided in the rest of the report. [J. David Tabara, Spain]	Noted. We changed the title of the Table to clarify that the Table aims to provide an examples of behaviours that contribute to climate change mitigation or help to adapt to climate change, and not to indicate the effects of different policies. Hence, this paragraphs discusses behaviours that help mitigate or to adapt to climate change, not to assess effects of policy to change these behaviours - these are discussed in 4.4.3.2
61108	55	38	56	2	Table 4.6 should include a mitigation behavior that relates to land use. Several of the examples provided raise questions that are not clearly addressed in the text and should be clarified or modified, e.g., heat pumps (how are these innovative?), reducing use of aluminum products (some alternatives for aluminum may result in higher emissions), elevating barriers between rooms, contributing to environmental organizations or petitioning on climate action (suggest replacing these examples with something more generic, e.g., engaging through civic channels to encourage or support planning for low-carbon climate-resilient development). [United States of America]	Accepted. The Table aims to provide examples of mitigation and adaptation behaviour, and does not aim to provide an extensive overview, nor only providing innovative options - we changed the title of the Table to clarify this. Suggested changes were included. Elevating barriers between rooms is an example of flood-protective behaviour, as indicated in the Table
31864	55	39	55	40	It is stated that "population growth is associated with affluence and increases in carbon-intensive consumption". It is not clear what is meant by this, but this seems to me a very controversial claim. At the country level, the reverse is typically true: parts of the world with lower affluence tend to have higher population growth. I recommend revisiting this claim and its intended meaning. [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, the text has been changed into '…particularly when population growth is accompanied with increases in affluence and carbon-intensive consumption.'
3914	55	41	55	42	It is often stated that technically easy mitigation options are 'relatively easy'. And yet this ignores the behavioural and systemic complexity of these options (which is why they have not been achieved to date!). This sentence could be reworded to reflect the category of mitigation option, or removed. [Emily Tyler, South Africa]	Accepted. Now rephrased as 'Mitigation actions with a substantial carbon emission reduction potential (see Figure 4.3) that individuals will readily adopt would have the most climate impact'
31862	55	41	55	42	It is stated that "Mitigation actions with a substantial carbon emission reduction potential... that are relatively easy to change would have most climate impact". This seems a misleading or unfortunately worded claim. Of course, the emissions reduction potential of an action is related to its climate impact - but the latter is not associated with easy of change. In fact, some of the 'easiest' mitigation actions are, regrettably, rather trivial in their impact (such as switching off appliances on standby) compared to more difficult actions (e.g. changing diet). If what is meant is that the potential for emissions reduction is a function of the value of an action and its plasticity/ ease of action, then this should be stated more unequivocally. [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Now rephrased as 'Mitigation actions with a substantial carbon emission reduction potential (see Figure 4.3) that individuals may readily adopt would have the most climate impact'
3916	55	44	55	44	The table heading could be clarified by including the words 'behavioural and lifestyle' to assist the reader. [Emily Tyler, South Africa]	Noted. The Table lists examples of behaviours, not lifestyles, so it would not be accurate to include behavioural and lifestyle. We adapted the title of the Table to clarify this
12358	55	44			Not sure of the provenance of Table 4.6. (Captioned on line 44). It is not clear how these behaviours in particular are relevant to a 1.5°C increase in average global temperature - or the scale are which these behaviours and technologies would have to be adopted to for them to contribute towards limiting the increase in average global temperature to 1.5°C. Figure 4.4. is a better example in that sense. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. The behaviours are relevant for reducing climate change, and thus for 1.5C, as they are associated with less GHG emissions. Unfortunately, limited data is available on the mitigation potential of different behaviours, but see Figure 4.3 for exceptions.
28636	55	44	56	1	Table 4.6: the list of relevant behaviours seems limited, and at the same time not very well defined. E.g. measures mentioned in SDG12 such as recycling, waste reduction and prevention, reuse, extension of life-time of products, sustainable design of products, sustainable management and use of natural resources (circular economy) and dematerialisation are missing. On the other hand, structural and infrastructure decisions that may be out of the reach of many individuals (such as "implementing resource efficiency in buildings") are qualified as "behavioural change" - the table seems to refer more to "mitigation and adaptation actions" than "behaviour/lifestyle change". We would highly recommend to put out a more consistent framework and then populate the table comprehensively, also providing references for examples of studies that have looked at the potential of specific actions. In the line on Adaptation, please specify what is meant by "Travelling to cool places" - moving to cooler places / rooms / shady areas nearby, or actual (seasonal) travel to avoid, e.g. specifically hot months of the year? Please specify. [Germany]	Accepted The table was not aimed to provide a full overview of mitigation and adaptation behaviours, but rather provide some protypical examples to demonstrate the wide range of behaviour options available - we changed the title to clarify this. We list different examples of behaviour. Travelling is replaced by moving
35538	55	44	55	46	Under mitigation options, reduction in consumption from affluent countries / regions / peoples is conspicuously absent, as is reduction of waste / introduction of closed loop systems etc. [Ashok Sreenivas, India]	Noted. Many behaviours included in the Table reflect consumption from affluent countries, eg reduce motorised and air travel, reduce meat consumption. The table was not aimed to provide a full overview of energy saving behaviours, but rather provide some protypical examples to demonstrate the wide range of behaviour options available.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
45520	55	44	55	44	Many examples are not purely behavioural (reocgnising socio-technical links) . More technical ones repeat earlier material [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The table includes behaviours, including adoption of technologies, which highlights that technological change implies behaviour change as individuals need to adopt and use the technology.
48116	55	44	56	46	Table 4.4. Row 5 : "Use of mass transit rather than fly". This seems to be more in the context of intercity transport. Please revise [Sarah Connors, France]	Noted. The table aims to demonstrate the wide range of behaviours that can mitigate or help adapt to climate change
54504	55	44			This list is good but it misses fundamental sources of mitigation and adaptation, like the sharing and circular (reduced waste) economies. [Thomas Thornton, United Kingdom (of Great Britain and Northern Ireland)]	Noted The table was not aimed to provide a full overview of energy saving behaviours, but rather provide some protypical examples to demonstrate the wide range of behaviour options available - we changed the title to clarify this. Sharing may not always reduce energy use, eg studies have shown that car sharing schemes attract users that did not drive before (S. Harms, Besitzen oder Teilen - Sozialwissenschaftliche Analyse des Car Sharings. PhD thesis. Verlag Rüegger, Zürich 2003, ISBN 3-7253-0753-9
58358	55	44			Table 4.6: this table is not really focused on the behaviour aspects, and therefore comes across as rather simplistic. Suggest to either focus in on the behaviour aspects of each policy, or cut the table [Andrew Prag, France]	Noted. The Table aims to provide an overview of behaviours that contribute to climate change mitigation or to adapt to climate change, and not to behaviour aspects of a particular policy. We changed the title to highlight this.
51286	55	46	56	46	Under "Mitigation" Climate action, "Energy saving behaviour" Type of action, "lower room temperature" has been mentioned. It needs to be changed to "Lower room temperature for space heating" and "Higher room temperature for cooling". [Muhammad Latif, Pakistan]	Accepted
55862	55	46			Table 4.6. Change adoption of renewable energy sources to mitigation and adaptation as we make the argument of DRE for adaptation throughout the chapter, and also in Ch. 5 [Debora Ley, Guatemala]	Accept, changed accordingly
14228	56		56		In the Table 4.6 under the climate action 'Adaptation' there is a Type of Action witten as "Drought and Lack of freshwater supply" which I believe it is not an adaptation action but rather climate change impacts. I suggest it should read "Promoting efficient water use during water shortage crisis" [United Republic of Tanzania]	Accepted, changed accordingly
56370	56		56		In the line "Organisational behaviour": This table seems to me very conservative and overlooking important emerging trends. I suggest to add the following example: "Sharing the use of a large number of goods (bikes, cars, consumer goods, etc.)". In case a reference is needed: Stahel, w. R. A vision of the world in 2030 and a back casting in order to guide actions today. Societal Wealth Should Be Measured In Stock, Not Flow, <http://www.product-life.org/> (2013) [Nuno Bento, Portugal]	Noted The table was not aimed to provide a full overview of mitigation and adaptation behaviours, but rather provide some protypical examples to demonstrate the wide range of behaviour options available - we changed the title to clarify this. Sharing may not always reduce energy use, eg studies have shown that car sharing schemes attract users that did not drive before (S. Harms, Besitzen oder Teilen - Sozialwissenschaftliche Analyse des Car Sharings. PhD thesis. Verlag Rüegger, Zürich 2003, ISBN 3-7253-0753-9.
31544	56	1	56	1	The content of the 2nd row from the bottom and the central column of Table4.6 ("Drought and lack of freshwater supply") needs to be modified because it is not "Type of action" of adaptation. [Japan]	Accepted, see response to comment 2709
39258	56	1	56	4	Missing on the list for citizen behavior change are critical elements of reduced material consumption, reduced food waste, family planning, educating girls, readjust current economic paradigms which enable continued root causes. [Lindsey Cook, Germany]	Noted. The table was not aimed to provide a full overview of mitigation and adaptation behaviours, but rather provide some protypical examples to demonstrate the wide range of behaviour options available - we changed the title to clarify this.
62796	56	1	56	1	I think land use related behavioural changes are missing here. Changing diets is particularly relevant for reducing livestock and thus areas needed for grazing and Non-CO2 livestock emissions (independently of lowering energy demand). [Elmar KRIEGLER, Germany]	Accepted, the type of action in third row has been rephrased as follows: Buy products and materials with low GHG emissions during production and transport
10106	57				Figure 4.4: First, to what extent are the various numbers on mitigation in the figure comparable or consistent given they are obtained from different studies with different methodologies and different time frames and scope. Second, what makes these number specific or relevant to 1.5c -- one may argue that they are applicable wide range of warming levels. [Saudi Arabia]	Noted. Indeed, the numbers are applicable to a wide range of warming levels - more substantial and wide scale changes in each behaviour will be needed the more ambitious the temperature goal. The numbers are not directly comparable as some reflect %GHG emission reductions, some transportation emissions (which is more specific), while others are even more specific. The limited literature base does not provide numbers that are directly comparable
46992	57		57		Colourblind check for this figure. Please avoid using greens and reds together in figures as they are hard to distinguish between. [Sarah Connors, France]	Editorial
54716	57				Fig 4.4 not at all readable [Qudsia Zafar, Pakistan]	Editorial
13976	57	1	57	1	I like this figure, but I do not understand why these particular countries are chosen. The rationale should be included in the figure caption, so that the figure is stand alone. Are these the only studies that exist? Or the most important? But there is a lack of information from the global south (only india). [Natalie MAHOWALD, United States of America]	Noted. Indeed, these are the only studies we found in the literature search
31724	57	1	57	1	The text size in Figure 4.4 may need to be increased for legibility [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
39260	57	1	57	1	Excellent - if possible relay positive examples of policy which build on some of the most effective citizen actions, like diet change. [Lindsey Cook, Germany]	Noted. Effects of policy is assessed in 4.4.3.2
35540	57	1	57	4	It is extremely interesting / distressing to note that the literature referenced speaks of mitigation potential in a country such as the US only in the range of 1-5% while it has mitigation potential in a country such as India of 35% - 70%, when the former consumes much more on an aggregate and per-capita basis and has done so for a hundred years as compared to the latter. Such tables and statements patently dent the credibility of reports such as this. [Ashok Sreenivas, India]	Noted. See reply to comment 2714 - The limited literature base does not provide numbers that are directly comparable. For example, some reflect %GHG emission reductions, some transportation emissions (which is more specific), while others are even more specific; the unit is clearly specified in the figure.
46418	57	1	57	4	Add a triangular sign (for Transportational behaviour) in Norway, with the following text and reference: "59% less CO2-eq in private mobility by households forced to halve emissions by policies asked by them." Source: Moberg K. R., Aall C., Dorner F., Reimerson E., Céron J.-P., Sovacool B. K., Piana V., Sköld B., "Mobility, food, and housing: Responsibility, individual consumption, and demand-side policies in European deep decarbonisation pathways", Energy Efficiency, Special Issue on "Demand-side policies, governance and socio-technical mitigation pathways of limiting global warming to 1.5°C", 2018. [Valentino Piana, Italy]	Noted. The paper has not been published in a peer reviewed journal yet so cannot be assessed
52184	57	1	57	2	The colours are too similar, it's hard to read, the fonts are also small. [Jason Donev, Canada]	Editorial
61110	57	1	57	4	The examples in this figure require more context. Are the quantitative emission reductions cited global, national, or local? Also note that some sources are somewhat dated. [United States of America]	Noted. The assessments reflect national emissions in the country indicated, unless specified differently (ie savings in CO2-eq globally in the centre of the Figure)
62004	57	1	57	5	A world map may not be needed if examples come only from 3 regions (Indian, Europe, USA). [Valérie Masson-Delmotte, France]	Noted. Although a limited amount of examples in other countries may exist, the World's map is also useful for pointing to the knowledge gaps on behaviour change impacts in countries that are not Europe, USA or India.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
30638	57	2	58	5	We can see important differences in the examples. The US examples take into account GHG emissions, whereas the other examples consider "emissions". For instance: * carpooling: -1% GHG emissions in the US vs -13 to 18% in example 4 (NL). [France]	Noted. See reply to comment 2714 - The limited literature base does not provide numbers that are directly comparable. For example, some reflect %GHG emission reductions, some transportation emissions (which is more specific), while others are even more specific; the unit is clearly specified in the figure.
31546	57	2	57	2	Using a world map can unavoidably stress geographical differences and may mislead readers if there are missing literature. Therefore, it should be noted whether all available literature are covered. [Japan]	Noted. Figure 4.3 includes existing examples to the best of our knowledge, but the list may not be complete.
45522	57	2	57	2	Must avoid the impression that these add up to 1.5 (or even that individual examples are sufficient [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, title changed into: Figure 4.3: Examples of mitigation behaviour and their GHG emission reduction potential. Mitigation potential assessments are printed in different units, and based on [1] (Carlsson-Kanyama and González 2009); [2] Tuomisto and Teixeira de Mattos 2011; [3] Springmann et al. 2016; [4] Nijland and Meerkerk 2017; [5] Woodcock et al. 2009; [6] Salon et al. 2012; [7] Dietz et al. 2009; [8] Mulville et al. 2017; [9] Huebner and Shipworth 2017; [10] Jaboyedoff et al. 2004; [11] Pellegrino et al. 2016; [12] Nägele et al. 2017.
47962	57	2	57	2	Kindly check: except Dietz et al., 2009 all references are not available in the reference list. [Sarah Connors, France]	Noted. References have been added.
53584	58		65		Section 4.4.3.1 on factors related to climate action is a very interesting section, in particular the linkages between worldviews and acceptance of climate policy and RE systems if one has an egalitarian worldview is fascinating. An extension of that would be a reflection upon typical ideologies which drive public investments towards hihg-carbon development pathways. This is eluded upon in the statement that "policymakers displayed action biases (wanting to demonstrate positive action in spite of potential negative consequences)" (Patt and Schröter, 2008). The point I am trying to make is that the extensive discussion on why and how individuals and people engage or dont engage in climate action, is extremely useful. It would be equally interesting to read how this individual behavior converges with / reinforces / leads to climate action or inaction, at different scales of governance. [Sumetee Pahwa Gajjar, India]	noted, this is a very relevant question indeed. Unfortunately, we did not find papers on this topic.
54094	58	1	58	5	Two points should be raised in this context a) There is a growing body of evidence that combinations of policies can provide the desired cource of action, see for example Nissinen, A., Heiskanen, E., Perrels, A., Berghäll, E., Liesimaa, V., Mattinen, M.K., 2015. Combinations of policy instruments to decrease the climate impacts of housing, passenger transport and food in Finland. Journal of Cleaner Production 107, 455–466. https://doi.org/10.1016/j.jclepro.2014.08.095 and b) that experimentation at the local level can prove to be important in opening new routes for the changes to occur. See for example Jalas, M., Hyysalo, S., Heiskanen, E., Lovio, R., Nissinen, A., Mattinen, M., Rinkinen, J., Juntunen, J.K., Tainio, P., Nissilä, H., 2017b. Everyday experimentation in energy transition: A practice-theoretical view. Journal of Cleaner Production 169, 77–84. https://doi.org/10.1016/j.jclepro.2017.03.034; Kivimaa, P., Hildén, M., Huitema, D., Jordan, A., Newig, J., 2017. Experiments in climate governance – A systematic review of research on energy and built environment transitions. Journal of Cleaner Production 169, 17–29. https://doi.org/10.1016/j.jclepro.2017.01.027; Laakso, S., Berg, A., Annala, M., 2017. Dynamics of experimental governance: A meta-study of functions and uses of climate governance experiments. Journal of Cleaner Production 169, 8–16. https://doi.org/10.1016/j.jclepro.2017.04.140 [Mikael Hildén, Finland]	Accepted, we added text on combinations of policy. Policy experimentation is indeed important, but results may not always be translated to other contexts if different barriers and enablers play a role. The assessment of the literature is in many cases based on policy experimentation and evaluation
46934	58	2	58	2	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	accepted, changed into will
12360	58	4	58	5	Suggest ending the current sentence on line 4 after "... Stern, 2011)." and beginning a new one as "This suggests that different policy approaches may be needed in 1.5°C pathways in different contexts." Please note that this also corrects the dropped space in "1.5°Cpathways" and pluralises "context" on line 5. [United Kingdom (of Great Britain and Northern Ireland)]	accepted, changed accordingly
34640	58	5			Please separate "1.5ºCpathways" to 1.5° pathways [Mexico]	Editorial
3918	58	7	58	12	It is not clear that this assertion is relevant for developing countries and less mature democracies - certainly for south africa - where environmental issues, particulaly that of GHG emission reduction - do not feature as voting issues. Perhaps this distinction could be noted, including that different strategies are therefore likely in developing countries.(For example In South Africa progress is being made through the regulatory arena by environmental NGOs). This is linked to the comment below. [Emily Tyler, South Africa]	Accepted, now indicated that this is based on studies in US and EU
31866	58	7	58	12	The picture of international public opinion on climate change is much more complicated than portrayed, and this section is rather Western (EU and US) - centric. One review that assesses the international and temporal picture of public perceptions is doi: 10.1002/wcc.321 - this points out the relevance of factors such as economic downturn and experience of extreme weather on climate change perceptions, as well as national-cultural factors (particularly the prevalence of relatively high levels of scepticism in Anglophone countries) in addition to the 'elite cues' identified by Brulle et al. (2012). [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Noted, see response to comment 2740. Please note that this section discusses the effects of political factors, not public opinion. More generally, due to space restrictions, we focus on factors related to climate action, and effects and acceptability of climate policy, and do not assess the literature on factors related to climate concerns on beliefs, or other factors related to other predictors of climate action.
31868	58	7	58	12	A global perspective on public concern is also given by DOI: 10.1038/NCLIMATE2728 - this points to South/Latin America as especially concerned; this study also finds educational attainment and experience of local temperature change to be key influences on awareness/concern. [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Noted, see response to comment 2741
39262	58	7	58	7	Please highlight this important statement for policy makers in BOLD. [Lindsey Cook, Germany]	Noted, printing text in bold is not in line with IPCC guideline
54432	58	7	58	7	Consider citing Jensen and Spoon (2011) alongside Dietz et al. 2015. Jensen, C.B. and Spoon, J.-J., 2011. Testing the 'Party Matters' Thesis: Explaining Progress towards Kyoto Protocol Targets. Political Studies, 59 (1), 99–115. [Conor Little, Ireland]	Accepted
61112	58	7	58	7	Recommend deleting this paragraph, which does not connect directly with 1.5°C pathways. Note also that the claim on line 7 is very sweeping and relies on a single source; it should be deleted. [United States of America]	Noted, additional reference is added.
12362	58	10	58	12	Should read "In the European Union, the perceived threat of climate change is higher…" as the definitive article is currently missing. Also, the term higher is a comparative, but no comparison is offered. Is the perceived threat higher than the global average? Than certain other countries?? [United Kingdom (of Great Britain and Northern Ireland)]	Editorial, sentence has been rephrase. A comparison is made between countries where political party elites are united versus divided in their support for environmental issues
5652	58	10	58	12	appreciate the important statement that political systems and national government conditions can have substantial impract o adaptation efforts and success! Though it might also be useful to mention the way in which money can have influence on the political process. In Norway, for example, the closeness of the petroleum industry to the government can have undue influence on the ability to address climate change, despite the best intentions and rhetoric of politicians. The same can be said about Germany, where the scandals around car makers manipulating emissions reductions in the car production process has undermned the German governments commitments to be a technological powerhouse in green technology. (similarly, the US government under the current president has moved away frmo its commitments, leaving the space for mayors and other non governmental or subnational actors [Marion Grau, Norway]	Noted, see response to comment 2740. Due to space restrictions, we focus on factors related to climate action, and effects and acceptability of climate policy, and do not assess the literature on factors influencing political processes

Comment No	From Page	From Line	To Page	To Line	Comment	Response
33982	58	10	58	12	We appreciate the important statement that political systems and national government conditions can make personal climate actions more likely. Though you might also consider to mention in what way business can influence lifestyle and behaviour change e.g. throught marketing and lobbying. [Norway]	Noted, the influence of business on behaviour is considered a contextual factor, We described the role of such contextual factors in a general statement at the start of section 4.4.3.1: Mitigation and adaptation behaviour is affected by many factors that shape which options are feasible and considered by individuals. Besides contextual factors (see other sub-sections in Section 4.4), these include abilities and different types of motivation to engage in behaviour.
46936	58	11	58	11	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Editorial, rephrased
12364	58	14	58	16	On line fifteen there is a dropped space, on "1.5°Cpathways"… after the comma on line 15 the sentence should read "… , as well as the effects and acceptability of policy approaches…" for clarity. [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
34642	58	15			Please separate "1.5ºCpathways" [Mexico]	Editorial
55864	58	15	58	15	Space between C and pathways [Debora Ley, Guatemala]	Editorial
61114	58	16	58	17	Two case studies are mentioned but not identified. [United States of America]	Accepted, case studies has been replaced by boxes
3920	58	20	61	11	This section addresses both climate mitigation and climate adaptation action. This comment is with reference to climate mitigation only: The type of 'action' described in this section focuses on individuals. This is one way to consider 'action', which has greater relevance the more empowered individuals are. The perspective of low income, low emitting people is noticeably and jarringly absent throughout this section. The only reference to this majority is in paragraph 26 to 34 of page 58, a confusing paragraph which does not clearly articulate that the issue from a low income perspective is around low carbon development (See Winkler, H., Boyd, A., Torres Gunfaus, M, Raubenheimer, S. (2015) Reconsidering development by reflecting on climate change. International environmental agreements: politics, law and economics, DOI 10.1007/s10784-015-9304-7). Individual 'climate mitigation action' makes no sense in a poor context. The poor are already low emitters, and their priority is survival in the short term. The heading 'ability to engage in climate action' therefore does not make sense from the perspective of the poor, neither does 'motivation to engage in climate action' and 'habits and mental shortcuts'. I am not sure how this can be remedied, as it is a framing issue. But perhaps a paragraph situating the discussion in a wealthy context, and acknowledging existing 'climate action' or 'low carbon lifestyle' of the poor, its context of poverty, and responsibility for 'action' from this perspective might assist. With a link to Chapter 5. Another entry point would be to consider mitigation action from the perspective of social practice (See Shove, E. (2014) Putting practice into policy: reconfiguring questions of consumption and climate change. Contemporary Social Science, 9,4,415-429), but this might be a more difficult change to make in the context of the Chapter as a whole. [Emily Tyler, South Africa]	Noted, indeed, chapter 5 discusses the relationships between climate action and SDGs including poverty. As similar factors relate to mitigation and adaptation, we did not include different sections on mitigation and adaptation, but rather discuss both together
31876	58	20	64	49	A major concern I have with sections 4.4.3.1 and 4.4.3.2 is that there is not adequate attention given to the types of behaviour and lifestyle change which are necessary for mitigation for 1.5C pathways, nor how to achieve this. Many of the studies cited in these sections, while sound and giving general insights into e.g. the role of identity or norms on environmentally-significant action, do not address the need or the potential for substantial (rather than trivial) reductions in emissions at the household or individual level, within high-emitting societies. As a result, these sections read in a rather generic manner, and are not contextualised to other parts of the 1.5C report that do recognise the scale of the challenge. The need for major shifts at the level of behaviours and lifestyles should be explicitly acknowledged - to achieve deep emissions cuts requires pronounced lifestyle change, of a sort that has not been achieved thus far. One study that overviews these issues is DOI: 10.1080/17583004.2015.1020011 [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Types of behaviour change relevant to 1.5C are discussed in the first part of the paper. The scale of change is assessed in Chapter 2. Many different ways of behaviour change or relevant for 1.5C, the IPCC does not provide normative statements of which changes are needed or should be prioritised. This section indicates that many different strategies can be followed, next popular approaches such as information provision and financial instruments
57368	58	20			Some sections here refer to specific cases/cultural contexts, while others are phrased in a very generalised way, although they are certainly context-specific as well (e.g., more relevant for global south/north) [Hans Poertner, Germany]	Noted; the literature on behaviour and lifestyles changes has a strong focus on industrialised countries, which we indicate in the section on knowledge gaps
61116	58	20	65	46	This section addresses decisionmaking in the abstract, and is not well-connected to specific kinds of decisions that are needed to limit warming to 1.5°C. It is noted later in the section on knowledge gaps that there is very little to no information published about these sorts of issues specific to 1.5°C. Recommend that, to the extent possible, some examples of relevant decision types be mentioned here. Alternately, this section should indicate more clearly that there are gaps in research and this section should be prefaced in terms of what a reader/decisionmaker should take away from this section in light of these research gaps. [United States of America]	Noted, see response to comment 2765
61118	58	20	65	46	Overall, this section does not match surrounding sections in writing style. Recommend incorporating more specific examples throughout and editing section to match writing style of the rest of the report. [United States of America]	Noted, not possible due to space restrictions
61120	58	20	64	49	In general, this discussion is not directly linked to the objective of the report and would be a strong candidate for deletion in order to provide a more usable and higher-impact chapter. At a minimum, it should be redrafted to focus tightly on factors that are essential (as demonstrated in particular sectoral discussions) to 1.5°C pathways. [United States of America]	Noted, see response to comment 2765
62006	58	21	58	55	It is possible in this section to identify the regional context for the assesment of factors related to climate actions? Why is the topic of information to consumers not mentioned within the drivers of climate action (e.g. energy efficiency labels etc). [Valérie Masson-Delmotte, France]	Noted. Now indicated that different policy approaches may be needed in different contexts and regions depending on which contextual or psycho-social factors enable or inhibit climate action in the particular context or region. Knowledge is considered as a factor influencing climate action, while information is a strategy to promote climate actions, which is discussed in section 4.4.3.2 , including labelling
61122	58	25	59	11	The discussion beginning at line 25 does not connect well with the title. It does not clearly add value to the chapter. Suggest deleting, or condensing, for example by removing the paragraph beginning at line 36. [United States of America]	Accepted see response to comment 2760
31870	58	26	58	28	It is stated that "Individuals are more likely to engage in adaptation … and mitigation behaviour when they feel more capable to do so, so it is important to consider how ability to act on climate change can be enhanced". Arguably two distinct issues are being conflated here: the perception that one can act (perceived behavioural control) and the actual ability to do so (behavioural control). Both are important but neither alone sufficient to prompt action (it's no use thinking I can act, if there's nothing I can really do; if I don't realise I can act, there is no benefit to there being an opportunity to do so). [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	accepted, now phrased of: when they are or feel more capable.…
46938	58	26	58	26	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Editorial, rephrased
12368	58	27			Dropped space after "… Koerth et al., 2017)and…" [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
56372	58	27	58	27	Typo [Nuno Bento, Portugal]	Editorial
12366	58	28	58	29	The sentece should perhaps read: "Ability depends on income and knowledge, amongst other things." [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
7964	58	36	58	36	Double negated sentence: remove "lack of" at beginning [Christopher Bataille, Canada]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12370	58	36			Should read "Lack of knowledge on the causes and consequences of climate change and on ways to reduce…" [United Kingdom (of Great Britain and Northern Ireland)]	editorial
31872	58	36	58	36	The double negative in this sentence - "Lack of knowledge on causes and consequences of climate change and ways to reduce GHG emissions is not always accurate" is misleading. [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
54438	58	36	58	36	Typo here? [Conor Little, Ireland]	Editorial
52186	58	36	58	45	The psychological apprehension of nuclear power is also legion and should be discussed here. Many people think that because nuclear plants produce so much energy, they must be giving off GHGs. Many people also believe that because so many newspaper articles have existed about accidents like Chernobyl and Fukushima, there must be a lot of environmental devastation or death from them, but actual studies have shown that the toll on both nature and people is always overestimated by people. People inevitably believe that because we've had nuclear power for 50 years that it couldn't possibly be an important part of the solution to climate change. I was very opposed to nuclear power until I was forced (by my teaching schedule) to investigate what is true about nuclear power, as opposed to what I believed about nuclear power. I am ashamed by how much I allowed my environmental identity to dictate how I viewed nuclear power, and by how wrong I was. This sort of anti-nuclear identity creates significant barriers for people to recognize that nuclear power must be used and impedes knowledge about causes and consequences. Sadly, evidence shows that the more educated we are, the harder it is for us to let go of our invested viewpoint of the universe, which was why it was so hard for me to overcome my own prejudices. [Jason Donev, Canada]	Noted, no action taken. No literature references are given (or known to the authors) that support the points made. In any case, the statements that "nuclear power must be used" would be policy-prescriptive and cannot be adopted.
53244	58	36	58	45	relevant to *Bioenergy carbon impacts* This section is literally insulting and condescending, not to mention ignorant, when it says that some people "misperceive climate impacts of energy sources. For example, some people think natural gas is a renewable energy source or think bioenergy is a fossil fuel as it involves burning materials, which can inhibit choices for low GHG emission options (Butler et al., 2013; Devine-Wright, 2003). Seriously? Is the author trying to imply here that people who are concerned about the well-understood carbon impacts of bioenergy are actually just confused, and think that it's actually a fossil fuel? We suggest removing this whole paragraph, as it does nothing except betray the authors' lack of understanding of bioenergy carbon impacts. [Mary Booth, United States of America]	Accepted, the sentence has been removed as the reference included was not peer reviewed literature
62202	58	36	58	37	Lack of knowledge… is not always accurate ? The sentence can be clarified… [Antoine Bonduelle, France]	Editorial
55866	58	40	58	41	Close parenthesis opened with the i.e. [Debora Ley, Guatemala]	Editorial
13196	58	41	58	44	Delete the text "For example, some people think natural gas is a renewable energy source or think bioenergy is a fossil fuel as it involves burning materials, which can inhibit choices for low GHG emission options (Butler et al., 2013; Devine-Wright, 2003).". [Eleni Kaditi, Austria]	Accepted see response to comment 2760
5656	59		60		On these pages it would also be good to talk somewhere about the interaction between individuals and communities. Realistically, humans exist in communities, and so even if some individuals feel more empowered, then that, too, has to do with how the community or society enables them to feel this way. so, how about highligthing the interaction and co-emergence of individual and community here??? [Marion Grau, Norway]	Noted, social factors are discussed on page 59, line 39-47
61124	59	1	59	1	It is uncertain whether high impact events with low frequency have a greater influence than low impact regular events. Even for those direct impacts, low frequncy events are quickly forgotten when it comes to prudent adaptation investment decisions. [United States of America]	Partially accepted, text amended: There is evidence to suggest that high impact events are remembered (and perceived more strongly) than low impact events. However, the reviewer's suggestion of how frequency of events intersects with impacts to shape perceptions is duly noted. Text has been amended accordingly. Examples from literature to evidence the amended text include: 1. Perceptions of drought in Ethiopia: Meze-Hausken, E., 2004: Contrasting climate variability and meteorological drought with perceived drought and climate change in northern Ethiopia. Clim. Res., 27, 19–31, doi:10.3354/cr027019. 2. Perceptions of water scarcity and drought in India: Singh, C., P. Dorward, and H. Osbahr, 2016: Developing a holistic approach to the analysis of farmer decision-making: Implications for adaptation policy and practice in developing countries. Land use policy, 59, 329–343, doi:10.1016/j.landusepol.2016.06.041. 3. Perceptions of climate change in USA: Weber, E. U., 2010: What shapes perceptions of climate change? Wiley Interdiscip. Rev. Clim. Chang., 1, 332–342, doi:10.1002/wcc.41. "The evaluation of risky options under the repeated sampling in decisions from experience follows classical reinforcement learning that gives recent events more weight than distant events." (p 333) 4. Perceptions of multiple risks in Uganda: Sullivan-Wiley, K. A., and A. G. Short Gianotti, 2017: Risk Perception in a Multi-Hazard Environment. World Dev., 97, 138–152, doi:10.1016/j.worlddev.2017.04.002. "Those who have experienced mild forms of a hazard, for example, tend to underestimate subsequent danger, with an attitude that Mileti and O'Brien (1992) describe as ''normalization bias", whereby people interpret the mild impacts of the early experience as the norm and believe that future severe impacts can also be avoided." (pg 139) 5. Perceptions of climate variability in Mozambique: Patt, A. G., and D. Schröter, 2008: Perceptions of climate risk in Mozambique: Implications for the success of adaptation strategies. Glob. Environ. Chang., 18, 458–467, doi:10.1016/j.gloenvcha.2008.04.002. "Memories are vivid when they are recent (which would correlate with higher frequency), but also when they created a strong emotional impact (which would not necessarily correlate with higher frequency)." (p 460)
12372	59	4			missing "does" and an unneccesary plural on "translates", this should read "… Demskiet al., 2017), although this does not always translate into…" [United Kingdom (of Great Britain and Northern Ireland)]	editorial
12374	59	5			Two dropped spaces after "… Taylor et al., 2014)." 1) "Collectivelyconstructed notions..." and 2) "risk and expectationsof future climate…" [United Kingdom (of Great Britain and Northern Ireland)]	editorial
32280	59	5			check sentence. Several words joined [Jamaica]	editorial
34644	59	5			Please separtate "Collectivelyconstructed" [Mexico]	editorial
52188	59	5	59	5	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	editorial, rephrased

Comment No	From Page	From Line	To Page	To Line	Comment	Response
56374	59	5	59	5	Typo [Nuno Bento, Portugal]	Editorial
46940	59	7	59	7	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Editorial, rephrased
12784	59	8	59	8	add "Whitmarsh & Corner (2017)" to references in brackets - full reference = Whitmarsh L and Corner A (2017) Tools for a New Climate Conversation: A Mixed-Methods Study of Language for Public Engagement Across the Political Spectrum. Global Environmental Change 42: 122–135 [Jamie Clarke, United Kingdom (of Great Britain and Northern Ireland)]	Noted, not added due to space restrictions and earlier references are added
12376	59	9			Dropped capitalisation in author name, should read "McCright et al., 2013)…" [United Kingdom (of Great Britain and Northern Ireland)]	editorial
13198	59	9	59	11	Delete the text "This may explain why extreme weather experiences enhances preparedness to reduce energy use among left- but not right-leaning voters (Ogunbode et al., 2017).". [Eleni Kaditi, Austria]	Reject. The text is supported by a peer-reviewed reference, and no reason is given why the text ought to be removed.
3784	59	13	60	25	Why is there no attention paid here to the one and only factor that can motivate support for long-term measures, to wit: future generations (and/or the fate of one's own (grand)children)? Without that interest, nu human has any rational grounds to look beyond hi/her own expected life span of, on average, 30 years. [Marcel Wissenburg, Netherlands]	Noted. The scientific literature assessed suggests many other factors motivate support for long-term measures, such as environmental considerations
8084	59	13	59	13	Why not mentioning "nudges" anywhere in this report? [Quentin Perrier, France]	Noted. Nudges are discussed in the section on biases and heuristics, and in section 4.4.3.2 (e.g., social influence strategies like social norm interventions). These are not labelled as nudges, we rather use the more specific labels of relevant factors
30640	59	13			Why not mentioning "nudges" anywhere in this report? [France]	Noted. Nudges are discussed in the section on biases and heuristics, and in section 4.4.3.2, but not labelled as nudges, as nudges refer to rather different processes and variables
31012	59	13	61	11	I find this part really interesting and good framed. [alberto fichera, Italy]	Noted
33984	59	13	60	25	On these pages it would also be good to talk somewhere about the interaction between individuals and communities. [Norway]	Noted, social factors are discussed on page 59, line 39-47
61126	59	13	60	25	This discussion has limited value to the report, is not closely linked to 1.5°C pathways, and could be deleted or condensed. Several parts of the discussion contain implict or explicit value judgments that are inappropriate for an IPCC report and/or are unbalanced and should be deleted. These include page 4-59, lines 18-24, and the use of quotation marks at page 4-60, line 20. [United States of America]	Noted. Types of behaviour change that are relevant to 1.5C are discussed in the first part of the paper. The scale of change is assessed in Chapter 2. Many different ways of behaviour change or relevant for 1.5C, the IPCC does not provide normative statements of which changes are needed or should be prioritised. Please note that the section discusses how people's values, motivations, ideologies, perceptions relate to their climate actions; in line with IPCC guidelines, we provide no judgements on whether these are good or bad.
12786	59	15	59	15	add " Corner et al (2014)" to references in brackets - full reference = Corner, A. J., Markowitz, E. and Pidgeon, N. F. (2014). "Public engagement with climate change: the role of human values". Wiley Interdisciplinary Reviews: Climate Change, 5(3), 411-422 [Jamie Clarke, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We refer to the most recent meta analysis, due to space restrictions
39264	59	18	59	24	Since our economic systems are exacerbating the problem, these findings are critical and should be in the SPM [Lindsey Cook, Germany]	Taken into account. This will be incorporated in the comments for the SPM
46942	59	19	59	21	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	editorial, rephrased
9646	59	22	59	24	While I can understand that this paragraph "Motivation to engage in climate action" addresses values, worldviews, and even philosophies, this paragraph is written in a biased manner that leaves no room for assessing the drivers and rationales by practitioners in the free markets who also see value in reducing emissions. Such practitioners also use the free market in market-based mechanisms such as emissions trading to seek out the lowest cost emissions reduction option, thus benefiting both the environment and fostering innovation and minimizing economic disruptions. For more information, please seek out studies and reports from the International Emissions Trading Association, www.ieta.org [Arthur Lee, United States of America]	Noted, the section assesses scientific knowledge on factors that motivate climate actions published in peer reviewed papers, in line with IPCC guidelines. It does not take position, but rather describes how values and worldview relate to climate action
9590	59	26		30	While this is an interesting point, the authorscited here are not themselves Indigenous (which should be pointed out) and it should be added that this is not to be used as an excuse for NOT engaging Indigenous peoples in discussions of climate change. [Joanna Petrasek MacDonald, Canada]	Noted, wording of paragraph changed, additional references added (including work authored by an Indigenous person). Note that explicitly referring to the ethnicity of authors is not IPCC protocol).
33986	59	26	59	30	We appreciate that this chapter shows the nuances of communities, belief systems, narrative frameworks etc. However, there are only one example of an indigenous culture. Perhaps consider to add somewhat more on religious communities, whose ways of engaging can look different and requires different narrative approached and pedagogies. One example is Katherine Hayhoe, who has ably functioned as a scientist speaking to evangelicals in ways they will be able to hear and engage in. Climate pedagogy in terms of religious, ethnic and ethical frameworks is absolutely key. Again, please consider further strengthening treatment of the role of religious narratives and pedagogies in similar way as is done in these lines. Good job! [Norway]	Noted, we discuss values and ideologies rather than religions, as the former appear to be more predictive of climate action
52190	59	26	59	26	In dealing with cultures like this, is it possible to frame the discussion as 'we are angering the natural phenomena by what we have ignored for a century'? [Jason Donev, Canada]	Noted, but unable to address due to a lack of literature to substantiate this point
3922	59	32	59	32	It may be worth clarifying that the benefits and costs spoken of in this paragraph go beyond climate costs and benefits. This could be done using that language of 'co-benefits' used earlier in the report, to qualify 'actions' in line 32. [Emily Tyler, South Africa]	Noted. The section discusses other costs and benefits later on, including affective (feelings), collective costs and benefits, social costs and benefits
46944	59	32	59	32	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	editorial, rephrased
61128	59	36	59	37	Unsure the intent of the sentence that reads "People prefer decentralized renewable energy systems that guarantee higher independence, autonomy, control ..." Is the point that not all decentralized renewable energy systems meet this guarantee and only only those that do are preferred. Or, that all decentralized renewable energy systems proivde these attributes, and that's why they are preferred over other energy systems. Please clarify. [United States of America]	editorial, clarified
12378	59	39	59	44	Final clause seems redundant and only repeats what the previously clause already states. Given that the sentence is already spread over a number of lines I suggest cutting "… particularly when they strongly identify with their peers… " And bringing the citations given forward. [United Kingdom (of Great Britain and Northern Ireland)]	Editorial, rephrased
46946	59	40	59	40	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Editorial, rephrased
46948	59	44	59	44	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Editorial, rephrased
12380	59	48			The sentence begins "Next, feelings affect…" This could just read, "Feeling affect… " [United Kingdom (of Great Britain and Northern Ireland)]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
46950	59	50	59	50	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Editorial, rephrased
13978	60	1	60	25	It seems appropriate in this section to also talk about civil society organization as well as theories about social leaders and their influence. [Natalie MAHOWALD, United States of America]	Noted, institutions are discussed elsewhere in the chapter
46952	60	2	60	2	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	editorial, rephrased
46954	60	9	60	11	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	editorial, rephrased
48118	60	9	60	10	Please check if the reference Fielding and Head, 2012 corresponds to the statement [Sarah Connors, France]	Accepted, sentence has been deleted, responsibility is now included in the preceding sentence
46956	60	18	60	18	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	editorial, rephrased
40466	60	18	60	22	"Individuals are less likely to engage in adaptation behaviour when they rely on protection measures undertaken by the government (…) and when they believe 'God' will protect them (…). Moreover, individuals with a strong attachment to their community may be unwilling to migrate to protect themselves from climate risks (…)." The wording of this paragraph is potentially misleading and can even be offensive to some people's religious views. Everybody relies to some extent on protection measures undertaken by their government. The paragraph seems to imply that government protection measures or religious believes are a problem. Additionally, climate migration is generally harmful in many ways. Most people will be unwilling to migrate, even if they are not strongly attached to their communities. Attachments to the community, on the other hand, encourage social cohesion, environmental awareness, and social networks; and hence enhance effective adaptation and mitigation collective strategies. [Pedro Alfredo Borges Landaez, Venezuela]	accepted, rephrased
12382	60	24	60	25	The sentence "In sum, …" might serve better as the top line findings for this section on 'Motivation to engage in climate action' rather than something buried at the end. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. The summary statements have been removed, as these appear in the SPM
52192	60	28	60	44	This choice overload seems to best be addressed by effective policies that put low emissions easily within public reach. Advocacy of individual behaviour change through some sort of moral imperative seems like an ineffective large scale solution. People keep overestimating how much a wind turbine (or wind farm) puts out, or how much difference a solar panel makes. They also underestimate the power from large scale hydro plants or nuclear plants. I feel ashamed to admit that my own biases have caused me a great deal of trouble on this very front and struggle to look at what works as opposed to what 'feels good'. I want to take climate actions based on what 'feels good' because then I can be a 'good person'. I am concerned that the literature reflects this bias in other scientists as well, with a strong prejudice against large central project like hydro and nuclear plants which really do so much more than wind, geothermal, tidal and solar. [Jason Donev, Canada]	Noted. In line with IPCC guidelines, we do not make normative judgements
46958	60	33	60	33	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Editorial, rephrased.
12384	60	36			It's easy to glide over the term "satisficing" - if this term is considered familiar enough amongst the audience for this document then perhaps it only needs a little more attention drawn to it. If it is not then the term should be explained. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted, explanation added
62204	60	46	60	49	sentence too long and not clear. Lacks an example [Antoine Bonduelle, France]	Editorial, rephrased.
55868	60	49	60	49	Close parenthesis opened with wanting [Debora Ley, Guatemala]	editorial
56376	60	49	60	49	delete ";" [Nuno Bento, Portugal]	editorial
9098	60	55	61	11	The authors should also comment on the role of behavioural spillover on environmentally friendly behaviours as outlined for example in: Nash, Nicholas, Whitmarsh, Lorraine, Capstick, Stuart, Hargreaves, Tom, Poortinga, Wouter, Thomas, Gregory, Sautkina, Elena and Xenias, Dimitrios 2017. Climate-relevant behavioural spillover and the potential contribution of social practice theory. WIREs Climate Change DOI: 10.1002/wcc.481 (Retrieved 20/2/18 from http://onlinelibrary.wiley.com/doi/10.1002/wcc.481/full) [Dimitrios Xenias, United Kingdom (of Great Britain and Northern Ireland)]	Noted, behavioural consistency is discussed on p 64, line 30-44
13200	60	55	61	1	Delete the text "Owned inefficient appliances and fossil fuel-based electricity can act as endowments, increasing their value compared to alternatives (Dinner et al., 2011; Pichert and Katsikopoulos, 2008).". [Eleni Kaditi, Austria]	Rejected - The endowment implies that people assign more value to goods/services simply because they own them (see Thaler 1980). Both studies show that the default option (e.g. incandescent bulb, non-green electricity) can represent (or be the result of) a reference point from which energy users are unwilling to move away, suggesting that. defaults (and corresponding framing) can act as instantaneous endowments.
46960	61	5	61	5	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	editorial, rephrased
13202	61	7	61	8	Delete the text "and renewable energy". [Eleni Kaditi, Austria]	Noted, the literature assessed refers to renewable energy programmes
39266	61	7	61	9	This is an important policy finding. Please highlight in SPM. [Lindsey Cook, Germany]	Taken into account. Due to space limits, we were not able to include this in the SPM - the SPM reports the main overarching insights
62206	61	8	61	8	a default opt-out rather than opt in option could be clarified. [Antoine Bonduelle, France]	Accepted, rephrased
12386	61	10	61	11	The sentence "It is important… " might serve better as the top line findings for this section on 'Habits and Mental Shortcuts' rather than something buried at the end. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. The summary statements have been removed, as these appear in the SPM
62008	61	10	62	26	Box 4.5 : is there an equity dimension that could be discussed in relation with pricing policy experiences? [Valérie Masson-Delmotte, France]	Noted. Equity issues are discussed in Chapter 5, and relationship fairness and acceptability is discussed in section 4.4.3.3
12388	61	15	61	17	There's a conversation here about top-down and bottom-up approaches but the examples given are all top-down appraoches to effecting action on climate change. Why is there not reference to public dialogue, or participatory engagment strategies if there is indeed an interest in fostering a bottom-up response? [United Kingdom (of Great Britain and Northern Ireland)]	noted, bottom-up initiatives are discussed in section 4.4.3.2, page 63
12390	61	19	61	22	There's scope here to mention that there is also a far lower emphasis on the social practices of various publics. [United Kingdom (of Great Britain and Northern Ireland)]	Noted, we emphasise low emphasis on socio-cognitive factors
12392	61	26			Missing space in "(see Section4.4.5.1)." [United Kingdom (of Great Britain and Northern Ireland)]	editorial
12394	61	27	61	28	I'd suggest that mitigation policies can also fall short of their true potential where they they do not seek to engage with and open dialogue with the public. [United Kingdom (of Great Britain and Northern Ireland)]	Noted, this is related to the statement on p 58 that policies will be more effective if they address key factors influencing behaviour - dialogue with the public is one approach to gather these insights

Comment No	From Page	From Line	To Page	To Line	Comment	Response
3924	61	28	61	30	Again here the issue of developmental context is absent, with an assumption that climate mitigation action is an individual rather than collective issue. This is a complex issue and problems are created in trying to reduce this complexity to any one or two causal factors (eg lack of adopting low carbon technology due to people not having cognitive resources). Multiple causality could be cited with a lack of cognitive resources as an example. [Emily Tyler, South Africa]	Accepted, rephrased as resources
12396	61	29			I'd suggest that "… technology may not be adopted or not be used as intended (REF) when people lack both the cognitive resources and the structural support to make informed decisions." as mentioned above, this isn't simply a case of the laity making poor decisions [United Kingdom (of Great Britain and Northern Ireland)]	Accepted, we deleted the word 'cognitive' and now refer to resources more broadly
45526	61	45	61	45	But they'd have to go much further to be compatible with 1.5! [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted. It is not likely that any single option or policy will be compatible with 1.5C, as indicated in Chapter 2
61130	61	45	62	26	This is a good set of case studies. It would be helpful if the examples of Singapore and London could discuss the social acceptability of congestion pricing in these cities. [United States of America]	Accepted, we rephrased the sentence in the first paragraph into 'Notably, acceptability of these policies has increased as people experienced their positive effects'. Acceptability is further discussed in section 4.4.3.3.
62208	62	30	62	39	This paragraph introduces interesting sociology studies.. With many contradictions. Maybe introduce it by saying "contradictions abound"… from the start of the text ? [Antoine Bonduelle, France]	Noted. The information provided is not necessarily contradictory, it reveals that the effects of information are different for different outcome variables, and that information is more effective under certain conditions
12398	62	31	62	32	Missing definitive article, should read "… often does not encourage engagement in the climate actions of individuals…" [United Kingdom (of Great Britain and Northern Ireland)]	editorial
39268	62	35	62	36	Highlight this finding alongside page 57 graph, as these are actions which citizens can take and can in turn be empowered to support overall mitigation/adaptation measures. [Lindsey Cook, Germany]	Rejected. Reviewer's point well considered, but will disrupt the narrative flow of the chapter. We discuss different factors influencing behaviour in section 4.4.3.1, and effects of different strategies to change behaviour in 4.4.3.2
12400	63	1			Next,… Could probably be replaced with "Further,…" for better flow. [United Kingdom (of Great Britain and Northern Ireland)]	editorial
12788	63	2	63	3	add after the sentence ending " 2012a)" - "There is growing interest in the impact that visual climate change communication has on public perceptions (O'Neill, 2017; Wang et al, 2017), with evidence-based recommendations for effective engagement using photographic imagery (Chapman et al, 2016) and data visualisation through graphs (Harold et al, 2017) now available." Chapman, D., Corner, A., Webster, R. and Markowitz, E. (2016). "Climate visuals: A mixed methods investigation of public perceptions of climate images in three countries." Global Environmental Change. 41, 172-182 Harold, J., Lorenzoni, I., Coventry, K. R., & Minns, A. (2017). Enhancing the accessibility of climate change data visuals: Recommendations to the IPCC and guidance for researchers. Report published by the Tyndall Centre for Climate Change Research, Norwich, UK. Available at: http://www.tyndall.ac.uk/datavisuals Wang, S., Corner, A., Chapman, D. & Markowitz, E. (2017). Public engagement with climate imagery in a changing digital landscape. WIREs Climate Change DOI: 10.1002/wcc.509 [Jamie Clarke, United Kingdom (of Great Britain and Northern Ireland)]	Noted, visualisation techniques are discussed in the next paragraph. Due to space restrictions, we can not add many more references
52194	63	3	63	4	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	editorial
12402	63	4	63	5	Missing space in "… households(Abrahamse et al., …). [United Kingdom (of Great Britain and Northern Ireland)]	editorial
12404	63	6	63	7	Suggest that the clause "…), which makes the implications… " is made into its own sentence as "Such information can make the implications of individual beahviour more salient." Also, is there a reference to support this claim? [United Kingdom (of Great Britain and Northern Ireland)]	editorial
57370	63	10	63	10	Term "ambient persuasive technology" needs to be explained. [Hans Poertner, Germany]	Accepted, added in glossary
61132	63	26	64	8	Box 4.6 could be shortened slightly. [United States of America]	Editorial – The text has been shortened to articulate the case studies more clearly and adhere to IPCC guidelines on in-chapter boxes.
62010	63	28	64	10	Box 4.6 : please check if statements are supported by any attribution study (AR5) or by the assessment of chapter 3. What is the evidence (literature) for inundation during high tides enhanced by sea level rise? What is the evidence for drought trends in Fidji? At the end of the box, it may be relevant to consider the implications of climate variability versus long-term trends in response to GHG emissions. [Valérie Masson-Delmotte, France]	Accepted - References have been added to support the claims of climatic changes in the mentioned locations. Notably, the case study in the Philippines is attributed to seismic (i.e. non-climate) activity. This has been further clarified.
57372	63	32	63	33	Need a reference with evidence on the link of inundation to sea-level rise. [Hans Poertner, Germany]	Taken into account - combined with comment #2845
57374	63	36	63	36	This is a very generalised statement. All island communities have a strong place-based identity? Or particularly the Philippines' ones? More than continental places? Why…? [Hans Poertner, Germany]	Accepted - text revised to more accurately reflect the nature of place attachment in island communities. Notably, we added 'their physical separation from other locations facilitates the formation of place-based identities (Edgü and Cim?it 2011)'
7762	63	40			delete "more". [Amory Lovins, United States of America]	Editorial – copyedit to be completed prior to publication
39940	64		64		It can be add one more box, based on the system dynamic evaluation on climate change adaptation strategies forwater resources management in semi-arid zones in Iran. Reference: Gohari, A., Mirchi, A. & Madani, K. Water Resour Manage (2017) 31: 1413. https://doi.org/10.1007/s11269-017-1575-z [Hamidreza Solaymani Osbooei, Iran]	Rejected - Immediate relevance of the proposed citation to the current box is unclear, as it does not discuss bottom-up adaptation behaviour.
48286	64		64		It can be add one more box, based on the system dynamic evaluation on climate change adaptation strategies forwater resources management in semi-arid zones in Iran. Reference: Gohari, A., Mirchi, A. & Madani, K. Water Resour Manage (2017) 31: 1413. https://doi.org/10.1007/s11269-017-1575-z [Iran]	Rejected - Immediate relevance of the proposed citation to the current box is unclear, as it does not discuss bottom-up adaptation behaviour.
36136	64	1	64	3	The referred study (Kale, 2015) is for Maharashtra state of India only. This does not represent India as a whole. The plethora of rainwater harvesting structures including traditional ways of R/W that have been used to adapt to dry spells and dryland areas in India, are age-old, time tested, extemely effective and there are plenty of published peer reviewed references and need to be added. Authors are encouraged to look into published work and list citations for evidence. [India]	Noted - The text has been amended to suggest this is a specific case. We agree with the reviewer's point that India has a rich history of effective water harvesting but there is growing evidence of them falling into disrepair. Also, Maharashtra being one of India's largest states, the example of it has lessons for other semi-arid regions.
49902	64	1	64	3	India is known for programmes like Joint Forest Management which are community driven. In some tribal areas, the residents worked hard to declare that area as reserved to stop logging. There is research available on this and it would be injustice to just mention about a maladaptive outcome in India. More best practices could be covered like Watershed management programmes (Eg: Mid-Himalayan Watershed Development Project in Himachal Pradesh which is sustainable and working). [Himangana Gupta, India]	Noted - The text is not refuting India's exemplary initiatives in JFM and IWRM - these are well covered in AR5 and will be furthered in AR6.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
40852	64	4	64	4	Include: For instance in India, In India, adaptation to climatic risks lead to increase in farm profit but adaptation costs the small and marginal farmers. Additional cost is not always required for adaptation, and rationalizing agricultural expenditure is essential to adapt to climatic risks, particularly in medium-size farm holders. Moreover, the profit is not directly proportional to the cost of adaptation, if any, among different strata of farmers. At community level differential costs of adaptation and profits are likely. Policies for incentivizing these 'responsive adaptation' costs for small and marginal farmers would be required (Naresh Kumar et al., 2016) [NARESH KUMAR SOORA, India]	Noted by this point on adaptation costs is not directly related to the theme of this box which discusses bottom-up adaptation approaches.
40860	64	4	64	4	Reference: Naresh Kumar S., Anuja, Md. Rashid, S.K. Bandyopadhyay, Rabindra Padaria and Manoj Khanna 2016 Adaptation of farming community to climatic risk: does adaptation cost for sustaining agricultural profitability? Current Science, 110 (10): 1216-1224. [NARESH KUMAR SOORA, India]	Noted by this point on adaptation costs is not directly related to the theme of this box which discusses bottom-up adaptation approaches.
47172	64	5	64	5	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorial – text amended to avoid policy prescriptive language
37262	64	11	64	11	Ch2 refers to Chapter 4, e.g. to "Chapter 4 discusses how to accelerate progress on CCS": In Ch4 CCS is discussed explicitly in terms of were the technology stands today and what its feasibility is. In contrast I found it quite difficult to find measures to accelerate CCS other than generic type of accelerating measures. A proper reference in Ch2 to the relevant CCS related section(s) in Ch4 and/or an adddtional discussion of accelerating measuresper technology may be needed in Ch4. [Ton Wildenborg, Netherlands]	Taken into account. In section 4.4.5, we discuss the instruments that can be used to enable low-carbon technologies, including CCS, and in 4.5 more "what to do". However, we have to refrain from being prescriptive.
3786	64	12	65	46	There is only one morally permissible way to change people's beliefs, values and preference, and that is through an open and reasonable dialogue (respecting the burdens of judgment; cf. John Rawls, Political Liberalism, NY: Columbia University Press, 1993) in which all parties are willing to test and if necessary revise their convictions. This part of the text however stinks of self-righteous condescendence, intolerance and closed-mindedness. You do not take objections to and hesitations about climate change policy seriously, you do not respect people, when you bypass dialogue, when you seduce, nudge, force or threaten people into choosing your side, when you try to herd them like cattle. P. 65 lines 38-39 beautifully reflects this grave moral error: people do not jut evaluate and weigh different costs and benefits differently, they first and foremost (a) often perceive the moral universe in other terms than costs and benefits (cost/benefit, welfare, quality of life, utility etc being the consequentialist morality of dogs, children, psychopaths and technocrats) and (b) often see different costs and benefits than the would-be climate tyrants who wrote this subsection. IPCC should not be associated with such repulsive ideas. [Marcel Wissenburg, Netherlands]	Noted. We refrain from normative discussion, in line with IPCC guidelines
45528	64	12	64	13	Where does the 1.5 goal itself sit in this spectrum? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted. I would hypothesise that the goal is too high. Unless clear and feasible guidelines are provided. But this is a speculation
62012	64	20	64	28	Why are several references from prior to the AR5 assessed here? (e.g. from 2006-2008)? [Valérie Masson-Delmotte, France]	Noted. This literature has not been assessed in AR5
12406	64	22			… then imposed changes… should read "… than imposed changes…" [United Kingdom (of Great Britain and Northern Ireland)]	editorial
61134	64	24	64	24	The word "inappropriate" contains an implicit value judgment; an alternative formulation should be used. [United States of America]	Accepted, inappropriate has been deleted from the text
10108	64	30	64	49	The strategies and policy approached to climate change suggested can best be applied gradually to induce social and psychological behavior changes. Yet, in contrast the urgency and the tight window to limit warming to 1.5c probably would require fast accelerated changes-- then how these pieces can fit together? [Saudi Arabia]	Noted, the strategies can be applied to encourage gradual as well as accelerated change
31874	64	32	64	33	While the text "Endorsement of mitigation and adaptation actions are positively related... both are more likely when people are more concerned about climate change" is a reasonable claim, nevertheless there may be differences between attitudes to mitigation and adaptation depending on pre-existing concern; as argued in DOI 10.1007/s10584-016-1627-z "mitigation framings may be more engaging for those with high levels of concern [vs adaptation], whereas adaptation framings may be more engaging for low-concern individuals [vs mitigation]" [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Due to space restrictions, we only assess literature on factors influencing climate action, and the effects and acceptability of climate policy, and do not report which factors in turn affect antecedents of climate actions
46962	64	33	64	35	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	editorial, rephrased
3926	64	46	64	49	Section (4.4.3.2) references the findings of a lot of studies which have been abstracted and generalised. The importance of context is briefly referred to here in the final paragraph. Putting this paragraph up front in the section, and expanding on the limitations of generalisation and abstraction together with the importance of context, particularly for policy, would enable a truer reflection of the studies themselves. Such a move would also make the section more palateable to readers, particularly those from developing countries where many of the assumptions underpinning these studies hold only in weak forms if at all. [Emily Tyler, South Africa]	Noted. The importance of context has been indicated in the start of section 4.4.3, in which we indicate that which factors affect climate actions depends across contexts and regions. Also, we indicate that role of context is discussed in the other sections of 4.4.
52196	64	46	64	46	In sum? This is an odd phrase [Jason Donev, Canada]	Accepted. The summary statements have been removed, as these appear in the SPM
7966	64	49	64	49	Separate "1.5Cpathways" [Christopher Bataille, Canada]	Editorial
34646	64	49			Please separate "1.5ºCpathways" [Mexico]	editorial
52198	64	49	64	49	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
7374	64	52	65	46	The section is generally much improved compared to the FOD, but I believe it relies a bit too heavily on reviews rather than linking to the underlying research on the topic. I understand that this is "effective" as it reduces the number of citations (which may be necessary), but I believe an IPCC report should primiarly be a review of the underlying research, and not a review of reviews. Two specific reviews (Drews and Bergh 2016, and Perlaviciute and Steg 2014) are referred to extensively throughout the section. I believe it is important to point readers in the direction of these reviews as they will give a better overview of the topic than reading a few specific papers (and perhaps they should be explicitly introduced as exactly that). However, in the next few comments I have made a few specific suggestions to add some references to specific papers. [Steffen Kallbekken, Norway]	Noted. Indeed, we refer to review papers that summarise multiple papers due to space restrictions, and because reviews integrate the literature. Interested readers can easily look for the original studies by reading these reviews
61136	64	52	65	46	The discussion in 4.4.3.3 contains many references to "acceptable" policies or "acceptability." This should be reframed to choose a locution that is not used to convey value judgments but rather to address the potential for public acceptance of a particular policy. The discussion of SRM at lines 12-17 is highly questionable given that there is no meaningful empirical example of SRM having been deployed. The underlying study is presumably based on responses to a hypothetical scenario; this should be made clear if the example is retained. (Note that it may be redundant with the SRM sections of the chapter.) [United States of America]	Noted. We define acceptability as the degree to which a policy or system change is evaluated favourably, which does not convey a value judgement, we added this definition to avoid confusion
7372	64	53	64	53	The opening statement that "policy and system changes can meet public opposition" reads a little to static and top-down. It implies that policy and system changes are somehow suggested or imposed by authories, and might then meet public opposition. Policy development is a more dynamic process where the public is (to varying extents) involved, and where potential public opposition is often considered in the design phase. Hence, the role of public support is not only as a reaction to proposed or implemented policies, but something broader. I suggest rephrasing the opening line to say "Public support is a key factor that kan shape, enable or prevent policy and system changes." [Steffen Kallbekken, Norway]	Accepted, changed accordingly (but shorter due to space restrictions)
47964	64	54	64	54	Kindly check: Drews and Bergh, 2016 has three authors in the reference list (Pg 139, line 46) [Sarah Connors, France]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
39270	65	2	65	6	This is an important policy finding. Please highlight in SPM. [Lindsey Cook, Germany]	Taken into account. Due to space limitations, we were not able to include this in the SPM, the SPM reports main overarching conclusions
7376	65	8	65	12	Suggested rewrite of the sentece to refer to more of the underlying research and to "backload" the references as some of the factors increasing support have a parallel factor decreasing support (e.g. egaltarian worldviews and individualistic worldviews): "Climate policy and renewable energy systems are more acceptable when people strongly value other people and the environment, or support egalitarian worldviews, left-wing or green political ideologies, and less acceptable when people strongly endorse self-enhancement values, or support individualistic and hierarchical worldviews (Cherry et al., 2017; Dietz et al., 2007; Drews and Bergh, Perlaviciute and Steg, 2014). New reference: Cherry, Kallbekken and Kroll, Accepting Market Failure: Cultural Worldviews and the Opposition to Corrective Environmental Policies, Journal ofEnvironmental Economics and Management 85, 185-214. [Steffen Kallbekken, Norway]	accepted
13204	65	8	65	8	Replace "renewable energy" with "sustainable, clean energy". [Eleni Kaditi, Austria]	Noted, the literature refers to renewable energy systems
48666	65	8	65	8	The statement about climate policies and renewable energy systems applies also to reducing energy demand [Yamina Saheb, France]	Noted, energy policy can be aimed at reducing energy demand - we did not specify energy policy due to space restrictions
13206	65	9	65	9	Delete the text "left-wing or green political ideologies". [Eleni Kaditi, Austria]	Noted, we summarise findings from the literature
7764	65	10			fix syntax [Amory Lovins, United States of America]	Editorial
47966	65	10	65	10	Kindly check: Drews and Bergh, 2016 has three authors in the reference list (Pg 139, line 46) [Sarah Connors, France]	Editorial
12408	65	12	65	14	I suggest that the sentence on Solar Radiation Management be moved to the end of the paragraph (currently line 19), and be given as "For example, geoengineering techiques like solar radiation management… " as the point, presumably is more generally about technological fixes than SRM in particular, so it is worth making that clear. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. The paragraph discusses the role of different factors related to acceptability. This sentence reflects relationships with values and acceptability of SRM, and the previous sentence also reflects the role of values. The next sentence discuss other predictors (climate beliefs and environmental awareness)
7378	65	14	65	19	An important addition to the factors listed in this sentence is that climate policies are more acceptable when the public trusts the underlying science. Suggested reference: Ding, Maibach, Zhao, Roser-Renouf and Leiserowitz, Support for climate policy and societal action are linked to perceptions about scientific agreement, 2011, Nature Climate Change 1, 462. [Steffen Kallbekken, Norway]	Rejected, the paper by Ding et al shows that perceived scientific agreement affect support for mitigation policies mainly indirectly, via global warming key beliefs including the certainty and human causation of climate change, collective efficacy, harm timing and harm extent. We focus on factors influencing policy support, not factors influencing the predictors of policy support
47968	65	16	65	16	Kindly check: Drews and Bergh, 2016 has three authors in the reference list (Pg 139, line 46) [Sarah Connors, France]	editorial
7766	65	17			I suggest adding "many energy efficiency techniques" to this list. The report tacitly leaves the misimpression that efficiency technology is fairly static (except in lighting, line 11) when in fact it is highly dynamic in both quantity and cost. [Amory Lovins, United States of America]	Noted, this section discusses factors influencing acceptability of climate policy and technology
9648	65	17	65	19	This sentence is written in a biased manner that leaves no room for assessing the drivers and rationales by practitioners in the free markets who also see value in reducing emissions. Such practitioners also use the free market in market-based mechanisms such as emissions trading to seek out the lowest cost emissions reduction option, thus benefiting both the environment and fostering innovation of technology and minimizing economic disruptions. For more information, please seek out studies and reports from the International Emissions Trading Association, www.ieta.org [Arthur Lee, United States of America]	Noted. The sentences describes how individuals evaluate different types of policies, and how this is related to individuals' environmental awareness. It is not our purpose to judge whether individuals may be biased, but merely describe individuals' views and evaluations
61138	65	17	65	19	This claim is not relevant and relies on a single source, and should be deleted. [United States of America]	Noted. See reply to comment 2883. The sentences describes how individuals evaluate different types of policies, and how this is related to individuals' environmental awareness. It is not our purpose to judge whether individuals may be biased, but merely describe individuals' views and evaluations
33132	65	21	65	24	critical point made in this sentence. Important to keep it in. [Tara Shine, Ireland]	Noted
39272	65	21	65	23	This is an important policy finding. Please highlight in SPM. [Lindsey Cook, Germany]	Taken into account. The importance of distributional fairness for policy acceptability is included in the SPM
47970	65	22	65	22	Kindly check: Drews and Bergh, 2016 has three authors in the reference list (Pg 139, line 46) [Sarah Connors, France]	Editorial
7380	65	24	65	28	Suggested additional reference on use of compensation to increase public support: Cowell R., Bristow G., Munday M., (2011), "Acceptance, acceptability and environmental justice: The role of community benefits in wind energy development" Journal of Environmental Planning and Management (54) 539-557. [Steffen Kallbekken, Norway]	Noted, we refer to review papers that summarise the literature
47972	65	30	65	30	Kindly check: Drews and Bergh, 2016 has three authors in the reference list (Pg 139, line 46) [Sarah Connors, France]	Editorial
12410	65	31	65	33	The sentence "Public support for multilateral…" feels like a bit of a non sequitur at present and needs some further context or set up. [United Kingdom (of Great Britain and Northern Ireland)]	Editorial, rephrased slightly
13208	65	34	65	35	Delete the text "renewable energy development (Devine-Wright and Howes, 2010; Warren et al., 2005) or". [Eleni Kaditi, Austria]	Noted. This literature is relevant for 1.5C
54434	65	34	65	35	Consider citing Stokes (2016). Stokes, L.C., 2016. Electoral Backlash against Climate Policy: A Natural Experiment on Retrospective Voting and Local Resistance to Public Policy. American Journal of Political Science, 60 (4), 958–974. [Conor Little, Ireland]	Noted, the paper discusses electoral backlash against climate policy, which is not the focus on this section
12412	65	38	65	39	The sentence "Hence…" might serve better as the top line findings for the section 4.4.3.3 Acceptability or policy and system changes' rather than sometihng buried at the end. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. The summary statements have been removed, as these appear in the SPM
33134	65	41	65	43	climate actions can undermined human rigts when they are not based on adequate particitaion / attention to people and their rights. Climate actions that are informed by human rights yield benefits for people and planet. See Robinson, M. & Shine, T. (submitted) Achieving a climate justice pathway to 1.5oC. Nature Climate Change. Mary Robinson Foundation – Climate Justice (2015a) Rights for Action: Putting People at the Centre of Action on Climate Change. Available online at https://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-Rights-for-Action-edition-2.pdf [Tara Shine, Ireland]	Noted, the relationship between climate actions and the SDGs are discussed in Chapter 5
7108	65	42	65	42	Unclear what does "living comfort" exactly means, maybe add an example, such as technology to access to water, or what else can the author use to illustrate? [Jose Di Bella, Canada]	Accepted, rephrased into daily comfort
12414	65	43			The concept of "nature-based solutions for climate adaptation…" needs context, and example, an explanation, or reference to somewhere else in the report where it is explained more fully. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - A brief explanation and example are now provided.
12416	65	43	65	45	The sentence "Further, climate actions can enhance quality of life (REF) as doing so is meaningful." is unclear. Do you mean to say that "climate actions can enhance quality of life, and this has intrinsic value" …? [United Kingdom (of Great Britain and Northern Ireland)]	Accepted, clarified. Sentence now reads: Further, climate action can enhance quality of life (Kasser and Sheldon 2002; Schmitt et al. 2018; Xiao et al. 2011) because pursuing meaning by acting on climate change can make people feel good (Venhoeven et al. 2013, 2016; Taufik et al. 2015), more so than merely pursuing pleasure
62014	65	45	65	45	Inconsistencies in this paragraph. Lack of IPCC calibrated language. [Valérie Masson-Delmotte, France]	Editorial, rephrased
7484	65	49	65	49	Section 4.4.4 should also discuss how to deal with emissions increasing innovations. [Axel Michaelowa, Switzerland]	Accept. Innovation of GHGs increasing technology and rebound effects are addressed. They are also mentioned in 4.4.4.1

Comment No	From Page	From Line	To Page	To Line	Comment	Response
28638	65	49	70	1	Chapter 4.4.4 deals with the topic technological innovation and climate change on a rather general level. Although it takes up the question of 1.5°C in the short introduction (p 4-65, l 51-54) the following text seems applicable to climate change in general - and not is specific for reaching 1.5°C. Therefore, it would be very helpful within the scope of the report if authors could focus on and additionally work out the following issues: a) the specific challenges of reaching 1.5°C for technological innovation , b) the specific contribution technology and innovation can play to reach 1.5°C (e.g. which additional R&D-activities are needed? How could innovation dynamics be stimulated to reach this ambitious goal? Which barriers have to be overcome ? by which policy-instruments?,...). if there is a lack of literature to cover these topics, it should be clearly stated. [Germany]	Accept. It is true that the 1.5C-specific literature on Technology & innovation is sparse. We therefore focus on the literature that relates to technology (including GPTs) that are prominent in mitigation pathways and in adaptation responses.
40468	65	49	65	49	(4.4.4 Enabling technological innovation) There is no discussion here on the national and international systems of intellectual property rights and their role as barriers and-or enablers of innovation. This is a controversial but very important issue. There is relevant literature on the topic (See papers by Carlos Correa and Joseph Stiglitz; e.g Baker, Jayadev and Stiglitz .2017. Innovation, Intellectual Property, and Development, Center for Economic and Policy Research (CEPR); and Correa .2016. Innovation and the global expansion of intellectual property rights: unfulfilled promises, South Centre, Research Paper No. 70) [Pedro Alfredo Borges Landaez, Venezuela]	Rejected. IPR issues have been covered in detail in AR5 and although we could locate a limited number of new papers, no literature that is particularly relevant to 1.5C could be identified.
45532	65	49	65	49	Is this trying to do all of AR6? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accept. This section deals with only latest development that may be relevant to 1.5C. This is added to the chapeau text.
48260	65	49	70	1	1-Economy dependent to oil and gas revenues these countries should be supported by international financial and technology. 2- The issues of technology transfer and developing, supplying financial resources and capacity building has been mentioned briefly in the report. It is necessary to assign a special section to this issues to clearly address the technology transfer, supplying financial resources and capacity building in developing countries, as well as means of implemenation to achieve global warming bellow 1.5 °C. [Iran]	Taken into account. There is a section on tech transfer (4444) and in finance (now in 445).
50064	65	49	69	15	The section on innovation policy is very weak, as it does not discuss what constitutes effective innovation policy and it does not make a clear distinction between R&D for new technologies versus improving and disseminating existing technologies. The orderr in which various issues are being discussed at the moment is also somewhat strange: it would make sense tohave section 4.4.4.3 first, as this provides the concepts of "technology push" and "demand pull", which are good categories to further discuss innovation and innovtion policy. Discussion of innovation in fossil fuel technologies, discussed in section 4.4.4.1 is now put at equal footing with low carbon technologies. That is not helpful, as the fossil technology innovation makes it harder for clean technologies to compete. So fossil technology innovation needs to be referred to in that sense. The extensive discussion of enabling technologies in section 4.4.4.2 now constitutes a disproportial part of the text on innovation; that is very unbalanced and can certainly be treated more concisely, making space for a discussion on effective innovation policies (which is the key for policy makers). Section 4.4.4.4 on technology transfer is very general and not of much use to policy makers. I would like to see a discussion on the most effective national policies to enhance the diffusion and transfer of technology, which is a critical element of 1.5 degree strategies, since rapid application of clean technologies across the world is one of the key characteristics. [Bert Metz, Netherlands]	Partially accept. It is not that easy to identify effective innovation policies. We are adding some literature on this point, but universal conclusions are difficult to draw; each country has its own strategy. Point about fossil fuel innovation potentially hindering climate action innovation taken, but we could not find literature that demonstrates this point.
3928	66	1	66	3	The description of the incorporation of technologies in a 'socio-technical system' is one view, using a particular theoretical framework. Notwithstanding that this is a very valuable one, presenting this as the way the world 'is' closes down opportunities for advancing knowledge and understanding about our experience of the world. Alternatively, this view could be presented as one perspective, one understanding. For example: 'New technologies have been described as emerging, as part of ....' [Emily Tyler, South Africa]	Accept. Text modified according to the suggestion.
7972	66	1	66	48	Sections 4.4.4.1 and 4.4.4.2 are missing a standard economic dynamic: improved technology expands the production frontier, which potentially allows both more input subsitution and more production. GHG emissions are a function of this dynamic, depend on the energy source, and are subject to rebound effects, the net of all of which is empirical/quantitative [Christopher Bataille, Canada]	accepted rebound effects and GHG increasing technological change is addressed as follows " However, it may result in more emissions by increasing economic activities. It may also have unintended negative consequence on sustainable development. While ICT increases electricity consumption (Aebischer and Hilty 2015), the energy consumption of ICT is usually dwarfed by the energy saving by ICT (Koomey et al. 2013; Malmodin et al. 2014), but rebound effects and other sustainable development impacts may be significant. An appropriate policy framework could address the potential negative impacts by GPT (Jasanoff 2007)."
7968	66	2	66	17	Odd grammer issues in first two paragraphs, especially first sentence of page 66 [Christopher Bataille, Canada]	accepted grammatical error corrected
7970	66	4	66	4	Replace "accelerationg" with "can accelerate" [Christopher Bataille, Canada]	accepted grammatical error corrected
56134	66	10	66	17	You develop the variety of technological developments that have or will contribute to climate action. And what's about the blockchains technology? According to a lot of observers, this new information storage and transmission technology could boost climate action. https://cop23.unfccc.int/news/un-supports-blockchain-technology-for-climate-action [Emilie ALBEROLA, France]	Noted. However, block chain is not added to the list since the table includes many ICT enabled GHG cut already and it does not mean to be exhaustive.
13210	66	11	66	12	Delete the text "more efficient drilling techniques making fossil fuels cheaper,". [Eleni Kaditi, Austria]	Rejected. No literature supporting the deletion of the text.
57782	66	13	66	14	In the phrase: "In addition, costs of fuel cells (Iguma and Kidori, 2015), shale gas and oil…" I suggest to add another reference: "In addition, costs of fuel cells (Iguma and Kidori, 2015; Hydrogen Council, 2017), shale gas and oil…" - NEW REFERENCE: Hydrogen Council "Hydrogen scaling up - A sustainable pathway for the global energy transition" (2017), <http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-Scaling-up_Hydrogen-Council_2017.compressed.pdf >. [Mario Valentino Romeri, Italy]	Taken into account. Literature added on the fuel cell added to the text. However suggested new literature is not added as it is out of context.
28640	66	15	66	17	The quintessence that "General Purpose Technologies" have some impact on rise and reduction of greenhouse gases is certainly true. However, a much less cursory description of possible quantitative effects would be very helpful. [Germany]	Reject. No literature available.
18638	66	20	27	12	(CONTINUED...) Wilenius and Kurki (Wilenius, M. and Kurki, S., Surfing the Sixth Wave. Exploring the new 40 years of global change. Turku: Finland Futures Research Centre, Turku, 2012) reach the same conclusion analysing the Kondratieff cycles. Those authors conclude that moving to a sustainable, low-carbon economy could exploit the potential of ICT, Artificial Intelligence, etc.... but we are not there. Suggestion: Please mention that the potential of enabling technologies/GPTs is still untapped. [Andrea TILCHE, Belgium]	Accepted. Text modified. However, the suggested literature is not added as it is not peer reviewed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
18636	66	20	27	12	This section on innovation presents some issues: (1) Its positive tone somehow contradicts the executive summary of the own chapter, p. 5, lines 25-27, which challenges the current impact of innovation ("falling short"); (2) it focuses on the potential of enabling technologies/General Purpose Technologies such as ICT... but the actual impact of those technologies is discussed in literature. For example, Carlota Pérez et al. (Pérez, C. et al., Changing gear in R&I: green growth for jobs and prosperity in the EU. Report by the European Commission Expert Group ''R&I policy framework for Green Growth & jobs'', Publications Office of the European Union, Luxembourg, 2016, at: https://publications.europa.eu/en/publication-detail/-/publication/893ae121-02cc-11e6-b713-01aa75ed71a1/language-en) argue that the ICT revolution is already present, but it is not yet leading a societal shift and a prolonged period of employment and prosperity compared with major technological innovations in the past (steam machine, steel, electrification, mass production of car, etc.); i.e. its transformative potential remains largely untapped. Wilenius and Kurki (Wilenius, M. and Kurki, S., Surfing the Sixth Wave. Exploring the new 40 years of global change. Turku: Finland Futures Research Centre, Turku, 2012) reach the same conclusion analysing the Kondratieff cycles. Those authors conclude that moving to a sustainable, low-carbon economy could exploit the potential of ICT, Artificial Intelligence, etc.... but we are not there. Suggestion: Please mention that the potential of enabling technologies/GPTs is still untapped. [Andrea TILCHE, Belgium]	Accepted. Text modified. However, the suggested literature is not added as it is not peer reviewed.
54060	66	21	66	30	This paragraph echoes business biased optimism on the use of new technologies. While technologies may be useful to confront climate change, a more balanced and nuanced approach is needed in this paragraph, including taking into consideration indigenous and local technologies, as well as the need for technology assessment . We suggest to delete the sentence starting with "Similarly.... until ICT (WBCSD, 2015)" as this proposal - if carried at all, as this seem to be more propaganda - could increase GHG by increasing industrial and chemical agriculture. We suggest to add a paragraph that says "Although technologies can contribute to confront cliamte change, the potential environmental, social and economic impacts of new technologies should be evaluated before deployment, including the potential to exacerbate inequalities between and within countries". [Elenita Daño, Philippines]	Accept. The text was modified according to the suggestion of the reviewer (making the sentence suggested non-prescriptive).
28642	66	25	66	26	In the past, several positive expectations on energy saving effects in the sector of information and communication technologies later have proven too optimistic. More powerful processors, higher volumes of data to be transported and stored, the growing internet-of-things and several other trends and developments led to a total increase of energy demand. However, the numerous well-known indirect energy trends and benefits as e.g. the use of more intelligent temperature controllers or the more frequent application of videoconference techniques are hard to quantify with respect to CO2 balance. The same is true for possible rebound effects. Therefore the estimate appears overly optimistic, unless these caveats are being discussed and refuted. Also, please include more scientific literature or state the lack thereof. It does not seem appropriate to rely on a single publication by a stakeholder group to cover the potential of ICT for GHG mitigation. [Germany]	Accept. Text removed because there is insufficient literature basis.
52200	66	26	66	26	Is GeSI an appropriate source to cite here? [Jason Donev, Canada]	Accept. Text removed in response to comment 28642. However, we did make transparent that this source was from industry.
61140	66	32	66	38	Recommend moving to the earlier discussion of transportation in 4.3.2 or 4.3.4. [United States of America]	Rejected as this is really about GPTs. However text modified to improve coherence.
10110	66	34	66	35	Is Falton et al, 2017 is the only study looking into this? What the other literature says about the GHG emission reduction potentials urban passenger transport? What are the assumptions about vehicle turnover in Falton et al to cut 80% of carbon dioxide emissions from urban passenger cars by 2050? [Saudi Arabia]	Accept. Literature added. However describing details of study is beyond the scope of section.
57376	66	37	66	38	What about other resources from the whole life-cycle of ICT products, that increase with increasing use of these technologies? This needs to be considered when seeing it in the context of sustainable development, not only looking at net emission reduction through ICT. [Hans Poertner, Germany]	Accepted. Text modified to address potential SD impacts by ICT
7768	66	44	66	45	Larson and Zhao are cited for the proposition that telework may encourage sprawl. This should be explicitly distinguished from spurious claims of backfire (rebound >1 so increased energy efficiency increases energy use), which has never been observed. [Amory Lovins, United States of America]	Rejected. There is potential backfire as the literature suggests. No evidence for removing the statement is given.
5658	67		67		Table 4.7. seems to come from a noticably different source and has some less solid terminology in it, such as Big Data and internet of things. This reader does not think the data in this table has the same kind of solidity as much of the rest of the chapter. Change language, explain things? [Marion Grau, Norway]	Accepted. Text modified "Big data" is removed and "IOT" etc. are explained in the text.
16526	67				Table 4.7 - Could add to Agricutlture - the reduction of methane from effluent and food waste etc. [Australia]	Noted. Unfortunately, literature is not available
16528	67				Table: Explain methane emission controllers for livestock [Australia]	Accepted Table modified.
36138	67		67		Table 4.7 in Agriculture row, include ICT and low carbon technologies under enabling GPT column [India]	Accepted ICT added. However low carbon technology is not GPT.
40862	67		67		Table 4.7 in Agriculture row, include ICT and low carbon technologies under enabling GPT column [NARESH KUMAR SOORA, India]	Accepted ICT added. However low carbon technology is not GPT.
28644	67	1	67	6	This table is biased towards / in favour of ICT (right column). To realize the mentioned "Examples of mitigation/ adaptation technological innovation" much more technological sectors are necessary (+ additional socio-economic innovations). Mainly addressing ICT/KI/IoT/ Big Data gives the wrong impression that you only/ mainly have to focus on these fields to realize 1.5°C. Please ensure the provision of appropriate context or remove entirely. [Germany]	Accept. Line added in caption: the GPTs by themselves do not reduce emissions or increase climate change resilience.
33988	67	1	67	5	Table 4.7: Please explain some of the terms used in this table better, such as "Big Data" and "internet of things". [Norway]	Accepted. Big Data is removed, the Internet of Things is still in the table but is explained in the glossary.
35542	67	1	67	4	AI could be an enabling GPT for practically all items (e.g. improving logistics, better management of appliances for energy conservation, custom optimisation of transport solutions etc.) [Ashok Sreenivas, India]	Accepted. Text modified
45530	67	1	67	1	Carefulto avoid GPTs being elevated from one strand of literature to an organising principle [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accept, text in caption modified to Table 4.9: Examples of technological innovations relevant to 1.5°C enabled by General Purpose Technologies (GPT).
45968	67	1	67	1	Energy efficiency in industry is rather business as usual. More innovative practices come from electrification of bulk material production processes such as iron and steel or new materials like new cement types or bio-based polymers. [Deger Saygin, Turkey]	Noted. However they are covered in AR5 extensively, as well as in section 4.3.4 in the Final Draft. There is no literature that these radical options are facilitated by GPTs
48668	67	1	67	5	See Table 4.1 Page 61 of the JRC report entitled "Energy renovation: The Trump Card for the New Start for Europe" for a more complete table about technologies for buildings [Yamina Saheb, France]	Noted, literature not added as not peer-reviewed.
52202	67	1	67	4	It woud help to explain more what these terms mean and to have consistent use of capital letters. [Jason Donev, Canada]	Accepted text modified. Capital lettered acronyms are added to the glossary
58362	67	1			In the buildings section of Table 4.7, line referring to reduced transport use (citing IEA Digitalization of Energy report among others) appears to be out of place - should it be in the transport section? [Andrew Prag, France]	Accepted Table modified.
58368	67	1			Table 4.7: as biotech is mentioned for agriculture, it could also be mentioned in terms of bioenergy and BECCS. In the transport section, improvement of car resource use through autmoation and sharing (Supported by ICT and IoT) could be more explictly listed [Andrew Prag, France]	Accepted Table modified.
62016	67	1	67	4	I was wondering where energy consumption and emissions associated with ICT are covered in this report, reading the positive outcomes that ICT could bring for mitigation or adaptation. [Valérie Masson-Delmotte, France]	Accepted literature added on lifecycle base ICT emission

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17766	67	4	67	5	In agricultural sector, soil carbon sequestration is one of the most feasible methodologies to prevent soil carbon from being released from the soil with less disturbance. ICT could be used to optimize more soil carbon in soil with crop yield and less irrigation. [Republic of Korea]	Rejected. Literature not available. Soil carbon sequestration is covered in section on CDR.
28646	67	4	67	5	In table 4.7, the General Purpose Technology "Artificial Intelligence" is mentioned in the context of plasma confinement for nuclear fusion. Possibly, there could be more convincing examples mentioned for applications of artificial intelligence (in combination with robots) in other sectors as e.g. Industry. [Germany]	Accepted. Examples added.
32974	67	4			Technologies related to tropical farming systems are not included among the examples of technological innovations that associate mitigation and adaptation in agriculture. I suggest the inclusion of systems such as no-tillage with straw (zero tillage) or integrated crop systems. [Brazil]	Noted. However literature not available.
54062	67	4			In the box, delete reference that biotechnology and bioinformatics would be helpful in agriculture, as it only referes to one source and a) after 20 years of GMOs there is ample evidence to the contrary (i.e., increased GHG emission due to huge increases in the use of agrochemical; and b) these technologies are aimed to enhance more industrial agriculture which is one fo the single most importat drivers of climate change. Ref: ETC group, 2016 http://www.etcgroup.org/content/deere-co-becoming-monsanto-box [Elenita Daño, Philippines]	Taken into account. Text added as follows "However, it may result in more emissions by increasing economic activities. It may also have unintended negative consequence on sustainable development." The suggested deletion is not accepted since it is not more than the list of examples. Suggested literature is not accepted as it is not peer reviewed.
3930	67	6	67	12	Governments also have the important role of considering ethics and unintended consequences of technological progress which should be mentioned here. Whether these technologies advance or undermine climate resilient inclusive development cannot be determined by considered the technologies in isolation of their societal context. (See Jasanoff, S. (2007) Technologies of humility, Nature, 450, November 2007. [Emily Tyler, South Africa]	Accepted. The text added as follows "It may however, result in more emissions by increasing the volume of economic activities, with unintended negative consequence on sustainable development. "
39274	67	8	67	9	Please note that the AR5 states economic growth one of the greatest drivers of CO2 increases, so could you engage with this when quoting OECD and economic growth - when is growth safe and when is it driving CO2? Please articulate. [Lindsey Cook, Germany]	Accept. Added "and sometimes conflicting"
54096	67	15	67	25	As noted above, governments have a crucial policy role not only in supporting new developments but also in removingf support for incumbents, thereby creating space for innovation. See Kivimaa, P., Kern, F., 2016. Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. Research Policy 45, 205–217. https://doi.org/10.1016/j.respol.2015.09.008 [Mikael Hildén, Finland]	Accept, paper is cited in section 4.4.4.3
61142	67	15	70	1	The discussion in these subsections (4.4.4.3, 4.4.4.4) is very generic and not tightly linked to 1.5°C. This text should be deleted or significantly tightened. [United States of America]	Accept. The text is further enriched by more climate-change-specific references that indicate the relevance and possibilities for innovation policy for climate change in general. Unfortunately, the literature on 1.5C related to this is non-existent.
12418	67	23	67	25	Some governments have successfully supported innovation policies (Mazzucato, 2013) to address climate change (See Box 4.7 on bioethanol in Brazil). This feels very weak. Surely there are many more examples of successful government support for innovation? [United Kingdom (of Great Britain and Northern Ireland)]	Accepted text modified removing the case study on bioenergy in brazil is elaborated, and reference to GEA added
63270	67	24	67	25	Add: .....supported innovation policies (Mazzucato, 2013) to address climate change (See Box 4.7 on bioethanol in Brazil). Given the early-stage nature of many CO2 management methods such as CDR, it will be important to continue to encourage and support the emergence and testing of competitive, new or hybrid methods while supporting the development and testing of currently favored approaches. This will avoid lock-in and save time and resources in seeking optimum pathways. [Greg Rau, United States of America]	Taken into account. Regarding the role of government in innovation and technology, this text here not enough, but it is beyond the scope of the report to discuss it in general, not specific to 1.5C,. General discussion on the role of government in technology push and demand pull is covered in AR5 chapter 15. On the other hand, there is lack of literature specific to 1.5C.
28648	68	1	68	53	Please make sure that potential sustainability implications, e.g. rising emissions and impacts on biodiversity and indigenous peoples that are often associated with bioenergy development, in particular when large areas of primeval forest are converted, are well reflected in the discussion, in particular if this is to be illustrated as a best-practice examples for bioenergy and the role of governments. Please make sure that potential sustainability implications, e.g. rising landuse emissions and impacts on biodiversity and indigenous peoples that are often associated with bioenergy development, in particular when large areas of primeval forest are converted, are well reflected in the discussion of best-practice examples for bioenergy and the role of governments. Specifically, while some of the drawbacks in the Brazilian case are broadly touched upon, it should be specified if “bioethanol induced displacement” is referring to other agricultural production being displaced due to increased bioethanol production, and whether in line 29 “by forest substitution by croplands” is referring to deforestation, since these would constitute important findings regarding decisive trade-offs associated with up-scaling bioenergy production. Also at the end of the box (47-52) the potential of extending the Brazilian experience to other areas is briefly considered. Here it would be relevant to add why attempts were unsuccessful. [Germany]	Noted - please refer to the references cited, especially the recent publication by Jaiswal et al (2017) which models the potential ethanol production without displacement of agricultural (food) or forest. On the contrary, in São Paulo, the state where most of the Brazilian ethanol is produced, biodiversity and forest increase over the last two decades. We can try to add something commenting why they were unsuccessful would require more space for this box. This will depend on space availability.
61144	68	1	68	52	This lengthy box should be shortened or deleted. [United States of America]	Rejected - it is a good example of how bioenergy was developed in a whole country scale successfully. It is already short enough with the positive and negative aspects pointed out.
18640	68	5	68	13	It should be mentioned that the ethanol policy was NOT driven by environmental considerations, but energy security and trade balance concerns. [Andrea TILCHE, Belgium]	Taken into account - In the first paragraph of the box explain how Brazil started the use of ethanol. Brazil has approved laws that forbid burning of sugarcane to avoid pollution and health problems to the population in São Paulo. There are several policies related to the use of ethanol that are environmentally oriented. This information is into the revised text.
4552	68	10	68	13	The "flex-fuel era" did not start in the 1990s but with the introduction of flex-fuel vehicles in 2003. In addition, both blended and pure ethanol have been available on the Brazilian market since the 1970s. For instance, see Luciano Charlita de Freitas and Shinji Kaneko (2011), "Ethanol Demand under the Flex-fuel Technology Regime in Brazil", Energy Economics 33: 1146-1154. [Florian Rabitz, Lithuania]	Taken into consideration - reviewer is correct. The start of the flex ear is indeed 2003. Text modified.
18642	68	15	68	19	If "co-benefits" are mentioned, it would be essential to note the environmental costs in terms of land use (biodiversity and carbon loss) and other factors. E.g., Sugarcane production led to depossession of people and involved slave and child labour even today, and cane processing (incl to ethanol) is a major source of air pollution. Perhaps these do not outweigh the benefits, but not negligible, and certainly to be considered when such monocultures are presented as a positive example. [Andrea TILCHE, Belgium]	Noted - During the phase of ethanol production there is no scientific report about slave work, but about poor work conditions. This has drastically changed along the years. Over a couple of decades burning has decreased massively and the several programs to redirect jobs due to mechanization were implemented in São Paulo. Sugarcane in São Paulo is amidst a myriad of rain forest patches, therefore still associated with biodiversity which provides high carbon sequestration to the system (see Buckeridge et al., 2012).
18644	68	26	68	31	Whilst past efforts of Brazil in reducing undesirable land-use change should be commanded, some of the the advances are -currently- rapidly rolled back. It would be more prudent to refer to specific measures of the past, where results can be assessed (and there is literature to support that). [Andrea TILCHE, Belgium]	Take in into account - thank you for the suggestion. Text was modified to comply with this suggestions. We added some text about the problems of human health that took place during the 2000s. The resolution was faster than previously though Lack of space in the box prevents us to go deeper into de past events
57378	68	26	68	28	Reference needed [Hans Poertner, Germany]	Noted - references on this assertion are given throughout the text.
62210	68	26	68	31	this box is quite interesting, but too optimistic in tone especially for this lund use part where studies may not give highly precise results. [Antoine Bonduelle, France]	Noted - we tried to be balanced and not optimistic. The chapter is about options to stay well below 1.5C when we are using the history of bioethanol production in Brazil as an example or application of public policies that ended up producing one of the cleanest energy matrices in the planet. Is the reviewer suggesting that we should be more pessimistic? We would need literature to back this up.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
49904	68	26	68	29	The lines mention that 'Despite the intensive use of sugarcane as a bioenergy crop to produce ethanol, it was reported to have limited impact on food production and forests. This due to Brazil's progressive land-use policies....' Still, the carbon sink in Amazon is decreasing. Authors may consider adding more references. As Page 22, lines 26-28 mention that 'However, the carbon sink of the Amazon appears to be decreasing slowly due to the combined effect of increasing tree mortality and a reduction in net primary productivity.' Both these sentences could be consistent. [Himangana Gupta, India]	Noted - the two subjects are not connected. One thing is the sugarcane production, which is mostly down south in São Paulo and some in Mato Grosso. Another completely different thing is the decrease in carbon sink by the Amazon, thousands of km north of where sugarcane is planted. One of the Brazilian policies is the agro ecological zoning, which forbids crops in preserved areas in the amazon. Please see Jaiswal et al. 2017 for details.
4554	68	27	68	27	Forest Codes should be "Forest Code" to the extent that it refers to the 2012 federal law [Florian Rabitz, Lithuania]	Noted, due to the lack of space, we had to take the discussion about the Forest Code from the text. It would be too complicated and take too many words to explain and elaborate on it.
18646	68	39			The "new generation of biofuels" should be made more specific. The two known cellulosic ethanol plants in Brazil report small (negligible) and essentially unverifiable production, and the situation in the US is similar. The only sizable EU plant has gone bankrupt. [Andrea TILCHE, Belgium]	Noted - one of the 2G companies in Brazil has stopped for a while to solve problems with pre-treatment. Once solved, they will keep on. The other company producing bioethanol is Raysen, which is going so well that is now expanding its 2G production. No comment about the US as the box is on Brazil only.
53254	68	41	68	41	relevant to *Technical feasibility of BECCS* This section states, “The potential to combine sugarcane bioethanol with CO2 capture and storage at bio-refineries is a potential cost-effective, short-term technological option for Brazil, and on the longer term, with more innovation, negative emissions could be achieved via large-scale deployment of BECCS (Burns and Nicholson, 2017; Fajardy and Mac Dowell, 2017; Fuss et al., 2014) (see Section 4.3.8).” We thought that was interesting that there were references that would mention using BECCS with sugarcane biorefineries, so we checked them. In fact, while the references here do deal with BECCS, not one of them discusses using BECCS with sugarcane refineries. This is sloppy – these references should not be used here because it implies there have been studies of pairing CCS with sugarcane refineries, when in fact there have not. [Mary Booth, United States of America]	We added a couple of references (Fuss 2014 and Rochedo et al., 2016) about Carbon Capture in Brazil. There are several other papers on this issue by the same group.
13980	68	47	68	51	The example of sugar cane biofuels in Brazil works in many ways, but there are also studies showing social (land grabs) and environmental damage (e.g. burning cane impacts on air quality) from the expansion of sugar cane. Do you want to mention? (Chapter 5; page 31; line 48) [Natalie MAHOWALD, United States of America]	Taken into account - some text about the negative effects on health and environment were noted in the text.
61146	68	47	68	51	The last paragraph discusses the potential application of the Brazilian bioethanol experience to other countries. It states that the African experience was unsuccessful, but provides no insight or explanation as to why it failed. [United States of America]	taken into account - text was revised and better explained.
62814	68	47	68	47	Why Brazil bio-éthanol experience was unsucessful in Africa? [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	Partially. Success would have been much higher if the EU had continued in the process. Some text was added to the box, but due to the space limitation we can not go deep. Please see Favretto et al. 2017 for details.
37412	68	47	68	51	I think this para should be more comprehensive and in particular also point out that key reasons why the Brazilian example may not be transferable in many situations (not only in other sugar-cane growing tropical countries) is that Brazil has a low population density and in many parts of the country good conditions for very high yields given e.g. climate conditions (temperature, precipitation). It seems hardly conceivable to transfer this model to densely populated regions with less ag. potential as e.g. Japan or Europe [Helmut Haberl, Austria]	Noted - reviewer is correct. The idea of transferring the Brazilian technology to other regions is limited to countries with similar characteristics of Brazil, namely some countries in Africa, some regions of India and China. However it cannot succeed in highly population dense regions. Unfortunately there is no space to elaborate more on that. Neither there is literature specifically dealing with this side of the story.
57380	68	49	68	49	Why were these attempts unsuccessful? [Hans Poertner, Germany]	taken into account - text was revised and better explained.
7974	69	4	69	8	Convoluted grammar obscures the meanign of this long sentence. [Christopher Bataille, Canada]	Accept. Text revised; the sentence is split in two and made active.
13212	69	5	69	6	Delete the text "and carbon pricing". [Eleni Kaditi, Austria]	Accept. It wasn't sitting well here.
7486	69	10	69	15	Insert after "Glachant and Dechezleprêtre, 2016" "The Clean Development Mechanism under the Kyoto Protocol contributed significantly to mitigation technology transfer to developing countries (Zhang, Yan 2015)." Reference: Chi Zhang, Jinyue Yan (2015): CDM’s influence on technology transfers: A study of the implemented clean development mechanism projects in China, Applied Energy, 158, p. 355–365 [Axel Michaelowa, Switzerland]	Reject. This is not relevant in this section or for 1.5C very much, and the literature on TT in the CDM is extensively reviewed in earlier IPCC reports.
35544	69	10	69	12	Technology transfer to developing countries may have happened - but at what cost / rate as compared to the counter-factual of there being effective international treaties for such transfer? [Ashok Sreenivas, India]	Noted. However literature not available
9650	69	11	69	17	This paragraph about regulatory measures (sometimes known as 'direct regulations') and about market-based instruments is stated in a way to give a sense of false equivalence - that regulatory measures have faults and that market-based instruments have faults. While both do have faults if not well designed, the market-based instruments will yield greater economic and environmental results if well designed. Direct regulations run the risk of high cost, as can be shown in long histories of such regulations, while achieving environmental results. For more information, the authors of this section need to look at more information from the International Emissions Trading Association, www.ieta.org [Arthur Lee, United States of America]	Rejected. The text is not about comparison between market mechanisms and regulation. Literature suggested is by an advocacy organisation for emissions trading. The section where this is addressed is 4.4.5.
13214	69	13	69	13	Delete the text "(based on lower carbon prices)". [Eleni Kaditi, Austria]	Reject, but further explanation is added as it was not obvious why it was there and what it meant.
1662	69	18	70	1	It is suggested to add the disccsuion on "Technology cooperation and transfer could greatly decrease global mitigation cost and enhance developing countries' mitigation contributions (see reference: Huang W, Chen W, Anandarajah G. The role of technology diffusion in a decarbonizing world to limit global warming to well below 2?°C: An assessment with application of Global TIMES model. APPL ENERG. 2017;208:291-301) [Wenying Chen, China]	Accept. Reference and text included.
54064	69	18	70	1	Tech transfer in UNFCCC - there needs to be a recognition of the importance of non-institutional channels/mechanisms for technology transfer especially among communities in developing countries where local and traditional knowledge systems and practical innovations of communities based on their specific needs and conditions have enabled people to cope with the impacts of climate change and global warming. [Elenita Daño, Philippines]	Taken into account. This is addressed earlier in this section.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
17768	69	21	69	23	- The paragraph, including this sentence, touches upon The value of 'technology development and transfer'. However, this sentence deals with only 'technology transfer'. The aspect of technology development needs to be included. - Also, this sentence delivers ambiguous meaning. I suggest that this sentence needs to be re-written with more specificy and clarity from The references. · I think technology transfer itself incudes The process of adapting technologies to local circumstances, rather than 'help adapting technologies to local circumstances'. · Also, what does it mean by 'technology transfer reduce costs'? what kinds of costs does it reduce? · does 'technology transfer develop indigenous technology'? to my understanding, more appropriate expression is that technology transfer can help develop endogenous capacity for (economic) development in developing countries. Also, seemingly, it is financial support/policy system/or IPR institution that develops indigenous technology. · what kinds of 'capabilities are built globally by technology transfer'? Technological capabilities? Capabilities to respond to climate change? what is it? - If The author is ready to take a bold step, I suggest that The author writes a new sentence on The definition of 'technology development' and 'technology transfer' or 'technology development and transfer' rather than refining The afore-mentioned sentence. [Republic of Korea]	Accept. Focus on tec transfer only here explained, "help" is removed, "financing" added to costs (as it can reduce risks), in the definitions in earlier IPCC reports, TT also includes the process of developing local capabilities, and capabilities are explained further.
48120	69	27	69	27	Reference format. Has an additional bracket. Also at several other places [Sarah Connors, France]	Reject. Bracket is needed here.
17770	69	30	69	33	- The paragraph, including this sentence, is about the international institutional landscape on technology development ad transfer. Out of many elements that constitute this landscape, the author takes only two elements of i) non-UN multilateral initiatives (example: Mission Innovation) and ii) numerous initiatives (example: Breakthrough Energy Coalition). - My question is why the author takes these two elements in this paragraph. Without specific explanation, this part can lead to the misunderstanding of whether these two elements are better or worse than the UN-based technology initiatives. · There is no explanation on this. · Does the author intend to say that these types are more appropriate? · The author says 'it is difficult to evaluate its(Mission Innovation's) effectiveness'. Does this implicate that this non-UN multilateral initiatives are inappropriate? · Also, what kind of effectiveness does the author intend to mean? Effectiveness in terms of behavioral change through participating nations' policy change? Or, effectiveness in terms of consequences of enhanced technology development? [Republic of Korea]	Rejected. This chapter focus on latest development since AR5. AR5 has an extensive discussion of this; this is an update since the AR5, of developments and literature. The paragraph, upon rereading, in our minds does not say that non-UN and other initiatives are the only ones. We unfortunately don't have the space to be exhaustive. Effectiveness is removed.
17772	69	35	69	37	- I suggest this sentence needs to be re-written in the following way; "Most technology transfer is driven through the markets by the interests of technology seekers and technology holders, in particular in regions with well-developed institutional and technological capabilities such as developed and emerging nations (Glachant and Dechezlepretre, 2016)". - The reason why I am suggesting this change is that 'market' itself is formed by 'human needs', and 'technology transfer' is a transaction that happens between technology seekers and technology holders on their own interests. [Republic of Korea]	Accepted text modified
17774	69	37	69	39	- In this sentence, the author uses the term 'landscape'. Is this term the same with 'the international institutional landscape' in the 20th line? Then, does this sentence intend to say that the current 'international institutional landscape' has gaps on 'technology transfer', in particular, to least-developed countries? Then, what kind of gap does the author intend to say? From this paragraph, I can only conjecture regional gap. - This sentence leads me to question what the intention of this paragraph starting in the line 35th is. If the author want so talk about the gaps that the current UN and non-UN based initiatives cannot fill out, isn't it the gap on the kinds of climate technologies or the gap on certain stage in the technology cycle of a specific climate technology? This paragraph is not clealy indicate what the author intends to tell. [Republic of Korea]	Accept, text clarified.
17776	69	39	69	42	- Now this sentence talk about the management of all the UN and non-UN based initiatives. Then, there should be some explanation on this, before the sentence starting in the 39th line. [Republic of Korea]	Accept, text clarified.
30642	69	40	69	41	« to 'let a thousand flowers bloom' » Poetic, but unclear [France]	Accept. Text clarified. It's commonly used in innovation literature and even in international relations.
17778	69	44	69	48	- This sentence starts with 'for adaptation specifically' after the paragraph on the initiatives. However, it talks about the balance between technology development and transfer all of a sudden. - Integrity and connection among the paragraphs need to be concerned. [Republic of Korea]	Accept. This text is based on only one reference, as the literature on adaptation and tech transfer is very limited. Paragraph removed as it's also very condensed and not so clear.
17780	69	50	70	1	- This paragraph talks about the technology framework. I thought that this paragraph will talk about the inclusion of the relation between the UN and the non-UN based initiatives as the key theme of the technology framework. However, this paragraph all of a sudden talks about the development and updating of the technology needs assessment (TNA) and the implementation of the TNA. I think this paragraph needs to be re-situated in this chapter of 4.4.4.4. or re-written in consideration of the whole context of this chapter. - Furthermore, why only TNA? If we look at the CO21 decision on the adoption of the Paris Agreement, what needs to be considered for the technology framework includes, inter alia, not only the TNA but also i) the provision of enhanced financial and technical support for the implementation of the results of the technology need assessments, ii) the assessment of technologies that are ready for transfer, and iii) the enhancement of enabling environments for and the addressing of barriersto the development and transfer of socially and environmentally sound technologies. I hope that the author needs to have a more neutral and comprehensive attitude with regard to this part. [Republic of Korea]	Taken into account. Text on TNAs removed.
47206	69	52	69	52	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accept. See response to 17778
47974	69	52	69	52	Kindly check: UNFCCC, 2015 is 2015a or 2015b or 2015c (Pg 183, line 39) [Sarah Connors, France]	Accept. Reference revised.
52204	69	53	69	54	It woud help to explain more what these terms mean and to have consistent use of capital letters. [Jason Donev, Canada]	Taken into account. Text on TNAs removed.
61148	70	3	77	4	Relatively little of the discussion in 4.4.5 is closely linked to 1.5°C. It should be revised to delete unnecessary discussion and make a closer connection to the pathways discussed elsewhere in the chapter and in Chapter 2. [United States of America]	Taken into account - the link with chapter 2 will be reinforced through a discussion about the corridors of marginal abatement costs. The rest of the paragraphs will be meaning because the focus is to underline the specific difficulties of the early phase of the transition. However, we will insist in that which is valid for the transition and the 1,5 target

Comment No	From Page	From Line	To Page	To Line	Comment	Response
3936	70	4	70	4	This section is framed by and focused on a neoclassical and public welfare economics view of policy and policy instruments for climate mitigation. Grubb, M., Hourcade, J. and Neuhoff, K. (2014) Planetary Economics argue that this frame requires expansion in order to deal with the complex nature of the problem, to the realm of behavioural economics on the one side (which is partially addressed here) but also into the realm of complex systems on the other. Whilst this issues are partially addressed in box 4.9, this is only from an evidence perspective, without linking back to implications for theory. There is a nascent literature dealing on policmaking for policymaking for long term issues, and also literature on addressing wicked or complex policy problems. See in particular Levin, K, Cashore, B, Bernstein, S, Auld, G. (2012) 'Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. Policy Sciences, 45, 2, 123-152. Issues of ensuring the policy direction is not reversed when a new politician comes to office, of adapting to how the system responds to the policy, designing for implementation rather than the 'right' carbon price, and building positive path dependencies are priorities in policymaking for complex problems. In climate mitigation policy generally there is an emphasis on theoretical economics rather than insights from the broader and particularly the post-positivist public policy literature, which considers 'how' policy is made, as opposed to the focus on the content and detail of the policy, such as getting the price right. Such an expanded view is particularly necessary for targeting the nature of infrastructure (See Lecocq, F., Shalizi, Z. (2014) The economics of targeted mitigation in infrastructure. Climate Policy, 14,2,187-208. [Emily Tyler, South Africa]	Accepted - The new structuring of the text will hopefully avoid this impression that the section is framed by neoclassical economics. It has been indeed framed starting from articulation between the short-term and long-term challenge faces of the transition and uses the Grubb et al. references you quote
45534	70	4	70	4	Is this trying to do all of AR6? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - to avoid this impression the final version will be clear about the fact we concentrate on the conditions of transition
50066	70	4	77	4	The introdution on page 70, lines 6-17 is the right framing: how to make a very rapid transition (which is what a 1.5 limit implies) happen with a combination of regulatory and market based instruments. That would in my opinion first and foremost call for a discussion on the balance of the policy packages. And the answer is clear: market based instrument, carbon pricing in particular, is not going to deliver strong incentives soon enough, so more emphasis is needed on regulatory instruments. That discussion is now missing. In stead, the section discusses the various policy instruments, mostly in a superficial manner and for carbon pricing in too much detail. It would be much better to summarise the assessment on policy instruments from AR 5 here (and only supplement it with new litterature if that really adds to the picture). Then the focus can be on the balance and the need to strenthen the regulatory approaches. The case study on car us in Beijing is a nice illustration: private car use has plateaud and is declining because the issuance of licence plates is strictly controlled, in addition to providing good alternative transport in the form of metro lines. The issue of cost and distributive effects (section 4.4.5.1 but also 4.4.5.2) is relevant as this issue will be more prominent in 1.5 degree strategies. But then I expect a deeper and more coherent discussion on how to handle this problem. The current treatment is too superficial and fragemented. At the end of the section (page 77, lines 1-4 the existence of post-AR5 literature is mentioned on how to make financial flows consistent with the Paris objectives. That sounds interesting, but there is no discussion at all. [Bert Metz, Netherlands]	Taken into account - We understand the critic but we think that this section shouldn't be isolated from the section of 4.4.3 with the introduction of non price policies. More globally, the structure has been totally changed and the former 445 and 446 section are now merged in a single one.
47174	70	8	70	8	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Taken into account - the phrasing of the final version merges the section 445 and 446
942	70	15	70	15	and designs of policy' should be 'and design of policy' [Robert Shapiro, United States of America]	Editorial - accepted
29650	70	17	70	17	Please insert after "1.5° world": (see Michaelowa et al. 2018 for a discussion about appropriateness of policies for a 1.5°C scenario)." Reference: Michaelowa, Axel; Allen, Myles; Fu Sha (2018): Policy instruments for limiting global temperature rise to 1.5°C – can humanity rise to the challenge?, in: Climate Policy, 18, p. 275-286 [Mareike Blum, Germany]	Taken into account - there are many papers about the appropriateness of policies for a low-carbon transition. In such circumstances, space constraints implied that we cannot quote all the interesting papers and selecting all of them will be perceived as arbitrary. For his one, what we have done is to add this paper in the references list. We received for example suggestions to include papers from M. Grubb, myself, Stavins and many others.
52206	70	20	70	24	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial - accepted
4494	70	21	70	24	Should add figure of MAC in 2100 from AR5. In addition, cost per GDP or consumption loss should also be incerted here as seen in AR5 (see Table SPM.2 and Figure 6.21 in AR5/WG3). I don't understand why GDP loss or consumption loss are omitted here. [Mitsutsune Yamaguchi, Japan]	Accepted - This is a problem of articulation with chapter 2 and the problem has been solved in the new draft
10112	70	21	70	24	based on chapter 2 and earlier sections of this chapter the figures for carbon prices associated with 1.5c are 3 to 7 times compared to 2c. [Saudi Arabia]	Accepted - This is a problem of articulation with chapter 2 and the problem has been solved in the new draft
12420	70	21	70	24	The transition to a low-emission energy system implies higher energy costs. Can this (and the following paragraph) be more nuanced? E.g. "The transition to a low-emission energy system may imply higher energy costs in the near term, but there is scope for this effect to be counterbalanced and potentially nullified." [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - in the final version we clarify better the notion the energy cost
31548	70	21	70	24	It says "For 1.5°C, figures are not available", but it is mentioned that MAC for 1.5°C is about 3 to 7 times higher than those of 2°C world in SPM and Chapter 2 (p.21 lines 22-23 and p.99, lines 11-12 each). Since these numbers are important, they should be mentioned in the SPM and executive summary. In additon,the information about “figure of MAC in 2100 “and “cost per GDP or consumption loss” (Table SPM.2 and Figure 6.21 in AR5WGIII) should be added. [Japan]	Taken into account - There is a real confusion between them and we will dispel the misunderstanding in the final version.
37096	70	21	70	23	Line 21-24 is not consistent with Chapter 2 (page 99, line 2-12) , On one hand, Chapter 4 states that worldwide marginal aatement cost for 2 degree target in AR5 was 130-260$/t-CO2 and the one for 1.5 degree is not yet available (page 70 line 23-24). On the other hand, Chapter 2 states that carbon price for "below 2 degreee", "return to 1.5 degree" and "below 1.5 degree" is in the range of 30-70$, 90-105$ and 240$ respectively. Chapter 2 also states that "below carbon price between "below 1.5 degrees 50%" and "below 2 degrees 50% or 66%" scenarios differ by about a factor of three to seven by 2050. There are many discrepacies. First, marginal abatement cost or carbon price for seeking below 2 degree (30-70$ in 2050) is much lower than the figure for seeking 2 degree in AR5 (130-260$). Why carbon prices for seeking more ambitious temperature "below 2 degree (30-70$ in 2050)" and "return to 1.5 degree (90-150$ in 2050)" are lower than AR5 figure aiming at 2 degree (130-260$)? Why carbon prices for 1.5 degree are presented in Chapter 2 while Chapter 4 states such figures are not yet avaiable? Readers will be very much confounded by such discrepancies. Since cost information is particularly crucial for policy makers, full consistency across the entire report should be secured. [Jun Arima, Japan]	Taken into account - There is a real confusion between them and we will dispel the misunderstanding in the final version of the report.
944	70	22	70	22	in2020' should be 'in 2020' [Robert Shapiro, United States of America]	Editorial
30644	70	22	70	23	Are those numbers comparable to those in chapter 2, p99, line 7 ? They seem to be both the cost of mitigating one extra unit of emission, here for 2°C and in chapter 2 for 1,5°C. However, in chapter 2, the price for 2050 is 90-105$ which is lower than the price here for 2050 (while in chapter 2 and in the SPM it is said that 1,5°C carbon prices are supposed to be 3 to 7 times higher than 2°C carbon prices) [France]	Taken into account - There is a real confusion between them and we will dispel the misunderstanding in the final version.
946	70	23	70	23	in2030' should be 'in 2030' [Robert Shapiro, United States of America]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
4496	70	23	70	24	In the SPM and Chapter 2, it says MACs for 1.5 world can be found. There MAC is described as around 3-7 times higher (p. 21, lines 22-23 of SPM and p.99 lines 11-12 of Chapter 2). In addition, MAC absolute values for 1.5 world can be found in p. 99, lines 8-9 in Chapter 2. Whereas here it says you don't have cost (MAC) figure for 1.5 degree. This is funny and this shows lack of communication between chapters. Please add all necessary figures of cost in the next version. Anyway, though MAC is important to assess competitiveness but real cost for the economy is GDP or consumption loss. These cost figures should also be shown in the SPM and executive summary. [Mitsutsune Yamaguchi, Japan]	Accepted - This problem of communication has been solved
7976	70	23	70	24	An absense of carbon prices corridors for 1.5C is noted, but it may be appropriate to quote the corridors in the High Commission on carbon pricing report https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices/. "This Commission concludes that the explicit carbon-price level consistent with achieving the Paris temperature target is at least US$40–80/tCO2 by 2020 and US$50–100/tCO2 by 2030, provided a supportive policy environment is in place." [Christopher Bataille, Canada]	Taken into account - by quoting the Tern-Stiglitz report, but the carbon prices quoted here are those reported in chapter 2 because the IPCC focuses on peer reviewed literature published in scientific journals
4498	70	31	70	33	This part to be shown in the executive summary following cost figures. [Mitsutsune Yamaguchi, Japan]	Accepted
7978	70	31	70	33	The claim about "most economic models" is very broad and not accurate for the context it is situated in. At least replace it with "Optimization based economic models in common use for global climate policy analysis assume …." To do this right would require an entire section, because most economic models used for direct national policy analysis include some measure of behavioural realism. There is whole literature on this, but I offer the following source as a beginning. Pye, S. and C. Bataille, (2016). Improving deep decarbonisation modelling capacity for developed and developing country contexts Climate Policy, 16:sup1, S27-S46 DOI 10.1080/14693062.2016.1173004 [Christopher Bataille, Canada]	Taken into account - in the final version of the report that has been totally restructured. However, at this stage we maintain that the majority of models are based, directly or not, on optimizing framework, at least they dominate the range of values found in literature.
31550	70	31	70	33	This part is important and should be added in the executive summary. [Japan]	Accepted
7770	70	35	70	37	The German description is oversimplified. High residential tariffs were mostly tax by longstanding public policy (as in Denmark) and were further raised by several billion Euros a year of cross-subsidy from households to industry. The high tariffs then stabilized and began to decline. They were never a serious political issue, though often misrepresented as one by anti-Energiewende propagandists. Of course, other countries following a similar course of feed-in tariffs would avoid most of the basic cause of high initial costs—namely the early volume-building and cost-cutting growth that Germany generously paid for, to the benefit of all other nations, and that then triggered massive Chinese scaleup, making modern renewables now the cheapest supply option nearly everywhere. Thus the German experience, however interpreted, need not be repeated because it fundamentally changed global market conditions, making lines 40–41 of doubtful validity. And even were this not the case, the German investment will soon reach breakeven and begin to return its initial investment with a handsome return over decades: in effect, Germany has already built an electricity system ?35% of whose output for decades to come will be virtually free, its capital cost having already been sunk, thus creating valuable cashflows and hedges against fuel-price volatility and other disruptive forces. [Amory Lovins, United States of America]	Taken into account - with a slight amendment recalling that this price increase in the early phase, with no judgment about what happens later
12422	70	40	70	42	Ultimately, during the early stage of a low-carbon transition, both energy prices and the prices of non energy goods will typically increase, causing lower consumer purchasing power and lower final demand for non-energy goods (see Box 4.8) - where has this come from? It needs to be referenced, and given some context. Box 4.8 doesn't refer to it [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - The reference into the box 4.8 is false, it's Box 2.1 in Chapter 2. in substance, higher energy prices and higher process on non energy goods impacts negatively the consumer purchasing power. Is a very simple mechanism described in all models but it is impossible to quote all the references explaining what is the simple and uncontroversial economic mechanism.
13240	70	40	70	40	Replace "low-carbon" with "low-emission". [Eleni Kaditi, Austria]	Accepted - edit amended
1672	70	45	72	5	It is suggested to add more years' data and more modes for Figure 1 (currently only till 2014). Why only bicycle, privete car and transit are shown in Figure 1 while without bus and taxi? [Wenying Chen, China]	Noted. No data beyond 2014 is available yet. The first figure does not include everything for simplicity of presentation. More is in the paper referred to.
40528	70	45	72	5	While improvements to this section have occurred since the FOD, I am still unsure why the peak car concept is getting so much attention in an IPCC report focused on achieving 1.5ºC. Is this concept relevant when there are other sections of the report emphasising the role of electrification in the LDV sector? Does a concept that has been observed in the short-term, have relevance to a report on achieving 1.5ºC in 2100? Do the all of the authors believe that this trend will continue from the current period until 2100 without any disruptions? The evidence behind the peak car concept is not particularly strong and has not been robustly validated using statistical analysis. This section does not mention any of the literature that has found that changes in car ownership can be explained by economic factors. Obviously, reduced demand for oil is important. However, is peak car more important than other key issues, such as the electrification of the vehicle fleet and other long-term trends (such as fuel efficiency)? Here is a list of the papers that argue that changes in economic variables are consistent with a plateau in car ownership: Bastian, A., Börjesson, M., & Eliasson, J. (2016). Explaining “peak car” with economic variables. Transportation Research Part A: Policy and Practice, 88, 236-250; Wadud, Z., & Baierl, M. (2017). Explaining “peak car” with economic variables: A comment. Transportation Research Part A: Policy and Practice, 95, 381-385; Bastian, A., Börjesson, M., & Eliasson, J. (2017). Response to Wadud and Baierl:“Explaining ‘peak car’with economic variables: An observation”. Transportation Research Part A: Policy and Practice, 95, 386-389; Stapleton, L., Sorrell, S., & Schwanen, T. (2017). Peak car and increasing rebound: A closer look at car travel trends in Great Britain. Transportation Research Part D: Transport and Environment, 53, 217-233; Manville, M., King, D. A., & Smart, M. J. (2017). The Driving Downturn: A Preliminary Assessment. Journal of the American Planning Association, 83(1), 42-55. [Thomas Longden, Australia]	Noted. Demand reductions are important in reshaping carbon intensity. Explaining peak car by economic decline is not explaining the data in this box and the new figure 2 shows this very clearly as car use and GDP have decoupled in Beijing.
61150	70	45	72	99	The text in Box 4.8 could be condensed. [United States of America]	Accepted. It has been reduced.
62018	70	45	71	21	The two examples are from the same country (China). What about having different examples on drivers of peak car use, illustrating both increased use of public transportation (metro here) but also other drivers (e.g. car sharing)? [Valérie Masson-Delmotte, France]	Noted. This could have been done but a Box is meant to be more of a case study.
13242	70	46	70	51	Delete the text "The phenomenon of ‘peak car’, reductions in per capita car use, provide hope for continuing reductions in greenhouse gas from oil consumption (Goodwin and Van Dender, 2013; Millard-Ball and Schipper, 2011; Newman and Kenworthy, 2011). The phenomenon has been mostly associated with developed cities, though apart from some early signs in Eastern Europe, Latin America and China (Newman and Kenworthy, 2015) there is great need in emerging economies (Gao and Kenworthy, 2017). New research is indicating that peak car is now underway in China (Gao and Gao).". [Eleni Kaditi, Austria]	Rejected. No reason is given for rejecting material based on trends in car use.
1674	70	50	70	51	New research is indicating that peak car is now underway in China is not correct. The meaning for "peak car" should be clarified (peak of car number? (not peak actually) , peak of car use? (not peak actually), peak of share of car use in some cities? [Wenying Chen, China]	Accepted. This indeed does not go for all of China but for Beijing and several other large cities. The new data show this quite clearly and they are published in Gao and Newman 2018, Urban Planning article. The text is revised to include this distinction, and the point is further elaborated in Box 4.9.
7772	70	51			A useful peak-car analysis for the USA (oddly omitted) is at https://www.rmi.org/insights/reports/peak-car-ownership-report/. [Amory Lovins, United States of America]	Noted. This was read with interest but cannot be used as it's grey literature.
61152	71	3	71	6	There is no mention of the strong policies that also contribute to peak car use. Can attribution to a primary cause (here mass transit) be concluded? [United States of America]	Accepted. The text shows multiple causes.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
52208	71	4	71	4	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Noted.
56378	71	4	71	4	Typo [Nuno Bento, Portugal]	Noted.
40530	71	6	71	7	Box 4.8, Figure 1 is not particularly convincing. A figure with a x-scale that has no observations between 1986 and 2000 does not capture a structural break. Rather it may be showing different stages in China's economic development. China/Beijing was a very different country/city in the periods between 1986, 2000 and 2005-2014. While it is important that commuters are using public transport, it is not clear that this is directly due to a peak car phenomenon. It is probably capturing the changes in the provision of public transport. How much relevance does the period between 2005-2014 have to achieving a 1.5ºC target in 2100? Will this trend continue if there are changes to the road infrastructure or city planning? Have emissions from LDVs stabilised in Beijing? Is this same trend being seen in other large Chinese cities? Rather than being an example of peak car, is this figure capturing the expansion of the Beijing metro between 2001 and 2008? [Thomas Longden, Australia]	Rejected. The data are elaborated much more in the associated paper (Gao and Newman, 2018, Urban Planning article) and other publications on peak car, especially the multiple causes. The new Figure 2 shows strong absolute decoupling of car use and GDP.
47976	71	16	71	16	Kindly check: China Association of Metros, 2017 is missing in the reference list [Sarah Connors, France]	Editorial; no longer cited
47978	71	20	71	20	Kindly check: NBSC, 2016 is missing in the reference list [Sarah Connors, France]	Editorial; no longer cited
33990	71	29	71	30	Comparing threee statements about CCS in 2050 to the information in Table 4.1: "0.8 – 1.8 GtCO2 avoided per year by CCS (median:1.5)": * Ch. 2, page 71, line 29-30: "In 1.5DS, total account for CCS in industry project a contribution of 1.5 [0.8–1.8] Gt-CO2 yr–1 by 2050" * Table 2.7: In 2050, annual contribution from CCS (Fossil fuels and industry) must contribute with 10.8 Mt ("Return 1.5C 50", median). * Ch. 2, page 49, line 2-3: "Most of the fossil fuel use with CCS occurs at point sources in the industry sector (Luderer et al., 2017c)." When comparing these statements, the number in table 4.1 seems very low. Please consider improving clarity on this. [Norway]	Accept. We have aligned the numbers between the chapters.
13216	72		72		Section 4.4.5.2 to present challenges on equity among nations as well. [Eleni Kaditi, Austria]	Taken into account - in the new structure of the section, that now merges sections 445 and 446, and that discussed the approaches to equitable access to development
48122	72	2	72	5	Please check the numbers. Also add year for Gao and Gao [Sarah Connors, France]	Accepted. Text revised.
47474	72	3	72	3	Invalid Reference: No news items or blog posts can be used as references in an IPCC report. Please find alternative reference or remove text. Please follow the IPCC guidelines for grey literature: https://wg1.ipcc.ch/guidancepaper/AR5GuidanceNotes_Literature.pdf [Sarah Connors, France]	Accepted. Text was removed with these citations.
49906	72	9	72	10	It could be added somewhere as to how non-market approaches itself (also outlined in the Paris Agreement) can help achieve adaptation goals or address joint mitigation and adaptation at the global level. References for those could be: LOCATELLI, B., EVANS, V., WARDELL, A., ANDRADE, A. and VIGNOLA, R. 2011. Forests and climate change in Latin America: linking adaptation and mitigation. Forests 2 (1): 431–450. LOCATELLI, B., PAVAGEAU, C., PRAMOVA, E. and DI GREGORIO, M. 2015. Integrating climate change mitigation and adaptation in agriculture and forestry: opportunities and trade-offs: Integrating climate change mitigation and adaptation in agriculture and forestry. Wiley Interdisciplinary Reviews: Climate Change 6 (6): 585–98. UNFCCC. 2015. Decision 16/CP.21: Alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests. United Nations Framework Convention on Climate Change. Report No.: FCCC/CP/2015/10/Add.3. [Himangana Gupta, India]	Rejected - because this important point of the link between adaptation and mitigation is treated in other sections of the report
48670	72	15	72	15	Geographical conditions matter also for cooling needs. Please add "cooling" [Yamina Saheb, France]	Accepted
32282	72	16	72	17	suggest "…as low-come areas in urban centers." [Jamaica]	Taken into account - the new version precise the importance of the link between the policies and competitiveness issues
4500	72	20	72	25	Competitive issue is one of the barriers to the intruduction of more stringent policies. This point should be stressed much more. [Mitsutsune Yamaguchi, Japan]	Taken into account - However, we work and there are very tight space constraints
12424	72	20	72	25	Can evidence be presented on how real a problem carbon leakage is? [United Kingdom (of Great Britain and Northern Ireland)]	Rejected - Literature quoted in this section explicitly refers to the magnitude of the carbon leakage
31552	72	20	72	25	It would be better to emphasize that one of the factors that makes it difficult to introduce "more stringent policies" is a decline in competitiveness. See the followings: Joseph E. Aldy, William A. Pizer, and Keigo Akimoto, Climate Policy published online, 11 Jan 2016. Joseph E. Aldy and William A. Pizer, Review of Environmental Economics and Policy, 2015, Advance online publication doi: 10.1093/reep/rev013. [Japan]	Accepted
7980	72	23	72	23	Replace "to generate" with "causing" [Christopher Bataille, Canada]	Editorial
32284	72	27			suggest "…depreciation of assets which value…" [Jamaica]	Taken into account - this type of phrasing has been included in the final version of the section which has been totally restructured.
33136	72	37	74	46	Section actually doesn't say much about equity. Useful reference :https://www.wri.org/sites/default/files/building-climate-equity-072014.pdf [Tara Shine, Ireland]	Taken into account - We try to improve the phrase, however, the type of equity considered here is the mechanical impact of higher carbon prices of higher energy prices on households purchasing power. It doesn't address the wider notions of equity that can be found in political sciences or about capabilities. We do not change the subtitle here because the links between equity and deficiency are core debate in economics since one century.
36140	72	37			In the Section on mastering the cost efficiency/equity challenge, regulations and standards are suggested. It should also be covered that creating functioning markets and regulatory structures is: (a) an inherent and evolutionary part of the development process; and (b) does not come without incremental costs. This fact needs to be incorporated in the Report (Section 4.4.5.2). [India]	Taken into account - in the new structure of the section. We hope that the language now respond this comment
52210	72	37	72	44	This is inconsistent with other commentary elsehwere in this report on carbon pricing. [Jason Donev, Canada]	Taken into account - we change the wording
61154	72	37	77	37	This section could benefit from significant streamlining. This section spends an undue amount of time discussing different types of policy responses and fiscal tools (e.g., carbon pricing in particular) without drawing out what is novel/relevant in the 1.5°C context. Much of it seems repetitive to previous IPCC reports. [United States of America]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
56868	72	37	74	46	This section is headed ""Mastering the cost-efficiency/equity challenge" but it does not discuss "equity". Its focus is on cost-efficiency. Cost-efficiency approaches and equity approaches are distinct and a concern for equity goes beyond cost-reduction and takes in to account the fair distribution of costs. For relevant discussions of equity and burden sharing see Caney (2010, 2018), Shue (2014). These discuss the role of principles such as ability to pay, historical responsibility, equality, development and so on. REFERENCES. Simon Caney (2010) 'Climate Change and the Duties of the Advantaged', Critical Review of International Social and Political Philosophy, vol.13 no.1 (2010), 203-228. Simon Caney (2018) 'Climate Change and Distributive Justice' in The Oxford Handbook of Distributive Justice (Oxford: Oxford University Press), edited by S. Olsaretti, 664-688. Henry Shue (2014) Climate Justice: Vulnerability and Protection (Oxford: Oxford University Press). [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - We try to improve the phrase, however, the type of equity considered here is the mechanical impact of higher carbon prices of higher energy prices on households purchasing power. It doesn't address the wider notions of equity that can be found in political sciences or in the words of sen about capabilities. We do not change the subtitle here because the links between equity and deficiency are core debate in economics since one century. For space constraints we cannot elaborate here the link between this precise debate and the overall discussions about justice in political philosophy. This notion of justice will be referred to later in other sections of this report.
7982	72	38	72	44	Climate and energy policies do not necessarily "mobilise dominantly non-price instruments". Very high excise taxation of energy is very common for gasoline and diesel, and carbon pricing is becoming more common. This is inaccurate and distracting statement as written. The meaning of this paragraph is clear and important, but it currently demonstrates unsubstantiated bias and needs to be toned back to the evidence base. [Christopher Bataille, Canada]	Accepted
61156	72	42	72	43	The discussion of "aspirational" carbon prices is very unclear. What is the scope of the emissions referred to in line 43? [United States of America]	Taken into account - reworded
49908	72	43	72	44	The reference can be updated to (World Bank, 2017) in State and Trends of Carbon Pricing 2017, which says that 'Overall, 67 jurisdictions—representing about half of the global economy and more than a quarter of global GHG emissions—are putting a price on carbon. Carbon pricing initiatives cover about half of these jurisdictions' GHG emissions on average, which translates to about 8 gigatons of carbon dioxide equivalent (GtCO2e) or 15 percent of global GHG emissions.' [Himangana Gupta, India]	Taken into account - We have updated although this doesn't change the orders of magnitude
63114	72	43	72	44	The line on coverage of global emissions covered by carbon pricing can be expanded to provide a more holistic snapshot on the current status and trends, e.g. the number of jurisdiction implementing carbon pricing. IPCC may also wish to use the latest 2017 World Bank publication of the status and trends of carbon pricing, which has more updated information, including the fact that with the implementation of China's national ETS, the share of global GHG emissions covered by carbon pricing will expand to between 20 to 25% of global emissions. [Singapore]	Accepted
8086	72	45	72	46	mariginal cost: not so obvious with inertia. See Vogt-Schilb https://doi.org/10.1016/j.jeem.2017.12.001 [Quentin Perrier, France]	Accepted
30646	72	45	72	46	« the marginal costs of abatement are equated across all sources of emissions » Not so obvious, see Vogt-Schilb https://doi.org/10.1016/j.jeem.2017.12.001 [France]	Accepted
948	72	49	72	49	of' should be 'to' [Robert Shapiro, United States of America]	Editorial
47176	72	49	72	49	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested alternative '...Party submits information…' [Sarah Connors, France]	Editorial
47114	72	50	72	50	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorial
10114	73	1	74	19	Box 4.9 summarizes very well the policy complexities of 1.5c in relation to the choice of instruments, their cost-effectiveness, and the associated distributional implications of deep decarbonization. Unfortunately, these important insights from the DDPP and CD-LINKS projects don't find their way to the executive summary of the chapter and as well to the SPM. Indeed these results are very relevant to the questions that policy makers are looking for special report to inform on. Hence, it would add to the value of the report if these results are summarized and included in executive summary and the SPM. [Saudi Arabia]	Noted - thank you for these encouraging comments. However, as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now and could also not be elevated to the SPM.
61158	73	1	74	19	Box 4.9 presents a useful and interesting topic, but the text could be sharpened and condensed to make the key points clearer. What are the implications of the discussion in lines 35-43 for 1.5°C pathways? [United States of America]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
7984	73	8	73	8	distil to "distill" [Christopher Bataille, Canada]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
49910	73	12	73	12	Unable to find (Pahle et al.) on the internet. Since several points are being made using this reference, it would be more convincing if the points are substantiated with more peer reviewed literature. [Himangana Gupta, India]	Noted - indeed, as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box.
12426	73	24	71	25	This is especially important to accelerate the transition to a 1.5°C world, which can be triggered by such incentives - what does "this" refer to? [United Kingdom (of Great Britain and Northern Ireland)]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
16530	73	27	73	33	It would be useful if this box briefly outlined what would be successful complementary policies. No all complementary policies are beneficial and some can increase costs without further improving outcomes for the electricity system or the environment. [Australia]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
16532	73	27	73	33	The article (Spencer 2018) is not yet available for checking, as it is not yet published, or accepted to be published as far as we know, however it seems unlikely to be a sustainable proposition that Australian governments have not designed and delivered complementary policies to mitigate financial risk to address stakeholders impacted by emission reduction policies. Can the claim with respect to Australia be substantiated? If not, please delete reference to 'Australia'. [Australia]	Noted - even though Spencer 2018 had in the meantime been published, much of the 1.5°C-specific literature on which the box was based did not make the literature cut-off, so we had too little material left to justify the box, which has been cut as a result.
12428	73	35	73	43	This para seems to need editing / rewording, as it's not clear what it's saying [United Kingdom (of Great Britain and Northern Ireland)]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
30654	73	36	76	36	« cities are increasingly comment » Do you mean "are increasingly common" ? [France]	Editorial
47980	73	39	73	39	Kindly check: La Rovere et al., 2017 is 2017a or 2017b? (Pg 156, line 59) [Sarah Connors, France]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
950	73	41	73	41	like' should be 'is' [Robert Shapiro, United States of America]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
52212	73	41	73	41	This paper is now out of date as the shut down of nuclear power plants in Japan in recent years have led to a significant increase in the imported coal for Japan, increasing their emissions and decreasing their energy independence. [Jason Donev, Canada]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
47982	73	42	73	42	Kindly check: Oshiroet al., 2016; put a gap between 'Oshiro' and 'et' [Sarah Connors, France]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
52214	73	47	73	51	The nuclear phase out in Germany has made for a significantly greater need for wind and solar than they would require if they were keeping their nuclear power plants. They are replacing low emissions with other low emissions, keeping their coal on line, and at times, increasing it. [Jason Donev, Canada]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
13220	74		74		Section 4.4.5.3 to focus on developing countries as well. [Eleni Kaditi, Austria]	Accepted
12430	74	2	74	4	What does policy costs mean here? Mitigation cost? Or implementation and other costs? [United Kingdom (of Great Britain and Northern Ireland)]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
7488	74	4	74	6	Insert after "Pahle et al. ": "Thus the role of market mechanisms to harness the lowest mitigation cost options is very important". Replace "The performance … concern" by: "In order for market mechanisms to mobilize mitigation, sufficient demand for emissions credits/allowances is necessary. This has been lacking in recent years". [Axel Michaelowa, Switzerland]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
7490	74	9	74	10	Please replace "Hoch 2017" by "Bodnar et al. 2018". Reference: Bodnar, Paul; Ott, Caroline; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily; Wagner, Gernot (2018): Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation, Climate Policy, 18:3, p. 368-382, [Axel Michaelowa, Switzerland]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
8244	74	9	74	10	Please replace "Hoch, 2017" by "Bodnar et al., 2018". Reference: Bodnar, Paul; Ott, Caroline; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily F.; Wagner, Gernot (2018): Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation, Climate Policy, 18:3, p. 368-382. [Angela Geck, Germany]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
37430	74	9	74	10	Please replace "Hoch 2017" by "Bodnar et al. 2018". – full reference: Bodnar, Paul; Ott, Caroline; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily; Wagner, Gernot (2018): Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation, Climate Policy, 18:3, p. 368-382, [Matthias Honegger, Germany]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
7774	74	14	74	15	fix syntax [Amory Lovins, United States of America]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
952	74	15	74	15	policy that undermine' should be 'policy undermine' [Robert Shapiro, United States of America]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
7776	74	16	74	18	I suggest putting this in plain English without the economic jargon: many readers are neither economists nor classicists. [Amory Lovins, United States of America]	Not applicable- as much of the 1.5°C-specific literature on which the box was based was still pending and finally did not make the literature cut-off, we had too little material left to justify the box. This text is therefore gone now.
52216	74	23	74	35	Industrial political pressure is non-trivial in almost every country in the world. This pressure from industry and lobbying groups representing industries resents the wealth redistribution. They are angry and they will fight, this must be understood and it must be communicated. These people are powerful and will do a great deal to come after any policies that will interfere with their ability to make the money that they want to make, that they have been making. I think that part of the solution has to be an increased transparency. It's not that everyone needs to know how much CO2 is emitted by every single company, or industry, or sector, but I do think that the information should be readily available to everyone who wants to find out. We will need an increased transparency, because these carbon pricing schemes will be unpopular with the people who have had power and don't want to relinquish it. [Jason Donev, Canada]	Accepted
56156	74	23	74	46	Congratulation for this very comprehensive synthesis of the way of the use of carbon revenues can support and even facilitate the low-carbon transition. [Emilie ALBEROLA, France]	Accepted
954	74	27	74	27	that it is difficult to evade' should be 'that is difficult to evade' [Robert Shapiro, United States of America]	Editorial
56136	74	27	74	27	Insert a space after the dot and before "Explicit". [Emilie ALBEROLA, France]	Editorial
956	74	28	74	28	between the tax burden on the informal sector' 'between' cant be correct between the tax burden and WHAT [Robert Shapiro, United States of America]	accepted
12432	74	30	74	31	Would be useful to briefly state the conditions for the double dividend here [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
30648	74	30	74	32	« The conditions of such a double-dividend of aggregate economic gain along with environmental benefit, is well documented » It is also still debated [France]	accepted
8088	74	31	74	31	The double dividend is still heavily debated. This paragraph should mentiion it. Another important reference is the meta-analysis of Patuelli, 2005 http://dx.doi.org/10.1016/j.ecolecon.2004.12.021 [Quentin Perrier, France]	Accepted - Thanks for the reference
30650	74	32	74	35	Another important reference is the meta-analysis of Patuelli, 2005 http://dx.doi.org/10.1016/j.ecolecon.2004.12.021 [France]	Accepted - Thanks for the reference
12434	74	38	74	39	Inflationary isn't quite the right word here - it's talking about the affect on real income of the poorest, rather than inflation in general [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - corrected
35546	74	38	74	39	Carbon taxes not only have an inflationary effect on energy prices but also make it harder to provide reliable, affordable access to modern energy in developing economies - would be good to highlight this. [Ashok Sreenivas, India]	Taken into account - this point has been reinforced in phrasing of the final version
39276	74	40	74	41	This is an important policy finding. Please highlight in SPM. [Lindsey Cook, Germany]	Rejected - The authors of this section do not control the content of the SPM
52218	74	43	74	43	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
56138	74	43	74	43	Insert a space after the bracket and before "for" [Emilie ALBEROLA, France]	Editorial
12436	74	45	74	46	The last sentence seems to need rewording [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - corrected

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7778	74	49			This is a decent summary of traditional policy instruments, but a bit impoverished. For example, other than quick mentions at 4-51:55, 4-76:18, and 4-79:2 (the latter two with superfluous hyphens), it does not include feebates (for autos, new buildings, etc), which can be size- and revenue-neutral, are in use in ~6 countries for autos, and are now favoured for auto-policy adoption in India. It would also be worth mentioning such simple and costless innovations as giving efficient buildings priority in local approval processes, or paying design professionals for what they save not what they spend (performance-based design fees). [Amory Lovins, United States of America]	Accepted
10116	74	49	75	1	Carbon prices may provide good proxy to understand the general equilibrium effects and the complex distributional issues in a perfect foresight distortion-free world, But implementation-wise carbon prices are neither necessary nor sufficient to inform how a 1.5c transition can be translated to reality. The institutional requirements for a well functioning markets are simply challenging for developing countries to build in time that the path to 1.5c would not be missed. [Saudi Arabia]	Accepted
58190	74	49			The authors may be interested in mentioning a new paper on divestment effects induced by announcing carbon pricing in the future. A core element of this study is that credible policy announcement leads to divestment in fossil fuel infrastructure and power plants well ahead of the actual policy implementation. Thereby, coordinating invostor expecations smoothes the transition to the policy implemenation and avoids disruptions . Bauer, N., McGlade, C., Hilaire, J., Ekins, P., 2018. Divestment prevails over the green paradox when anticipating strong future climate policies. Nature Climate Change 1. https://doi.org/10.1038/s41558-017-0053-1 [Nico Bauer, Germany]	Taken into account - in the final version that discusses the impact of climate policies and divestments
12438	74	50	74	50	The first statement doesn't seem to follow from what comes before [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - we articulate better the argument with the paragraph before
13982	74	50	74	51	Explicit carbon prices are thus a necessary 'lubricant' to accommodate the general equilibrium effects of higher energy prices. This statement seems very policy prescriptive, and it seems odd to use 'thus' as an introductory sentence in a section, without a citation or reference to a section. Please reword. [Natalie MAHOWALD, United States of America]	Rejected - because it is simply a matter of fact and it doesn't imply any prescription since it doesn't suggest a precise level to be reached and to the contrary describes the conditions for politic acceptable and economically beneficial carbon prices
56380	74	50	74	50	The reference to general equilibrium (models?) is unnecessary here when the report really means the effects in the real economy. [Nuno Bento, Portugal]	Rejected - because the word 'general equilibrium' refers to the results from the outcome of the many interdependencies within an economy. It does not, per se, implies any sort of perfect equilibrium. We could prefer the word interdependencies but it is difficult to change the well established concept in such a report
47178	74	51	74	51	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested replacemnt 'They control the rebound…' [Sarah Connors, France]	Editorial
12440	74	54	75	1	They will however, not suffice to trigger the low-carbon transition because of an 'implementation gap' which is likely to persist between the 'switching carbon prices' needed to trigger abrupt changes in behaviour and innovation and the carbon prices that are implementable. - this needs explaining and referencing more [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
52220	74	54	74	54	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
61160	74	54	75	1	The claim about the "implementation gap" requires a source. [United States of America]	Rejected - the term implementation gap is a simply use to note the gap between real prices. (See reference in the text) and the text reviewed in chapter 2
52222	74	54	75	15	I disagree that the price must be greater than the volatility. Underlying structure can often be seen even in the face of randomness. For example, under 30 cm of snow that has fallen with little wind, I can still see curbs that are smaller than the 30 cm. The carbon price must be large enough to create a response because it will still be a way for firms to notice that there is a cost associated with emitting GHGs. That being said, the price must be sufficiently high to make it worth the effort to attempt to reduce the GHG emissions. I suspect that it is mathematically equivalent (but not philosophically equivalent) to say that if we want actual change we will need to have the carbon price be larger than the volatility. The bigger difference though is that the volatility is something that needs to be weathered. Many firms view carbon pricing as something that also needs to be weathered until there is a shift in the government of a country. The comparatively rapid turnover of a democratic country's leadership provides a lack of faith in the endurance of a given carbon pricing. This uncertainty is a big effect in how much firms are willing to invest in shifting their GHG emissions. [Jason Donev, Canada]	Accepted
46964	74	55	74	55	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Editorial
47180	74	55	74	55	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorial
14142	75				This page lists some regulatory instruments to tackle climate change. However, it doesn't show to what degree these policies should be implemented in order to control temperature rise within 1.5 ?. In other words, the description has very weak connection with 1.5 ? pathway. The suggested way to improve this part is define the quality and quantity of these policies which may be in line with 1.5 ? pathway. [Yi-Chieh Chan, China]	Accepted
14144	75		76		These two pages describe different instruments for environmental policies. Here suggests the author group to partition the paragraphs through giving the title. From p.75 line 25 to 55, it can be named "regulatory instrument"; from page 76 line 1 to 20, it can be entitled "economic instrument"; from page 76 line 22 to 34, it belongs to information instrument. The segment will make this section more understandable. [Yi-Chieh Chan, China]	Taken into account - good suggestion
12442	75	3	75	8	The wording here doesn't make clear what the main point is, and the points don't seem to be backed up. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
56158	75	3	75	23	Congratulation for this very comprehensive synthesis on challenges for making carbon pricing efficient and acceptable. [Emilie ALBEROLA, France]	accepted - thank you
61162	75	3	75	8	It's not self-evident that carbon prices need to "outweigh the noise" from oil price volatility, regulatory policy shifts, and other price dynamics. Carbon prices like other incentive instruments would be incremental to other price signals. Also, price or policy volatility itself can induce behavioral responses, including in some cases a reduction in consumption of the good or service in question. [United States of America]	Accepted
10118	75	10	75	15	1- setting a carbon price floor is an interference with the working of the market forces that are presumably led to the cost-effectiveness of carbon pricing. If it is conceived that markets are not well functioning a better way fix would be to replace the price instrument with a carbon tax. 2- Fossil fuel subsidies play important role of enhancing energy access in developing countries. Phasing out / abolishing subsides would aggravate the energy access problem and negatively interfere with the SDG goals (particularly goal #7). The urgency for 1.5c should be judged with the framework of sustainable development and poverty eradication. [Saudi Arabia]	Accepted
52224	75	10	75	12	What are these fossil fuel subsidies? What forms do they take? How are they given out? Tax cuts? Rebates? Lower royalties? Be explicit. What is meant by this statement? I've heard a number of people talk about these at conferences, but no one is willing to be explicit about what they're talking about when they make these estimates. [Jason Donev, Canada]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
13218	75	14	75	14	Replace "these subsidies" with "inefficient subsidies that encourage wasteful consumption". [Eleni Kaditi, Austria]	Accepted
958	75	17	75	19	Whensystemicchangesareatplayonmanydimensionsofdevelopment,switchingcarbonpricesarecontingentuponotherpolicymeans. Thepricelevels'dependonthepathandthepathdependsonpoliticaldecisions' SPACING [Robert Shapiro, United States of America]	Editorial
3264	75	17	75	19	Sentence has no spaces [Vassilis Daioglou, Netherlands]	Editorial
3932	75	17	75	19	Formatting issue in these lines (and elsewhere in the remainder of this chapter). [Emily Tyler, South Africa]	Editorial
5660	75	17	75	19	spaces between words are missing . [Marion Grau, Norway]	Editorial
7110	75	17	75	19	Spaces are needed between words [Jose Di Bella, Canada]	Editorial
7986	75	17	75	19	All the spaces between words have disappeared? [Christopher Bataille, Canada]	Editorial
12444	75	17	75	19	Everywordisjoinedtogether [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
30652	75	17	75	19	Formatting [France]	Editorial
31726	75	17	75	23	A majority of the text in this paragraph is without spaces between words [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
33992	75	17	75	19	The spaces between words are missing. [Norway]	Editorial
34648	75	17			Please separate every word [Mexico]	Editorial
48328	75	17	75	19	Introduce blank between words: "Whensystemicchangesareatplayonmanydimensionsofdevelopment,switchingcarbonpricesare contingentuponotherpolicymeans. Thepricelevels'dependonthepathandthepathdependsonpoliticaldecisions'(Dréze and Stern, 1990)." [Miriam Solera Ureña, Germany]	Editorial
50604	75	17	75	19	Whensystemicchangesareatplayonmanydimensionsofdevelopment,switchingcarbonpricesare contingentuponotherpolicymeans. Thepricelevels'depend onthepathandthepathdependsonpoliticaldecisions repalced by "When systemic changes are at play on many dimensions of development,switching carbon prices are contingent upon other policy means. The price levels' depend on the path and the path depends on political decisions" [Jean-Yves CANEILL, France]	Editorial
52226	75	17	75	20	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
55870	75	17	75	19	Need to add spaces between the words [Debora Ley, Guatemala]	Editorial
56140	75	17	75	19	Insert spaces between words [Emilie ALBEROLA, France]	Editorial
56382	75	17	75	19	format problems. Please, correct. [Nuno Bento, Portugal]	Editorial
62020	75	17	75	20	lack of spaces between words repeated in this page and the following one. [Valérie Masson-Delmotte, France]	Editorial
62212	75	17	80	20	blurred sentences. Same applies page76 line45, page78 lineéé, page 80 line 19 [Antoine Bonduelle, France]	Editorial
34650	75	18			Please separate every word [Mexico]	Editorial
34652	75	19			Please separate every word [Mexico]	Editorial
50606	75	24	75	24	In line with what I said in my previous remark (line 16 of this excel sheet) I am proposing to add a small paragraph discussing the benefits of carbon pricing coordinated policies. This paragraph or notice could be done in other parts of this chapter but I found that it was the natural place (it could be placed also if not here , page 47, line 48). This new paragraph could be : "It is important at this stage to mention the theoretical potential in costs saving which could exist through enhanced international cooperation on carbon pricing policies, as highlighted for instance by the World Bank Group Report (World Bank Group, 2017). Many authors have looked at what should be the benefit brought by coordination among a group of countries to capture at least partially this economic potential (Weischer et al.,2012, Petsonk et al., 2015 and Hermwille et al. , 2017). In that respect, ongoing discussions on the precise implementation of Article 6 of the Paris Agreement appear to be important, in order to give the institutional framework that will enable countries to cooperate in that way and introduce ambitious policies compatible with reaching collectively a 1,5°C target." [Jean-Yves CANEILL, France]	Taken into account - basically for reason of space constraints we could no enter deeply in this discussion but the overall idea is now more developed in the new structure that now merges 445 and 446 on finance.
42826	75	25	75	37	In the case of appliances using refrigerants, the mandates under the Kigali Amendment to the Montreal Protocol create an opportunity to improve energy efficiency in redesigning the appliances to use alternative refrigerants, which could be incorporated as part of regulatory practices relating to implementing the Kigali Amendment. Shah N., Wei M., Letschert V., & Phadke A., (2015) BENEFITS OF LEAPFROGGING TO SUPEREFFICIENCY AND LOW GLOBAL WARMING POTENTIAL REFRIGERANTS IN AIR CONDITIONING, Ernest Orlando Lawrence Berkeley National Laboratory. [Kristin Campbell, United States of America]	rejected - This reference is cited in 4.3.6, not here.
43074	75	25	75	37	In the case of appliances using refrigerants, the mandates under the Kigali Amendment to the Montreal Protocol create an opportunity to improve energy efficiency in redesigning the appliances to use alternative refrigerants, which could be incorporated as part of regulatory practices relating to implementing the Kigali Amendment. Shah N., Wei M., Letschert V., & Phadke A., (2015) BENEFITS OF LEAPFROGGING TO SUPEREFFICIENCY AND LOW GLOBAL WARMING POTENTIAL REFRIGERANTS IN AIR CONDITIONING, Ernest Orlando Lawrence Berkeley National Laboratory [Durwood Zaelke, United States of America]	rejected - This reference is cited in 4.3.6, not here.
7988	75	35	75	35	What two policy instruments? [Christopher Bataille, Canada]	Accepted - the right word was 'these'
61164	75	36	75	37	Suggest including reference to the Energy Star Program in the U.S., where it is not uncommon for every applicance in a major applicance store to have been certified as "EnergyStar". [United States of America]	Rejected - because of space constraints it was impossible it cut all the interesting programs on energy efficiency developed in the world
7990	75	39	75	45	Very vague statements on vehicle efficiency regs. Brazil, Canada, China, EU, Japna, Mexico and the US currenlty have light duty vehicle regulations. Canada, China, Japan and the US have heavy duty regs. Page https://www.theicct.org/sites/default/files/publications/ICCT_G20-briefing-paper_Jan2017_vF.pdf. I would suggest saying there is a wide scope for expanded regulation outside theese coutnries, based on their regass as templates. Source: website above and Du, L., Miller, J., & Kodjak, D. (2017). Status of clean vehicle and fuel regulations in select G20 countries. Washington, D.C.: International Council on Clean Transportation [Christopher Bataille, Canada]	Taken into account - by a better presentation of the vehicle efficiency regulations, however it was not just possible to include the references because the rule of the IPCC is to stick to peer reviewed literature
50094	75	39	75	45	The statement that only 4 countries have standards for fuel efficiency of cars is wrong. See https://www.theicct.org/publications/2017-global-update-LDV-GHG-FE-standards. It is also misleading to say that there is an absence of carbon taxes in the transport sector, since most countries apply fuel taxes that are in fact implict carbon taxes. [Bert Metz, Netherlands]	Accepted
61166	75	39	75	40	The restricted focus on *both* light and heavy duty vehicles seems a bit arbitrary here. [United States of America]	Accepted
61168	75	45	75	45	Note that a carbon tax would also not "limit" vehicle miles traveled though it would disincentivize travel in vehicles that are not carbon-neutral (i.e., not using carbon-neutral fuel). [United States of America]	Accepted
7992	75	47	75	55	The following article discusses the French and German building retrofit programs in the context of deep emissions custs, specficially that it requires an adapative management appraoch with ongoing monitoring and the capacity to adjust policy based on outocomes. Sandrine Mathy, Patrick Criqui, Katharina Knoop, Manfred Fischedick & Sascha Samadi (2016) Uncertainty management and the dynamic adjustment of deep decarbonization pathways, Climate Policy, 16:sup1, S47-S62, DOI: 10.1080/14693062.2016.1179618 [Christopher Bataille, Canada]	Rejected - Mathy et al was cited in 4.2.1, not here

Comment No	From Page	From Line	To Page	To Line	Comment	Response
50096	75	47	75	55	This paragraph is silent on renovation of existing buildings, which is a major challenge in 1.5C strategies. A good discussion on this needs to be added. [Bert Metz, Netherlands]	Rejected - this discussion is developed in a previous section of the final version of the document that have been totally restructured
13236	75	50	75	51	Delete the text "to avoid their lock-in to poorly performing buildings that remain in use for the next 50–100 years". [Eleni Kaditi, Austria]	Rejected - We do not understand why
40470	75	50	74	51	"Explicit carbon prices are thus a necessary 'lubricant' to accommodate the general equilibrium affects of higher energy prices." This must not be presented as a factual statement, is the result of a model with particular assumptions and high levels of uncertainty. It's a controversial point with alternatives and conflicting views that must be mentioned as well. In any case, uncertainty levels should be stated. [Pedro Alfredo Borges Landaez, Venezuela]	Accepted
48124	75	52	75	55	Please check the sentence in line with the conclusion from the reference Bertoldi et al. (2017) [Sarah Connors, France]	Accepted - checked
48998	75	52	72	53	The publication referenced here is not about existing buildings; It's only about new buildings. Furthermore, this publication provides wrong/partial information about the current definitions of ZEB for countrie slike Denmark and France. I would avoid referencing this paper. [Yamina Saheb, France]	Accepted - we delete 'existing buildings' but we can't delete the reference
960	75	53	75	53	ultimatelyconverget' SPACING [Robert Shapiro, United States of America]	Editorial
31728	75	53	75	53	ultimatelyconverge should be "ultimately converge" [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
52228	75	53	75	53	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
5662	76	1	76	2	spaces between words are missing . [Marion Grau, Norway]	Editorial
34656	76	2			Please separate every word [Mexico]	Editorial
52230	76	3	76	4	What are 'fee-bates'? Define this term. [Jason Donev, Canada]	Accepted
52232	76	5	76	6	How are fee-bates not a market based solution? What is meant by market based instrument here? [Jason Donev, Canada]	Accepted
8246	76	14	76	16	After "Subsidies can take the form of … or feed-in tariffs (Mir-Artigues and del Río, 2014)." please add: "Bodnar et al. (2018) suggest auctioned prize floors as an instrument which is able to maximise climate impact per public dollar and incentivize private investment in low-carbon technologies. Reference: Bodnar, Paul; Ott, Caroline; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily F.; Wagner, Gernot (2018): Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation, Climate Policy, 18:3, p. 368-382. [Angela Geck, Germany]	Rejected - This does not address the subsidy issue as taken in this sentence. We will insert this reference in the previous section about carbon pricing.
57382	76	22	76	23	Link back to section 4.4.3 which discusses the various factors that influence people's behavioural choices [Hans Poertner, Germany]	Accepted
962	76	36	76	36	are increasingly comment,' should be 'are increasingly common' [Robert Shapiro, United States of America]	Editorial
3266	76	36	76	36	…increasingly common… [Vassilis Daioglou, Netherlands]	Editorial
3934	76	36	76	36	common' rather than 'comment'. [Emily Tyler, South Africa]	Editorial
7492	76	36	76	38	Commitments are not policy instruments. Thus delete these phrases. [Axel Michaelowa, Switzerland]	Rejected - We cannot delete because there is a lot of suggestions to mention the role of the cities.
61170	76	36	76	36	Common, not "comment" [United States of America]	Editorial
52234	76	38	76	39	Is this supposed to be a new paragraph? [Jason Donev, Canada]	Editorial
3268	76	44	77	4	spaces missing between many words [Vassilis Daioglou, Netherlands]	Editorial
12446	76	44	76	45	The simultaneous launch of multiple policies in many domains is challenging, especially in a regional context where carbon prices are too lowto hedgeagainsttheirarbitrariness. - what does this mean? Arbitray in what sense? Hedge in what sense? [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
964	76	45	76	45	too lowto hedgeagainsttheirarbitrariness' SPACING [Robert Shapiro, United States of America]	Editorial
7994	76	45	76	45	Separate "hedgeagainsttheirarbitrariness". There seems to be some sort of machine-read problem in the text, as this happens a few times. [Christopher Bataille, Canada]	Editorial
29314	76	45	76	45	need comma [Yuanyuan Huang, France]	Editorial
30656	76	45	76	45	Formatting [France]	Editorial
34654	76	45			Please separate every word [Mexico]	Editorial
52236	76	45	76	45	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
56142	76	45	76	45	Insert spaces between words [Emilie ALBEROLA, France]	Editorial
56384	76	45	76	45	Typo (see also other typos in the paragraph). [Nuno Bento, Portugal]	Editorial
61172	76	45	76	45	Check spacing in line: "too lowto hedgeagainsttheirarbitrariness" [United States of America]	Editorial
966	76	51	76	51	the SocialValueofMitigation SPACING [Robert Shapiro, United States of America]	Editorial
7996	76	51	76	52	Again, separate "SocialValueofMitigation 52 Activities(SVMA" [Christopher Bataille, Canada]	Editorial
30658	76	51	76	51	Formatting [France]	Editorial
47208	76	51	76	51	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Editorial
52238	76	51	76	51	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
56144	76	51	76	51	Insert spaces between words [Emilie ALBEROLA, France]	Editorial
8264	77		80		Chapter four does not discuss Results-based climate finance. The "enabling climate finance" section should cover the potential for results-based climate finance initiatives in contributing to meeting the 1.5C° target. One paper to consider for this is: P. Bodnar et al. (2018), "Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation", Climate policy, 18(3), pp. 368-382 [Kelsey Perlman, France]	Taken into account - This paper is quoted in other sections of the chapter
968	77	2	77	3	'makefinanceflowsconsistentwithapathwaytowardslowgreenhousegasemissionsandclimate-resilient development' SPACING [Robert Shapiro, United States of America]	Editorial
7998	77	2	77	3	Separate "'makefinanceflowsconsistentwithapathwaytowardslow 3 greenhousegasemissionsandclimate-resilient development" [Christopher Bataille, Canada]	Editorial
30660	77	2	77	3	Formatting: spaces are missing [France]	Editorial
34260	77	2	77	3	Add spacing in quote: "makefinanceflowsconsistentwithapathwaytowardslow greenhousegasemissionsandclimate-resilient development" [Joe Thwaites, United States of America]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
56146	77	2	77	3	Insert spaces between words [Emilie ALBEROLA, France]	Editorial
61174	77	2	77	3	Check spacing in line: "makefinanceflowsconsistentwithapathwaytowardslow reenhousegasemissionsandclimate-resilient development" [United States of America]	Editorial
28650	77	7	80	48	We appreciate that this section (4.4.6) covers financial instruments also with regards to the role of the private sector, and would encourage the authors to expand that discussion. However we feel that the section could be improved by a structured elaboration of the different actors (public, private, institutional) and the different levels (local, national, multinational, transnational). Please also consider re-organizing the sub-chapters in 4.4.6 as follows: First, you may consider shortening section 4.4.6.1. A brief paragraph that we need trillions, but are currently far away from reaching this goal and a table with an overview of current estimations, acknowledging uncertainties, to give orders of magnitude would be helpful. Second, consider splitting 4.4.6.2 into two chapters, one on redirecting and one on de-risking. The latter should deal with de-risking of all kind of climate finance and not just low-emission investments. Third, please shift the parts on adaptation challenges of section 4.4.6.3 to 4.5.3.3 as it is not very clear why this should be discussed twice. In section-heading 4.4.6.4 it is not clear why only public actors should be in the focus. [Germany]	Accepted - This section have been totally restructured and the new structure responds to great part of your concerns
45536	77	7	77	7	Is this trying to do all of AR6? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - This remark rather concerns 4.4.5
58	77	9	77	19	It should be noted here, that finance is particularly important in the mitigation context due to the fact tha renewable energy technologies are more capital intensive than those based on fossil fuels. Two peer-reviewed papers that analyze this are (Ekholm et al, Energy Policy 59, 2013) and (Ng and Tao, Energy Policy 95, 2016). [Tommi Ekholm, Finland]	Taken into account - we have added the reference you give
3938	77	9	77	19	These two paragraphs do not clearly introduce the 'mitigation and adaptation finance challenge' referred to in line 23 of the same page. Is the challenge that climate change requires greater investment in long term infrastructure? Or different investment? Investment rather than consumption or investment rather than saving? Is this a challenge of the finance system generally, or specifically related to investment for climate change? The concluding paragraph (pg 78 lines 9-11 make this clearer, but a clear introduction will help the reader navigate the density of the subsection.) [Emily Tyler, South Africa]	Taken into account - this has been rephrased
12448	77	9	77	9	This phrase seems tautological/circular and is unclear. [United Kingdom (of Great Britain and Northern Ireland)]	Rejected - There is a problem with identifying what sentence you talk about
18648	77	9	77	12	Most of the references are old and one would presume that academic research in the area haas advanced. Moreover, the point of the paragraph remains a bit unclear. [Andrea TILCHE, Belgium]	Taken into account - the meanings of the 'jargon' have been clarified. However, the references are the right ones, the simply note that a lot of scholars are early had launched alerts about the short term bias of modern financial systems
18650	77	9	80	50	Section 4.4.6 should be considerably shorter since i) for the most part it is not directly related to reaching 1.5°C or deep decarbonisation pathways; ii) it considers a number of prescriptive proposals. [Andrea TILCHE, Belgium]	Accepted - This section have been totally restructured and merged with the section 445
28652	77	9	77	16	The introduction is very generalistic and at the same time the context it provides for the report is not clear. In its current form, we can't see the value added for the report. Suggest to rephrase or delete the first paragraph and the first half of the sentence in ln 15, and start with the reference to chronic underinvestment, including recent references. [Germany]	Taken into account -this impression has been corrected
31660	77	9	77	19	Climate finance can be framed as a 'second best' alternative to climate policy, in the case of too weak policies causing insufficeint pricing of GHG emissions, etc. Also, a major feature of many climate finance categories is that this is driven by the bottom-up initiatives, that is by actors in financial markets, such as pensions funds, insurance companies, cities/municipalities, and development banks, generating activities and vitality to climate-related initiatives that are missing or very hard to generate at the global, top-down level, confer the short-comings of global climate policies since 1992 compared to the huge challenge at hand. [Asbjørn Torvanger, Norway]	Taken into account - this point is made in the conclusion of the section 4.4.5
12450	77	15	77	19	For completeness this section should draw a more direct link between the structure of the financial system and costs of low carbon/resilient investement [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
21552	77	15	77	19	The "propensity to save or to invest" of each country depends on its level of development (if it is a developed or developing country for example) [Nathalie HILMI, France]	Taken into account - good point, but we cannot expand too much on this point because of space constraints
30662	77	18	77	18	« explores to how to overcome » Spelling : erase "to" [France]	Editorial
32044	77	18	77	19	Suggested drafting : “Emerging literature explores to how to overcome this bias, which operates against climate policies. Other contributions explore how to leverage the contribution of the financial sector to the transition (Boissinot et al., 2015)”. [France]	Taken into account - we have introduced this consideration later and we will check if we find Boissinot et al. Is published in the peer reviewed literature
32286	77	18			delete the word 'to'. Should read "Emerging literature explores how to overcome this bias,.." [Jamaica]	Editorial
28654	77	22	78	11	This section could be substantially condensed or even left out completely (with an additional chapeaux text briefly addressing the order of magnitude of the financial challenge). The different estimations presented cannot be compared in a meaningful way as they all build on different assumptions and estimation methods. In the description it is not made clear what is the baseline in each case and to which concepts the estimated numbers refer to exactly. Thus, the value added of referencing to these numbers is very limited. In this case, it may be preferable to address the aspect more generally: Data is poor, estimations are weak, methodology and definitions unclear. But we know that we need much more financing than those amounts currently available. To reach this, two approaches are most promising: redirecting financial flows and de-risking sustainable investments (see the following sections). [Germany]	Taken into account - Full box is currently devoted to explain the meaning of this numbers and their level of uncertainty
30664	77	23	77	26	Reference could be made to the climate finance 2013-2014 of the OCDE and CPI which remains a reference in accounting and to the recent work of the OCDE for the G20 (e.g. « investing in climate, investing in growth ») [France]	Accepted - This will be done in a box consolidating the studies on climate finance
3940	77	28	77	33	It may be useful to clarify and emphasise whether the investment figures given are additional to the investment required for infrastructure requirements generally? Does any of it include retrofitting? How do these figures then relate to the cost reductions being experienced in renewable energy technologies vs coal fired power? Some figures reported are incremental, for others it is not clear. Particular for developing country contexts the clarity of this distinction is critical. The OECD 2017 report 'Investing in growth, investing in climate' may contribute here. [Emily Tyler, South Africa]	Accepted - this has been done in a box
34252	77	28	77	33	The WEF figure of $85 trillion is incorrect. Their estimate in the report cited is $99.8 trillion between 2010-2030. Furthermore, both WEF and GCEC figures cited are for total investments needed for 2 degrees, of which only a small fraction are the incremental cost beyond investment needs under a business as usual scenario ($4 trillion under GCEC, $14 trillion under WEF). This could be better explained. While all infrastructure investment needs to be aligned to be 2 degree compatible, most of this is about shifting investment that would be needed anyway under BAU, rather than requiring additional flows. [Joe Thwaites, United States of America]	Accepted - All this data will be consolidated in a box
30666	77	30	77	31	What is the starting year of the period: 2013? 2014? [France]	Accepted - all this will be clarified in a box

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12452	77	31	77	33	we have concerns on the clarity and accuracy of this section: 1) the preceding statements only give size of the challenge. They don't define current action, meaning reference to an acceleration of action is unsubstantiated 2) it is not clear whether the investement being referenced is to meet the 1.5C goal or the SDGs or both. If both, it is not stated how much is needed only for the 1.5C goal. 3)there is over-reliance on a single, non-peer reviewed source-if using non-peer reviewed sources then more references should be provided. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - the creation of the use of non peer reviewed literature is a key question in this domain. We have clarified that in a box. As to the question of the comparison of current efforts and need for accelerating action we have found a reasonable reference for that
12454	77	35	77	36	It's unclear why investements may be underestimated, rather than overestimated - there is no supporting statement or evidence [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - The sentence isn't clear, we simply want to say that we don't have to consider only the investment on the energy sector
21554	77	35	77	39	The data gaps is well stressed here [Nathalie HILMI, France]	Editorial - thanks
30668	77	35	77	36	References? Suggestion: World Energy Investment Report, IEA [France]	Accepted - there will be an entire box dedicated to that
32046	77	38	77	39	The multiplier coefficient should be justified with more references. [France]	Taken into account - The problem is that only one attempt in this direction. We have rephrased the sentence on the conditional
8090	77	41	77	41	an initial assessment: by whom, according to which source? It is not very clear in this formulation [Quentin Perrier, France]	Accepted - This has been treated in a box with all references
10120	77	41	77	46	What is meant by incremental investment -- is it incremental to 2c? Further this assessment and the assessment of the size of the finance gap are critical components for the transition to 1.5c and should be reflected in the executive summary and the SPM. [Saudi Arabia]	Taken into account - we have clarified that in the last version with a reference to a box giving a comprehensive picture of the available assessments
12456	77	41	77	41	It's unclear where this information is from. Needs referencing. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - This has been treated in a box with all references
12458	77	41	77	42	Not clear where the statement that "the incremental investements for limiting warming to 1.5C would amount to !% of global GDP up to 2030 and 4% of total Gross Capital Formation" comes from [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - This has been treated in a box with all references
28656	77	41	77	42	Please specify the mentioned assessment (1% of global GDP and 4% of total GCF) - is it meant annually or total? And what does the "and" mean: additionally or as a comparison? [Germany]	Accepted - This has been treated in a box with all references
30670	77	41	77	42	A reference to the litterature could be added [France]	Accepted - This has been treated in a box with all references
33138	77	41	77	46	clarify that this means that the costs of adaptation and mitigation will be higher in developing countries - hence the need for international climate finance . [Tara Shine, Ireland]	Rejected - this sentence means that the assessments are more difficult, more specifically the distinction between redirected costs and incremented costs
62022	77	41	77	45	What is the source for the estimated percentage of GDP to be invested for limiting warming to 1.5°C? How robust is this assessment, and how can it be compared with the outcomes of chapter 2? [Valérie Masson-Delmotte, France]	Accepted - This has been treated in a box with all references
12460	77	43	77	43	We are unfamiliar with this phrase - needs referencing or rephrasing for clear communication [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - we have clarified it in the next version of the report
35548	77	43	77	43	Since the incremental investment need in developing countries - which are less capable or responsible for the problem - is higher than developed countries, it would have been good to have some analysis of how such incremental investments can be mobilized. [Ashok Sreenivas, India]	Taken into account - This is addressed later in the text and we have added more discussion about adaptation investments
1880	77	45	77	46	Estimates of the costs of adaptation indeed vary strongly, depending on the methodology used, the analytical principles applied, and the assumptions made. The adaptation gap report of UN Environment (2016) presents a good and balanced assessment based on national- and sector-based studies and concludes that, by 2030, adaptation costs are likely to be in the range of US$140-300 billion per annum. This is two-to-three times higher than the numbers mentioned by IPCC AR5 (which are essentially based on a 2009 Worldbank report) [Willem Pieter Pauw, Germany]	Accepted
3942	77	48	78	7	These two paragraphs are not clear. Terms are used and not explained ('levelised',' incremental costs', 'redirected investments') making it difficult to follow the thread of what is being communicated. There are also signficant tacit assumptions made about the desirability of an undifferentiated 'growth' and 'consumption', which could be usefully made explicit. (See for example Bergh, J. (2011) Environment versus growth - A crticism of "degrowth" and a plea for "a-growth". 70, 5, 881-890.) [Emily Tyler, South Africa]	Accepted - These words have been clarified in the final version
12462	77	48	77	48	Is this the critical issue? Is it not about bringing emissions down through mitigation. It seems "consumption" is being used here to mean economic activity but should probably be more explicit e.g. economic activity/economic growth/GDP growth. Perhaps also rephrase to "one of the critical issues" as there are other priorities [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account- We have clarified, the issue here is given that part of the revenue is devoted to savings or consumption, whether funding the low-carbon investments will be made at the expense of lower consumption of goods and services or, for the same ratio between consumption and savings throw redirection of savings. The final draft clarifies that.
39278	77	48	77	49	As comsumption levels globally are currently not sustainable, could you explain why this sentence is expressing concern on decreased consumption? [Lindsey Cook, Germany]	Taken into account- We have clarified, the issue here is given that part of the revenue is devoted to savings or consumption, whether funding the low-carbon investments will be made at the expense of lower consumption of goods and services or, for the same ratio between consumption and savings throw redirection of savings. The final draft clarifies that.
61176	77	48	77	51	Are real-estate and liquid financial products really the alternatives to "productive adaptation and mitigation investments"? Some productive future adaptation and mitigation investments might include real-estate and liquid financial products. [United States of America]	Taken into account - At each point in time putting the money in the real estates instead of in low carbon investments implies less low carbon investments. Obviously, adaptation and mitigation will imply to invest in new equipment or new materials in the buildings, but this is something else. The problem with liquid international products is that there are 'agnostics' regarding the end use of the money. Households and institutional investors put the money in such products in the absence of productive investments of which risk weighted returns is attractive enough. In other words the cash is retained, waiting for 'something better'
31	77	49	77	51	I'm not sure the cite literature and the statement about adaptation and mitigation investments are entirely in-sync. The statement presupposes that adaptation and mitigation investments are illiquid. This runs in contradiction to lots of emerging experience in funds and other products that not only utilizing underwriting that gives consideration to adaptation and mitigation but the investments themselves are focused on developing new asset classes. Therefore, this statement is not consistent with existing experience. I would request an edit to clarify that a shift in savings into liquid adaptation/mitigation focused products is possible. This most certainly could happen in the equity markets. In fact, it fundamentally has to in ordre to get the scaled capital necessary to have a chance at meaningful adaptation--this last point being my own subjective editorialization. [Jesse Keenan, United States of America]	Taken into account - The new draft develops and clarify this point and insists on development of new asset classes. The idea is that long-term investments are penalized directly because of they are not liquid enough and that the challenge is to make them more liquid.
12464	77	49	77	51	Seems a slightly narrow reference frame for this topic. Could better reflect literature around the economc opportunities associated with low carbon/resilient investment [United Kingdom (of Great Britain and Northern Ireland)]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14146	78				In the part of 4.4.6.2 Redirecting savings and de-risking low-emssion investment, it doesn't mention how much the investments in Green Climate Fund is enough under 1.5 ? pathway. Now GCF is the main financial mechanism that helps fund climate finance investment in low-emission and climate-resilient development. It would be good to show an estimated number in the report for urging developed countries to ratchet up the financial commitment and donation. [Yi-Chieh Chan, China]	Accepted - This section have been totally restructured and a box gives now the orders of magnitude at this state
970	78	1	78	1	the levelised circulated' what is 'levelised' [Robert Shapiro, United States of America]	Accepted - The meaning of the word levelised is clarified in the final version
8000	78	1	78	1	The levelized what? What is the comparator in this sentence? [Christopher Bataille, Canada]	Accepted - The meaning of the word levelised is clarified in the final version
12466	78	1	78	1	Levelised should read "level" [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - The meaning of the word levelised is clarified in the final version
12468	78	1	78	4	The narrative here does not convey clear messages [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - This section have been totally restructured and merged with the section 445
28658	78	1	78	1	The sentences is not clear. Do you mean "levelised investment costs"? Please add the missing word. [Germany]	Accepted - The meaning of the word levelised is clarified in the final version
61178	78	1	78	7	The text in this paragraph is unclear. [United States of America]	Accepted - This section has been totally restructured and merged with the section 445
35550	78	3	78	7	Are these sentences indicating that loss and damage is not relevant to the discussion? If so, they would be highly contentious. [Ashok Sreenivas, India]	Rejected - The sentence clearly says that is difficult to separate what losses and damages is due to pre-existing society and what is due pure climate change. There is logically a problem of attribution which cannot be solved easily. The reference is clear to this respect.
12470	78	6	78	7	It is unclear that this is the first priority - this is not sufficiently supported by evidence. A limited reference base is provided and the statement is overly prescriptive [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - Increasingly infrastructures that reduce the vulnerability of society is important. We deleted the term first priority
3944	78	9	78	11	This is an example of a number of instances in the second half of this chapter where a simplification is narrowly presented as the only way of understanding the social world. In this case: 'the triggering of the transition' depends on many factors. In relation to finance one of these are whether 'reforms of the financial system...' In all instances a rewording similar to that suggested to highlight that the causality indicated is one of many would improve accuracy and also assist in portraying the complexity of the transition issue. [Emily Tyler, South Africa]	Accepted
8002	78	9	78	10	This section needs expansion for clarity. Is it about balancing short cash flow and investment costs for renewables? Whose short term cash balances? [Christopher Bataille, Canada]	Accepted - This section has been totally restructured and merged with the section 445
12472	78	9	78	11	This section does not pull out the role of public finance in transformational change or of private sector innovation. It should include this for completeness. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
61180	78	9	78	11	Presents an unbalanced assessment of literature by focusing only on how "reforms of the financial system" without also acknowledging the role of broader domestic governance and regulatory regimes in impacting the risk-weighted capital costs of climate-resilient investments (or investment generally) and other factors that drive capital. [United States of America]	Accepted - This section has been totally restructured and merged with the section 445. In the new version we clarify that the reforms on the financial system concern also domestic governance
52240	78	10	78	13	What does this mean in this context? This is discipline specific thinking that hasn't been unpacked for this audience. [Jason Donev, Canada]	Accepted - The new version clarifies this point
3946	78	14	79	22	An aspect which is not addressed in the section on finance and which could be included in this sub-section (4.4.6.2. re-directing savings…) is considering the nature of financial valuation tools. Traditional financial metrics including Net Present Value, discounted cash flow, cost benefit analysis are not able to capture important aspects of value that are particularly important with regard to climate change, such as option values and flexibility. (See for example Yan, M., Blyth, W., Bradley, R., Clarke, C., Wilson, T. (2008) Evaluating the power investment options with uncertainty in climate policy. Energy Economics, 30, 4, 1933-1950. and Tyler, E. and Chivaka, R. (2010). The use of Real Options valuation methodology in enhancing the understanding of the impact of climate change on companies in Business Strategy and the Environment. Vol 10 Issue 1 p55-70) [Emily Tyler, South Africa]	Rejected - Very good point but it was judged impossible to enter this highly specialized description in this document. This like be something which should be developed in the AR6. Space constraints played a critical role in our rejection judgement
12490	78	14	79	22	we have concerns about the completeness of this section, a lack of which results in policy presctiptiveness. There is insufficient acknowledgement of full gamut of fiscal policy options and types of financial instruments that could be used in 'redirecting savings and de-risking low-emission invesetment'. Cherry-picking of policy ideas here leans towards being prescriptive. Sectionshould either be comprehensive or better qualify that options explored are only some of many possible options. we recommend that other policy measures are considered against guarantees in this section. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the new phrasing tries and avoid this problem
28660	78	14	78	14	A paragraph on the following is missing: Demand for climate finance is high; it is not provided to the degree that would be needed. At the same time, there is a glut of liquidity on financial markets. Thus, it is less a question of mobilizing climate finance, but more of redirecting financial flows toward climate investments. This is supported by the considerations of Carney, who.... [Germany]	Accepted
28662	78	17	78	17	Please revise: Literature does not confirm, but supports the evidence for sth. [Germany]	Accepted
52242	78	18	78	53	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
55872	78	18	78	18	Space between the comma and liability [Debora Ley, Guatemala]	Editorial
56148	78	18	78	18	Insert a space after the bracket and before "liability" [Emilie ALBEROLA, France]	Editorial
32048	78	19	78	20	Liability risk is only a special form of physical/transition risks / suggested drafting : "It encompasses the impact of climate events on the value of assets (Battiston et al., 2017) and the transition risk due to devaluation of certain classes of assets (Platinga and Scholtens, 2016). The first will be lower in a 1.5°C world, while the second will be exacerbated. The crystallization of the risk could result from direct exposure but also indirectly as liability risks (Heede, 2014)." [France]	Accepted
52244	78	19	78	19	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
8004	78	22	78	23	Separate climate- 23 relatedriskdisclosureinfinancialportfolios [Christopher Bataille, Canada]	Editorial
28664	78	22	78	22	Climate related risk disclosure in financial portfolios is just one aspect of green financial regulation. It should be made clear that green financial regulation is necessary and the risk disclosure can then be given as one example. For instance, green banking regulation is important (see Lindenberg and Volz (2016). "Green banking regulation: setting out a framework", Report for the Practitioners' Dialogue on Climate Investments (PDCI). GIZ, Eschborn). Also, please note that the G20 "Green Finance Study Group" has ceased to exist and the recommendations of the Task Force on Climate Related Financial Disclosure (TCFD) have been concluded in 2017, and are in several stages of implementation (see e.g. https://www.fsb-tcfd.org/). [Germany]	Accepted
32050	78	22	78	24	Disclosure from non financial actors is a prerequisite for disclosure by financial actors, on disclosure, need to cite also the final report of the TCFD (TCFD, 2017) [France]	Accepted
32052	78	22	78	24	The name of the G20 study group has changed recently [France]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
32054	78	22	78	24	Carbon risks management strategies (as discussed by Andresson et al., 2016) as little to do (directly) with the information/disclosure agenda / suggested drafting : “This diagnosis highlighted the importance for the financial sector involvement of transparency, and climate related risk disclosure (UNEP, 2015; TCFD, 2017). Such issues are now on the agenda of a dedicated G20 study group and of the Financial Stability Board. The current mispricing of transition risks may lead to the development of investments strategies by which investors effectively try to secure a ‘free option on carbon’ to hedge against risks of stranded carbon intensive assets (Andersson et al., 2016).” [France]	Accepted - This section has been totally rewritten and the new version includes your remarks
32288	78	22	78	23	words are joined up [Jamaica]	Editorial
48374	78	22	78	24	Some additional references could be cited on mispricing of risks : -Ingrid Hjort (2016) Potential Climate Risks in Financial Markets: A Literature Overview -Harrison Hong, Frank Weikai Li, Jiangmin Xu (2016) Climate Risks and Market Efficiency [France]	Accepted
48370	78	22	78	24	Carbon risks management strategies (as discussed by Andresson et al., 2016) has little to do (directly) with the information/disclosure agenda. Suggested drafting : « This diagnosis highlighted the importance for the financial sector involvement of transparency, and climate related risk disclosure (UNEP, 2015; TCFD, 2017). Such issues are now on the agenda of a dedicated G20 study group and of the Financial Stability Board. Altough documentation of actual mispricing is still on going (Hjort, 2016), a probable mispricing of transition risks may underpin investments strategies by which investors try to secure a ‘free option on carbon’ to hedge against risks of stranded carbon intensive assets (Andersson et al., 2016). » [France]	Accepted - This section has been totally rewritten and the new version includes your remarks
61182	78	22	78	26	Out of date. A number of low-carbon indices already exist. [United States of America]	Accepted - This section has been totally rewritten, however note that the IPCC basic rule is to quote only Peer reviewed literature
972	78	23	78	23	relatedriskdisclosureinfinancialportfolios,' SPACING [Robert Shapiro, United States of America]	Editorial
7112	78	23	78	23	spaces are needed between words [Jose Di Bella, Canada]	Editorial
12474	78	23	78	24	For completeness it would be worth considering whether to reference the recommendations published by the Task Force on Climate-related Financial Disclosure [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
18652	78	23	78	25	Should also refer to 2017 OECD investing in climate report, and possibly report of the EU high-level expert group on sustainable finance. [Andrea TILCHE, Belgium]	Accepted
29316	78	23	78	23	need comma [Yuanyuan Huang, France]	Editorial
31730	78	23	78	23	fix "relatedriskdisclosureinfinancialportfolios" [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
34658	78	23			Please separate every word [Mexico]	Editorial
55874	78	23	78	23	Need to add spaces between the words [Debora Ley, Guatemala]	Editorial
56386	78	23	78	23	typo [Nuno Bento, Portugal]	Editorial
12476	78	28	78	28	This wording is ambiguous. For clarity we suggest rewording to the same terminology used in the Paris Agreement [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
12478	78	31	78	31	Better substantiation of this claim is needed - we suggest icnluding a reference to a growth trend [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
12480	78	31	78	31	Lazurko and Venema is not referenced in the bibliography [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
28666	78	31	78	33	Lack of standardization is just one of several problems related to the increasing green bond market (see Berensmann et al (2018) “Demystifying Green Bonds”, IN: Boubaker, Sabri and Cumming, Douglas J. and Nguyen, Duc Khuong, Research Handbook of Investing in the Triple Bottom Line, Forthcoming; OR Berensmann et al (2016) "Green bonds: taking off the rose-coloured glasses", Briefing Paper 24/2016. Bonn: German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE)). [Germany]	Accepted - The IPCC rule implies that we only quote peer reviewed literature but the point you made is right and is considered in the new draft
32056	78	31	78	33	it is not exact to describe the green bond market as lacking standardization. And this is not leading to accounting challenges. Moreover some references could be provided. A more appropriate description could be (suggested wording): “These are indications of a changing mind-set amongst financial institutions, but the development of the green bond market could benefit from the continuation of the initiatives promoting standardization.” [France]	Accepted - The IPCC rule implies that we only quote peer reviewed literature but the point you made is right and is considered in the new draft
47984	78	31	78	31	Kindly check: Lazurko and Venema, 2017 is not available in the reference list. [Sarah Connors, France]	Accepted
30672	78	32	78	33	« but they face an accounting challenge due to the lack of standardisation of green bonds. » What is the reference for this ? [France]	Accepted - The IPCC rule implies that we only quote peer reviewed literature but the point you made is right and is considered in the new draft
28668	78	33	78	34	There is an emerging literature on green bonds (e.g. Berensmann et al (2018) “Demystifying Green Bonds”, IN: Boubaker, Sabri and Cumming, Douglas J. and Nguyen, Duc Khuong, Research Handbook of Investing in the Triple Bottom Line, Forthcoming; OR Berensmann et al (2016) "Green bonds: taking off the rose-coloured glasses", Briefing Paper 24/2016. Bonn: German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE)).) Please revise the line "This trend is too recent…" to read: literature is only emerging [Germany]	Accepted - The IPCC rule implies that we only quote peer reviewed literature but the point you made is right and is considered in the new draft
61184	78	33	78	34	The passing mention of a REDD+ example should be clarified: What did the literature say about REDD+ in this context? [United States of America]	Accepted - The mention has been deleted
28670	78	34	78	38	The sentence "Another debate…."would be better placed in a stand-alone section on de-risking. [Germany]	Accepted - This section have been totally restructured
30674	78	34	78	38	« into an ex-ante probability distribution » Not everyone uses a probability function. Cf the literature on "deep uncertainty" (Lemper, doi:10.1007/s10584-012-0574-6) [France]	Rejected - We simply quote the arguments made in literature even though this arguments should be more precise.
28672	78	39	78	41	This argument needs more elaboration. In the way it is given now, there are too many aspects missing. There is a trend towards greening portfolios, for instance among cities or regions. However, carbon intensive industries have influential lobbies (thus, it is not just that the asset managers can "not resist the attractiveness of carbon-intensive investments". Also, in many cases consumer protection regulation prevents greening of investment portfolios (here again is the link to green financial regulation mentioned before). There is also literature stating a "carbon bias" in indices (see e.g. 2° investing initiative and UNEP Inquiry for a sustainable financial system) [Germany]	Accepted - The new version includes your point

Comment No	From Page	From Line	To Page	To Line	Comment	Response
29364	78	40	78	41	Lines 40 and 41 are unsubstantiated and non-sequitur: Asset managers may however not resist the attractiveness of carbon -intensive investments in many regions - comment - what is evidence that carbon intensive investments are attractive?. In addition, decarbonising an investment portfolio is not synonymous with investing in a low-emission development pathway. comment - there is evidence that one can achieve emission reductions by removing support to fossil fuels - these reductions are INCREASED by investing some of the fiscal or financial space in low-emissions development - but that does not in itself negate the impact of ONLY removing support to fossil fuels. See source: Merrill et al 2017 (page 29) - http://norden.diva-portal.org/smash/get/diva2:1094676/FULLTEXT02.pdf [Shelagh Whitley, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - There is a misunderstanding here. We simply recognize that there are still carbon intensive investments in some regions, including the US and that the future behaviour of asset managers will depend upon their vision of where go the economic an political dynamics
30676	78	40	78	40	resist seems to have an intent or moral connotation". [France]	Rejected - There is no moral connotation here
28674	78	44	78	46	The argument in this sentence is unclear. Different aspects seem to be mixed up. Financial actors often claim that a "pipeline of bankable projects" is missing. It might be necessary to elaborate on the different financial needs of projects of different maturities and technologies. [Germany]	Accepted
32058	78	44	78	46	Drafting is very approximative and there is no uncontroversial evidence to support the idea that a decrease in RWA would have an impact on the capital cost of low carbon projects. We would suggest the group seek comments from the central banks and supervisors Network for Greening the Financial System on this issue. [France]	Accepted - This section has been totally rewritten and we hope the new rephrasing is less approximative
28676	78	46	78	48	The concept of leveraging finance is not clearly defined in the literature, thus it is doubtful whether the comparison made is tenable. What is more, it is highly questionable whether a high leverage ratio is always desirable (see Lindenberg (2014, pp. 29-30) "Public instruments to leverage private capital for green investments in developing countries", Discussion Paper 4/2014, Bonn: German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE)). [Germany]	Rejected - We found references in literature, moreover this remark is about the leverage effect currently registered and it suggest that we are not at risk of excessive leverage for the time being
12482	78	48	78	48	Maclean et al not properly referenced in bibliography [United Kingdom (of Great Britain and Northern Ireland)]	Rejected - IPCC rule says we can quote peer reviewed literature
12484	78	48	78	48	Ward et al not properly referenced in bibliography [United Kingdom (of Great Britain and Northern Ireland)]	Rejected - IPCC rule says we can quote peer reviewed literature
28678	78	48	78	51	The arguments given here are general financing problems of green investments and should not only be referred to the leveraging aspect. [Germany]	accepted - this section has been restructured and the new structure helps putting the leveraging issue in the border context
12486	78	51	78	54	we have concerns about the clarity of this sentence. 1) it is unlcear what the statements add to the overall argument and the list of actors is unexplained 2)we also quesiton the relevance of the references - are these needed to define what a 'shareholder value business regime' is? 3) it would be more useful to cite research confirming the reasons for companies not investing. we also have concerns about completeness of this section. there is a large list of reasons for this, including horizons / financial cycles, lack of data, lack of capacity and awareness in companies etc that we suggest are drawn out here. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the new phrasing should clarify this point however the notion of shareholder value business regime is well known in business sciences
28680	78	51	78	54	It is not clear, what you want to say with the last sentence of the paragraph and how it relates to the rest of the paragraph. Please revise. [Germany]	Accepted - the new phrasing should clarify this point
974	78	53	78	54	and householdswith ahighdiscountrate preferenceinenergyefficiency.' SPACING [Robert Shapiro, United States of America]	Editorial
7114	78	53	78	53	spaces are needed between words [Jose Di Bella, Canada]	Editorial
8006	78	53	78	54	Fix this " and householdswith ahighdiscountrate preference 54 inenergyefficiency." [Christopher Bataille, Canada]	Editorial
12488	78	53	78	53	Text is not spaced [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
32290	78	53	78	54	words are joined up [Jamaica]	Editorial
56150	78	53	78	53	Insert spaces between words [Emilie ALBEROLA, France]	Editorial
12492	79	1	79	1	no references are provided for the 'recent literature' [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - this sentence refers to all the references quoted in the chapter
28682	79	1	79	6	The paragraph could be formulated in a clearer way. For instance, guarantees can take a much more general form. In addition, they are not only given for the purpose of increasing the leverage ratio. It should be made clear that Green Infrastructure Funds are one example of structured funds, which consist of different risk and return tranches (and in many cases, public donors assume high risks and are rewarded with little return expectations). [Germany]	Accepted
31662	79	1	79	6	Refer to Torvanger, Narbel, Pillay, Clapp (2016), Instruments to incentivize private climate finance for developing countries, CICERO Report No. 8, CICERO, Oslo. [Asbjørn Torvanger, Norway]	Accepted - The IPCC rule implies that we only quote peer reviewed literature
7116	79	2	79	2	Typo: Fee-rates [Jose Di Bella, Canada]	Accepted
8248	79	2	79	2	After "tax breaks on low-carbon investments" please insert: ", auctioned prize floors". Reference: Bodnar, Paul; Ott, Caroline; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily F.; Wagner, Gernot (2018): Underwriting 1.5°C: competitive approaches to financing accelerated climate change mitigation, Climate Policy, 18:3, p. 368-382. [Angela Geck, Germany]	Rejected - We only quote literature accepted before October 2017
12494	79	5	79	5	de Gouvello and Zelenko is not properly referenced in bibliography [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
61186	79	6	79	6	Presents an unbalanced assessment of literature by only discussing "de-risking policy instruments" that are financial in nature without acknowledging the influence of broader governance and regulatory regimes on the risk-weighted capital costs of climate-resilient investments and other factors that drive capital. [United States of America]	Accepted - the new structure of the text avoids this type of confusion
36142	79	8	70	15	Overall, there is an overemphasis on mitigation. The adaptation needs are of particular importance for developing countries. The gap between propensity to save and propensity to invest is more magnified within the gaps between mitigation and adaptation. The report needs to cover this gap. [India]	Accepted - This gap have been reduced in the new version that reports on published literature in the field
61188	79	8	79	9	The second sentence "This risk can be mitigated..." appears to be confused in its use of MRV or is using this concept in a way that could lead to this sentence being misinterpreted in the context of this report. MRV typically refers to the system of ex-post monitoring systems that measure project impacts. These were not designed to be ex-ante tools for screening projects for financial viability or assess other factors that could identify or mitigate risk of financial default in the way implied here. [United States of America]	Accepted - your point is right, we mean that is that the perspective of MRV change ex ante the anticipations of actors. We hope this confusion is overcome in the final version
12496	79	9	79	9	Bellassen is not properly referenced in the bibliography [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
47986	79	9	79	9	Kindly check: Bellassen, 2015 is not available in the reference list. [Sarah Connors, France]	Accepted
56152	79	9	79	9	I don't find the reference (Bellassen, 2015) in the list of references. Bellassen, V., & Stephan, N. (Eds.). (2015). Accounting for Carbon: Monitoring, Reporting and Verifying Emissions in the Climate Economy. Cambridge: Cambridge University Press. doi:10.1017/CBO9781316162262 [Emilie ALBEROLA, France]	Accepted
12498	79	10	79	10	Carbon pricing gap is undefined/unreferenced - should be referenced or explained [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
28684	79	10	79	10	A new paragraph should start before "In the presence of carbon pricing gap…" Notional carbon prices are another way of de-risking investments. They are not only used by "public economics", but also by many firms. [Germany]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16534	79	11	79	14	The reference to paragraph 108 of the decision accompanying the Paris Agreement should be deleted. Paragraph 108 makes no reference to the "agreed Social Values of Mitigation Activities" it simply notes a number of benefits of voluntary mitigation action aand there is no indication that this was intended to be a reference to a specific concept. [Australia]	Rejected - the confusion comes from the fact that using google, you find, two documents about the decision of Paris Agreement. In one of them this sentence appears in paragraph 109. This is a mistake, the official site shows this sentence in paragraph 108
61190	79	11	79	15	The reference to "agreed Social Values of Mitigation Activity recommended in paragraph 108" of the decision adopting the Paris Agreement should be deleted as it misquotes the actual paragraph. Further, the way this reference is used here, at the very least, pre-judges Parties views on the meaning of this paragraph. Nothing in this paragraph can be construed as a recommendation for an "agreed" valuation. [United States of America]	Rejected - the confusion comes from the fact that using google, you find, two documents about the decision of Paris Agreement. In one of them this sentence appears in paragraph 109. This is a mistake, the official site shows this sentence in paragraph 108
28686	79	17	79	19	The sentence is unclear in itself and also in how it relates to the paragraphs before. Please revise. [Germany]	Accepted
31732	79	17	79	22	A majority of the text in this paragraph is without spaces between words [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
976	79	18	79	19	of financialproductsbackedby a new class ofcertified assetstoattractsaversinsearchof safeandethical investments' SPACING [Robert Shapiro, United States of America]	Editorial
8008	79	18	79	19	Fix this "financialproductsbackedby a new class of 19 certified assetstoattractsaversinsearchof safeandethical investments(Aglietta et al., 2015b)" [Christopher Bataille, Canada]	Editorial
12500	79	18	79	18	Text is not spaced [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
29318	79	18	79	18	need comma [Yuanyuan Huang, France]	Editorial
32292	79	18	79	20	words are joined up [Jamaica]	Editorial
34660	79	18			Please separate every word [Mexico]	Editorial
7118	79	19	79	19	Spaces are needed between words [Jose Di Bella, Canada]	Editorial
12502	79	19	79	19	Text is not spaced [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
28688	79	19	79	21	What is meant by the "fragmentation of climate finance initiatives" and why is this regarded as problematic? [Germany]	Taken into account - This is a usual word in discussions about overseas aid to point out the risks of non coordinated initiatives
34662	79	19			Please separate every word [Mexico]	Editorial
978	79	20	79	20	against thefragmentation of' SPACING [Robert Shapiro, United States of America]	Editorial
12504	79	20	79	20	Text is not spaced [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
34664	79	20			Please separate every word [Mexico]	Editorial
28690	79	21	79	22	This is indeed an important aspects that deserves more room: Many of the climate investments have to be undertaken in emerging economies, thus, it should be elaborated more in detail why the capital costs are higher, why this is problematic and what could be done against. [Germany]	Accepted
28692	79	25	80	6	This section is currently mainly about adaptation finance, which has an own section in 4.5.3.3 Both parts should be integrated to avoid an unbalanced focus on adaptation finance in this report. [Germany]	Rejected - This is a matter of the overall balance between mitigation and adaptation in the report which cannot be solved in this section
36144	79	25			The Report has to recognize the financial mechanism of the Convention and its role in addressing climate change actions. Rather, it recognizes explicitly ODA, MDBs and also highlights the national and subnational budgets. The recognition of multilateral climate finance under the Convention should be covered in Section 4.4.6.3. This may also be included in SPM. [India]	Rejected - this is a good point but the IPCC report cannot comment articles of a convention, it reports on scientific words about existing operational mechanism or purposed new mechanisms; It is likely that such scientific published in peer reviewed literature will be available for the AR6
61192	79	25	79	52	This section and/or 4.5.3.3 might include several additional points about adaptation finance, including: the challenge of financing what is often a public good, and the need for innovative approaches to incentivize private investment; the emergence of multilateral funding vehicles such as the PPCR and the Green Climate Fund; other estimates of adaptation finance needs such as that of the World Bank (cited on page 4-93 but not here); the importance of mainstreaming into existing budgets and financial flows to fill some of the gap in dedicated adaptation funding; and the importance of increasing climate finance readiness in many developing countries given major capacity limitations to mobilize and manage funds. [United States of America]	Accepted - The final draft will make that clearer
61194	79	25	79	42	The discussion of the quantitative challenge for mitigation in section 4.4.6.1 focuses on the energy sector and the incremental cost for energy investments required. However, the disucssion in section 4.4.6.3 on adaptation investments does not focus on the energy sector but rather takes a broader scope approach focusing on all aspects of adaptation. It would be helpful to provide an "apples to apples" comparison of costs for the energy systems, including estimates for both mitigation and adaptation. [United States of America]	Taken into account - The final draft includes now, in addition to a box on finance, a discussion about the financial dimensions beyond the only energy investment on mitigation
61196	79	25	79	29	These are not necessarily distinct from the case of mitigation, as suggested by the paragraph. [United States of America]	Accepted
13984	79	27	79	28	The first is the notion of incremental needs to enhance climate resilience through the provision of basic infrastructure, that are currently underinvested in . Awkward, please rewrite. [Natalie MAHOWALD, United States of America]	Accepted
12506	79	28	79	29	This claim is unsupported and needs a reference. For completeness we also recommend that the author qualify that needs and costs assessments for mitigation can also be difficult [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
12508	79	28	79	28	Gurara et al 2017 is not in bibliography [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - It is in the final version
56388	79	28	78	28	Uncomplete sentence? [Nuno Bento, Portugal]	Accepted
28694	79	31	79	35	Please consider that private adaptation finance may be also be relevant here: it is possible that adaptation investments are made without being flagged or registered as such. [Germany]	Accepted
31664	79	31	79	35	A useful word to describe many of the difficulties financing adaptation measures/investments, in particular private investments, is 'intangibility'. On this and ideas for overcoming such challenges, confer Pillay, Aakre, Torvanger (2017), Mobilizing adaptation finance in developing countries, CICERO Report No. 2, CICERO, Oslo. [Asbjørn Torvanger, Norway]	Accepted - Good suggestion, however we are limited in using it because of the constraints of using only peer reviewed literature
34254	79	31	79	32	Adaptation funding comes from more than just multilateral development banks - suggest adding bilateral funders and multilateral climate funds in this sentence. MDBs provided around $6.2bn in adaptation finance in 2016, but a similar amount flows from bilateral funders (27% of bilateral flows of $14.9-25.3bn/yr in 2013-14 were solely for adaptation, plus 20% was cross-cutting, supporting both mitigation and adaptation objectives) as well as a small but significant amount from multilateral climate funds (e.g. Green Climate Fund, Adaptation Fund etc. - 50% of $700m/yr in 2013/14). See: http://unfccc.int/files/cooperation_and_support/financial_mechanism/standing_committee/application/pdf/2016_ba_technical_report.pdf [Joe Thwaites, United States of America]	Accepted - Very good information. We are limited in using it because of the constraints of using only peer reviewed literature

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61198	79	31	79	31	Delete the sentence beginning with "therefore" as the statement that follows is not a logical or broadly supported conclusion of the paragraph that precedes it. Further, the conclusion that is being drawn is based on what is widely recognized as limited and incomplete data – given the inherent uncertainties of tracking adaptation finance in general and private sector investment in adaptation in particular. The only accurate statement that can be drawn from the current literature would be along the lines of "To date, most publicly available data relate to public domestic and international investment in adaptation" coupled with a statement on the uncertainty and lack of data on private investment. [United States of America]	Accepted - However, the final draft includes now, in addition to a box on finance, a discussion about the financial dimensions beyond the only energy investment on mitigation
61200	79	31	79	35	This section should note that the current commentary is based on limited existing data, which, given the inherent uncertainties in defining and measuring ""adaptation finance"" pointed out elsewhere in this report, are biased towards tracking public finance for adaptation. There is literature around the private sector's interest in financing adaptation (e.g., supply chain resilience, operational resilience) that highlights that the private sector often does not define such investment as ""climate adaptation finance"" and that it is difficult to track. Thus, there is not sufficient data to make a statement that public investment in adaptation currently outweighs private investment in adaptation. For example, see: Agrawala, S., et al. (2011), ""Private Sector Engagement in Adaptation to Climate Change: Approaches to Managing Climate Risks"", OECD Environment Working Papers, No. 39, OECD Publishing, Paris. http://dx.doi.org/10.1787/5kg221jkf1g7-en. (2) ODI 2016 ""Adaptation Finance and the Infrastructure Agenda"" https://www.odi.org/sites/odi.org.uk/files/resource-documents/10489.pdf. [United States of America]	Accepted - The new draft has clarified all these points
404	79	37	79	42	The finding of a gap between finance needed for adaptation and committed finance is highly policy-relevant. This finding should be included in the SPM [Harald Winkler, South Africa]	Accepted
1882	79	37	79	37	This section refers to the same report as I mention in my comment above. I would quote the 2030 cost numbers: these are more certain and probably more relevant for 1.5 degree than the 2050 cost indication. Also, I would describe the cost estimates on page 77 and delete it here [Willem Pieter Pauw, Germany]	Accepted - This is what the new draft does
28696	79	37	79	42	The quality of estimations is poor. Therefore, it may be preferable to point out that estimates are weak but generally indicate that existing climate finance is 1-2 orders of magnitude short of what is needed. [Germany]	Accepted - A new box clarifies these orders of magnitude
61202	79	37	79	37	Replace "committed finance" with "current levels of investment," as there is no basis for equating "committed finance" or "public finance" with "finance needed" and doing so here would be inappropriate and policy prescriptive. [United States of America]	Accepted
47988	79	38	79	38	Kindly check: UNEP, 2016 is 2016a or 2016b? [Sarah Connors, France]	Accepted
1886	79	40	79	42	I would not quote these two Oxfam reports as they are not very detailed on private adaptation finance. Instead, I would write something along this line of argumentation: although there are examples of private investments in adaptation all over the world and in every sector (see Pauw et al., 2016: https://link.springer.com/article/10.1007/s10584-015-1539-3), it is challenging to assess the extent to which private finance contributes to increasing resilience (data are scarce, the effectiveness of private sector investments is unclear, and the extent of maladaptation is unknown - see the 2016 Adaptation Finance Gap Report). Furthermore, perhaps with the exception of remittances, the international private sector is unlikely to be a major source of adaptation finance in the most vulnerable countries. The domestic sector play a larger role in adaptation in developing countries (see Pauw, 2017: From public to private climate change adaptation finance) [Willem Pieter Pauw, Germany]	Accepted - The reference to Oxfam has been deleted
12510	79	40	79	42	For completeness, more evidence is needed to support this statement. A reference is needed for the 'estimated USD 4 to USD 12bn' also more qualifying language would be useful around reference to 'far higher' [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - The new draft contains new and well referenced material on this
34256	79	40	79	42	The figure used doesn't appear to match the Oxfam sources - Oxfam 2016 estimates adaptation finance as $4-8 billion, with no mention of two to four leverage. However, this Oxfam estimate is grey literature and the number only counts finance flowing from Annex 2 Parties to non-Annex I Parties. Furthermore, it takes a position on omiting and recalculating certain types of adaptation finance flows which some governments dispute. UNEP's Adaptation Finance Gap report, cited earlier in the paragraph, has a different estimate: international public finance for adaptation was around $25 billion in 2014, of which $22.5bn went to developing countries. It would be good to include the UNEP estimate and corrected Oxfam estimate alongside each other, noting the different opinions about how to account for adaptation finance. See here for UNEP estimate: http://web.unep.org/adaptationgapreport/sites/unep.org.adaptationgapreport/files/documents/agr2016.pdf [Joe Thwaites, United States of America]	Accepted - This section has been deeply rewritten
61204	79	40	79	40	How much lower would the adaptation finance needs be in a 1.5°C world? This is a pivotal question for this report. [United States of America]	Accepted - Right, and we comment briefly in that in the final version. Note however that there is almost no studies published in peer reviewed literature
13986	79	42	79	42	However, they are far higher than the estimated USD 4 to USD 12 billion in public finance per year, retaining a two to four leverage on private finance I think you mean this is how much is currently eing provided, but this should be more clear. [Natalie MAHOWALD, United States of America]	Accepted
1884	79	49	79	52	Please include that these 18/-25% is public finance only [Willem Pieter Pauw, Germany]	Taken into account - Even though we don't quote this precise figure, we incorporate published material which gives the same message
12514	79	49	79	49	We do not think that this follows from preceding statements. To clarify, we suggest a qualifying addition "to address national capacity challenges in developing countries" [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
12516	79	49	79	49	Better if "but the 18-25% of identified/identifiable climate finance flows" as we know this is a major gap in our understanding (CPI "Global Landscape of Climate Finance" 2015) [United Kingdom (of Great Britain and Northern Ireland)]	Accepted
12512	79	50	79	50	Shine and Campillo [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
61206	79	51	79	52	Delete the phrase "international transfers are thus necessary" as the statement does not follow as a logical or supported conclusion from the preceding statements. Further, the conclusion of the sentence (i.e., "with small proportions flowing through UNFCCC channels") should be deleted as it could be misinterpreted as a commentary that more finance should flow through UNFCCC channels, which would be policy prescriptive. [United States of America]	Accepted
47990	79	52	79	52	Kindly check: Roberts and Weikmans, 2017 should be Roberts et al., 2017 (Pg 173, line 25) [Sarah Connors, France]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
30	80	1	80	6	In response to the question on line 1, there is a great example for this in the New York metropolitan regiona with U.S. states of New York, New Jersey and Connecticut. There is a current plan to tax through surcharges property and casual insurance lines and utilize that tax to float bonds and create a leveraged fund to invest in resilience and adaptation projects. Please see the following citations: Keenan, J.M. (2017). Regional Resilience Trust Funds: An Exploratory Analysis for Leveraging Insurance Surcharges. Environment Systems and Decisions. doi: 10.1007/s10669-017-9656-3 ; Keenan, J.M. (2017). Regional Resilience Trust Funds: An Exploratory Analysis for the New York Metropolitan Region. New York, NY.: Regional Plan Association. http://library.rpa.org/pdf/Keenan-Regional-Resilience-Trust-Funds-2017.pdf; Montemayor, L., Korman, E., Freudenberg, R., Calvin, E., McCory, S., Jones, C., Simons, D., & Keenan, J.M. (2017). Coastal Adaptation: A Framework for Governance and Funding to Address Climate Change. 4th Regional Plan. New York, NY.: Regional Plan Association. [Jesse Keenan, United States of America]	Taken into account - Thanks for the example, however it was difficult to include it given the space constraints in this section. We don't have the lines needed to explain this
10122	80	1	80	2	It is not just the money tied in the subsidies that should be looked at but also the welfare implications of the subsidies removal in developing countries, particularly in relation to energy access, poverty eradication, and economic development. [Saudi Arabia]	Accepted
12518	80	1	80	1	Unsure this is the question that follows from the previous section and the wording is informal. It does not specify who is raising funds, or how, or reflect opportunities in redirecting finance flows. This whole section also ignores the possibility of stimulating greater investement in resilience from the private sector. e.g better provision of climate data to calculate risk and better disclosure of exposure [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - it has been reworded in the new draft
13222	80	1	80	3	Delete the text "Possibilities include innovative removal of fossil fuel subsidies (Jakob et al., 2016), introduction of carbon taxes (Jakob et al., 2016) or levies on international aviation and maritime transport.". [Eleni Kaditi, Austria]	Rejected - The rule of IPCC is to text talk of published literature. The new draft however clarifies this type of statement
28698	80	1	80	3	The ideas to raise funds, i.e. removal of fossil fuel subsidies or carbon taxes, merit a broader discussion. The funds generated could be used for adaptation finance, but the underlying concepts would have a value-added for themselves. For instance, fossil fuel subsidies are one of the main barriers for investments in climate projects. Thus, these concepts should be taken up more generally. If there is a lack of scientific evidence, this should be clarified in the text. [Germany]	Accepted - We hope that the new structure of the section responds this critic
28700	80	3	80	4	Please adapt to read "the critical challenge is not only the availability of funds but also securing the efficient use of funds and the emergence of long-term assets using infrastructure as collateral, …" [Germany]	Accepted
35552	80	3	80	4	Not clear how it can be said that availability of funds is not a critical challenge when funds flow has been well below what has been promised. [Ashok Sreenivas, India]	Taken into account in the new draft
40472	80	3	80	4	References are needed for this statement: “the critical challenge is less the availability of funds than how to secure the efficient use of funds”. This is an arguable position that leaves aside the issue of access and will depend on time, place and circumstances. I suggest rewriting as “the availability, equitable access and efficient use of funds are critical challenges”. [Pedro Alfredo Borges Landaez, Venezuela]	Accepted
1890	80	9	80	49	This section goes in all directions (from collateral to NDCs to climate friendly Bretton Woods, ...) and needs a massive improvement in terms of focus and message. I would be happy to contribute here [Willem Pieter Pauw, Germany]	Taken into account - we hope that the new draft will be clearer. However note that because of space constraints we are forced to mention here very heterogeneous literature
10124	80	9	80	15	First, there is a great risk here of creating a large low-carbon investment bubble that will potentially hurt the functioning and stability of the global financial system and climate change finance. Second, There is a danger of introducing more distortions in the global financial system by altering the allocative efficiency of the market. These two types of risks are not well addressed in the cited literature and should be pointed as limitations or need to know areas. [Saudi Arabia]	Accepted - A new specific reference responds to this concern
28702	80	9	80	50	Section 4.4.6.4: Part of this section would better be integrated in 4.4.6.2. Other paragraphs of this section are loose arguments that are not directly related to the rest of the sub-chapter. On the other hand, what is missing is the role of different actors (public, private, institutional). Thus, a complete restructuring of 4.4.6.4 could be useful. [Germany]	Accepted - All the section has been restructured
55118	80	9	80	50	The issue of access to finance is lacking in this analysis. This should be considered. Failure to address this will undermine and slow implementation and prevent scaling up efforts. You can have all the money required, if the capacity/mobilization to access these funds or deploy these innovtive mechanisms by the relevant actors (not just governments, but also private sectors, NGOs, cities,...) is not there, we will fail.this is a major stumbling bloc that need to be addressed. [Yamide Dagnet, United States of America]	Accepted - This point is made more clear in the new draft
40474	80	9	80	9	(4.4.6.4 Public commitments and evolution of climate finance) There is no mention or discussion on the finance commitments under de UNFCCC and its Paris Agreement. This is a very relevant point in this section. Article 9: “A mechanism for the provision of financial resources on a grant or concessional basis, including for the transfer of technology, is hereby defined. It shall function under the guidance of and be accountable to the Conference of the Parties, which shall decide on its policies, programme priorities and eligibility criteria related to this Convention. Its operation shall be entrusted to one or more existing international entities. … 2. The financial mechanism shall have an equitable and balanced representation of all Parties within a transparent system of governance.”; “ Article 4: “The implementation of these commitments shall take into account the need for adequacy and predictability in the flow of funds and the importance of appropriate burden sharing among the developed country Parties.” [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account - IPCC quotes reports in the existing literature and the literature quoted in this section analyses public commitments. It does not comment about elaborate UNFCCC documents and the Paris Agreement
61208	80	9	80	9	Public commitments should be deleted from this subtitle as it is irrelevant and prejudicial framing to the actual substance discussed. [United States of America]	Taken into account - we deleted the references to public commitments in the new subtitles of the new draft
1888	80	10	80	12	I do not understand this sentence. When I think of public climate finance, I think of the climate finance regime that is build up predominantly around the USD 100 commitment first made in Copenhagen. [Willem Pieter Pauw, Germany]	Taken into account - The new draft explains better what is the meaning of public finance in this context
12520	80	10	80	10	This is an unsupported statement. Also no explanation regarding focus only on guarantees as opposed to other commercial instruments e.g. loans, equity [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - The explanation is given more clearly in the new draft
18654	80	10	80	12	The text needs to be revised. Money issurance is managed by central banks, while public climate finance consists of guarantees by governments and their agencies. Linking public guarantees to monetary creation is far-fetched, especially through eligibility of 'low emissions' collateral for open market operations. The sentence 'Hence, the link between climate finance and the evolution of the financial and monetary system is important.' is true for any type of finance, e.g. brown finance. [Andrea TILCHE, Belgium]	Taken into account - This section has been revised. However it simply notes that ultimately an important amount of public guarantees with a high leverage effect will end up in increasing monetary masses that are not in direct control of central banks
48372	80	10	80	11	This doesn't seem representative of a clear consensus within the economics community. Hence, it should be further documented or nuanced. Perhaps the view of Lord Stern, Thomas Sterner or Patrick Bolton could enlighten this [France]	Taken into account The rule of the IPCC is to report on published literature even it is not consensual. Note that the sentence is by the way prescriptive, it simply notes a diversity of suggestions. Anyway, this discussion has been developed in the new draft
53150	80	10	80	49	The section also does not address the role of public sector finance is mobilizing private sector investment, and what the public sector may need to do differently to lead to greater flows. On cities, yes, they are critical finance actors, but they are often constrained by the national governments from borrowing from IFI's or accessing bond markets or they don't have the creditworthiness to do so. It would be good to point out what national governments need to do to enable finance at the city and subnational level. [Westphal Michael, United States of America]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
61210	80	10	80	15	This opening paragraph is confusing and lays out connections between concepts that are not always logical, necessary, or based on the balance of the literature. Discussion of public financial support should be introduced more broadly than offering a (limited) definition of public guarantees. Reports by developed countries and the OECD show that public guarantees only represent 1-5% of overall public climate finance from developed countries, making them a poor starting point for an entire section on the role of public finance. Further, this attempted definition of what a public guarantee is does not lend itself to the overly-broad conclusion that is drawn here on the link between "climate finance" and entire global financial and monetary system. Finally, the commentary on SDRs is inappropriate for a framing paragraph and should either be deleted or placed in a more appropriate section. [United States of America]	Taken into account - It seems that new literature emerges that evokes scaling up of public guarantees to unlock financial resources for the low carbon transition and primarily to derisk investments. This discussion is far clearer in the ne w draft in which this section has been totally restructured
980	80	12	80	13	Rights tofundthepaidincapitaloftheGreenClimateFund' SPACING [Robert Shapiro, United States of America]	Editorial
8010	80	12	80	13	Fix this "ofundthepaid- 13 incapitaloftheGreenClimateFund(Bredenkamp and Pattillo, 2010) " [Christopher Bataille, Canada]	Editorial
12522	80	12	80	12	Text is not spaced [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
12524	80	12	78	15	This section focuses on niche solutions, not comprehensive and thus risks being prescriptive. The 3 points that follow in lines 17-29 further risk being prescriptive. In general this section does not provide a comprehensive enough assessment of policy options. Not consistent with title of section. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - it has been reworded in the new draft
21558	80	12	80	13	Typo: To fund the paid [Nathalie HILMI, France]	Editorial
28704	80	12	80	12	Please clarify the concept of IMF's SDRs clear to all readers and provide further explanations. [Germany]	Accepted
30678	80	12	80	13	Possibly outdated [France]	Rejected
34666	80	12			Please separate every word [Mexico]	Editorial
52246	80	12	90	41	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Editorial
56154	80	12	80	13	Insert spaces between words [Emilie ALBEROLA, France]	Editorial
29320	80	13	80	13	need comma [Yuanyuan Huang, France]	Editorial
34668	80	13			Please separate every word [Mexico]	Editorial
56390	80	13	80	13	Typo [Nuno Bento, Portugal]	Editorial
13224	80	14	80	29	Delete the text "Such an evolution of the financial system might be useful in three ways. First, to facilitate the access of developing countries to affordable loans via bond markets at lower exchangeraterisk,whichconstitutes a barrier for large long-terminvestments. These loans might be one way of establishing a burden-sharing mechanism between rich and poor countries, that enhances reciprocity and enables them to deploy ambitious NDCs (Edenhofer et al., 2015; Stiglitz et al., 2017). Second, the emergence of new asset classes may be necessary to redirect financial flows worldwide; compensate for 'stranded' assets caused by divestment in carbon-based activities that back part of the assets of financial and insurance institutions. This new class of assets could facilitate the low-carbon transition for fossil-fuel producers and help them to overcome the 'resources curse' (Ross, 2015; Venables, 2016). Third, the involvement of non-state public actors like cities and regional public authorities that govern infrastructure investments are critical for the penetration of low-carbon energy systems, shaping urban dynamics (Cartwright, 2015), and fostering changes in agriculture and food systems.". [Eleni Kaditi, Austria]	Rejected - The IPCC indeed reports on existing literature and cannot decide not to quote it unless the papers are evidently flawed. However, the restructuration of this entire section will hopefully demonstrate more clearly why this type of debate is relevant and scientifically grounded
18656	80	17	80	29	the text describes new instruments rather than supporting the assessment of mechanisms suggested in lines 12-15. Possible remedy: review last sentence in lines 14-15. [Andrea TILCHE, Belgium]	Taken into account - The new draft corrects this
61214	80	17	80	20	Any discussion on exchange rate risk needs to acknowledge the multiclausal nature of the problem, which is predominantly driven by domestic monetary, political, and regulatory factors. Thus, more effective governance would also be an important option to include when laying out different policy approaches to addressing the root cause of the problem, as opposed to simply buying down risk using public subsidies. [United States of America]	Accepted
28	80	18	80	18	exchangeraterisk is not one word. It should be "exchange-rate risk." [Jesse Keenan, United States of America]	Editorial
982	80	18	80	18	exchangeraterisk,whichconstitutes a barrier for large long-terminvestments. SPACING [Robert Shapiro, United States of America]	Editorial
7120	80	18	80	18	Spaces are needed between words [Jose Di Bella, Canada]	Editorial
12526	80	18	80	18	Brendenhoffer not properly referenced in the bibliography [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
12528	80	18	80	18	Text is not spaced [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
21556	80	18			Typo: long-term (space) investment [Nathalie HILMI, France]	Editorial
32060	80	22	80	24	It is unclear what these "new asset classes" are. Maybe useful to mention work done in various for a to develop infrastructure as a recognized asset class for example. [France]	Accepted
61216	80	22	80	25	This paragraph should be deleted/streamlined as it is vague and poorly substantiated. [United States of America]	Accepted - This paragraph has been totally restructured
18658	80	23	80	24	The issue of potentially stranded assets deserves attention. However, it seems unwise to suggest policy prescriptive measures such as the creation of special compensation vehicles without a thorough discussion of the implications. These could be several (not least moral hazard). [Andrea TILCHE, Belgium]	Accepted - We rephrased to avoid the policy perspective nature of the previous writing
34258	80	23	80	24	This appears to misstate the stranded assets thesis. It's not that divestment strands the assets, its that fossil fuel assets lose their value due to the transition to a low-carbon economy (which is driven by a variety of factors including policy and market shifts). This is Carbon Tracker Initiative's definition: "Stranded assets are now generally accepted to be fossil fuel supply and generation resources which, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return (i.e. meet the company's internal rate of return), as a result of changes associated with the transition to a low-carbon economy." https://www.carbontracker.org/terms/stranded-assets/ [Joe Thwaites, United States of America]	Accepted - The new phrasing clears away this ambiguity
62024	80	23	80	23	It would be relevant to have a broader focus on the notion of "stranded assets" in a 1.5°C warmer world (looking at both climate risks, e.g. for coastal infrastructures, but also implications of ambitious mitigation) [Valérie Masson-Delmotte, France]	Accepted - This is has been clarified in the new draft
52248	80	25	80	25	What does this mean in this context? This is discipline specific thinking that hasn't been unpacked for this audience. [Jason Donev, Canada]	Accepted - the new phrasing is hopefully more pedagogic
61218	80	25	80	25	The term "resources curse" is first used here and is not explained. [United States of America]	Accepted
18660	80	31	80	32	The text should acknowledge that the primary role of central banks is to maintain monetary and financial stability rather than act as a facilitator for low-carbon financial instruments. [Andrea TILCHE, Belgium]	Accepted - we hope that the new text is more explicit about the role of central banks
28706	80	31	80	36	This part should be shifted to the discussion in 4.4.6.1. The idea of a climate friendly Bretton Woods needs more explanations or otherwise should be deleted. [Germany]	Accepted - In the new structure of the chapter this reference will be located in a more relevant way
28708	80	31	80	36	If it is from a scientific perspective possible to mention alternative ways to alter the financial system, these ways should be discussed in greater detail. Otherwise the lack of analysis should be clearly stated [Germany]	Accepted - The new structure of the text takes care of this concern. Note however that the level of detail in which we can enter is constrained by the space limits of the section

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32062	80	31	80	33	A more neutral description would put the whole paragraphe into perspective / suggested drafting : "In that context, while policy initiative are ongoing to integrate and mainstream climate issue into the existing framework and practices of the financial system, some argue that it raises other questions such as the the premise that money should remain neutral (Annicchiarico and Di Dio, 2015, 2016; Nikiforos and Zezza, 2017). They further advocate that central banks could act as a facilitator of low-carbon financing instruments. This may, in time, lead to the use of carbon-based monetary instruments to diversify reserve currencies (Jaeger et al., 2013) and to differentiation of reserve requirements (Rozenberg et al., 2013) in a prospective Climate Friendly Bretton Woods (Sirkis et al., 2015; Stua, 2017)." [France]	Accepted
13226	80	33	80	36	Delete the text "This may, in time, lead to the use of carbon-based monetary instruments to diversify reserve currencies (Jaeger et al., 2013)and to differentiation of reserve requirements (Rozenberg et al., 2013) in a prospective Climate Friendly Bretton Woods (Sirkis et al., 2015; Stua, 2017).". [Eleni Kaditi, Austria]	Rejected - The IPCC indeed reports on existing literature and cannot decide not to quote it unless the papers are evidently flawed. For space constraints we are forced to assume that some historic references like Breton Woods are known by the readers
34264	80	33	80	33	enabling might be changed to "ensuring" or "maintaining", since this better describes the mandate of Central Banks. [Joe Thwaites, United States of America]	Accepted
7122	80	35	80	36	Add comas "Climate Friendly Bretton Woods", as this is a prospective name given by the author [Jose Di Bella, Canada]	Editorial
61220	80	35	80	36	Will the use of the phrase "in a prospective Climate Friendly Bretton Woods" have meaning to the audience? [United States of America]	Accepted
1892	80	38	80	41	I think I understand what the author means when he adds 'without crowding out private or public investment'. However, one could also read it as: in the new climate economy, ongoing investments should not be affected. Yset the new climate economy needs investments in fossils to be affected, that is the whole basis of it. [Willem Pieter Pauw, Germany]	Accepted - We hope that the new structure of the section will explain more clearly this message
12530	80	38	80	38	text is not spaced [United Kingdom (of Great Britain and Northern Ireland)]	Editorial
28710	80	38	80	44	The argumentation is not clear. What exactly would be the problem (in the sections before it had been argued that a redirection of investments is wanted, why should it be problematic now?). What about the new growth cycle? Would this be positive? Have secondary effects? Also the term "green financial bubble" is used for the first time here without further explanation. The link to the sections before is not apparent. [Germany]	Accepted - We hope that the new structure of the section will explain more clearly this message
31734	80	38	80	44	A majority of the text in this paragraph is without spaces between words [Michael SUTHERLAND, Trinidad and Tobago]	Editorial
61222	80	38	80	49	This section presents an unbalanced characterization of the literature and contains material omissions relevant to the topic being discussed. Two key aspects of any analysis of economic/financial implications of climate mitigation pathways (either 1.5 or 2°C) to avert potential future damages are discount rate and uncertainty of future costs/benefits. The work cited here, especially that of Stern et al., represents economic modelling done using a near-zero time discount rate. Thus, this section, the Executive Summary of Chapter 4, and the SPM paper should, to appropriate level of detail: (1) discuss the importance of discount rates in driving conclusions of such analyses, (2) present work by others in the field who use different discount rates, and (3) discuss how the relative importance of these variables would change in the 1.5 vs 2°C scenarios. For instance, given that near-zero discount rates minimize the impact of uncertainty about future potential costs/benefits, this section should highlight that the 1.5°C scenario, where future costs/benefits are even more unknown than the 2°C scenario and where society would have to make decisions about allocating even larger sums of capital even earlier /under even more uncertainty, could lead to a socially inefficient allocation of capital in the long run. This could have the effect of jeopardizing current and future global economic growth, reducing current and future welfare, and actually reducing intergenerational equity by making decisions now that could negatively affect and tie the hands of future generations. For example, the following is a seminal work in this area of literature: Nordhaus, W. Journal of Economic Literature; Vol. XLV (September 2007), pp. 686-702; "A Review of the Stern Review on the Economics of Climate Change." See also: Mendelsohn, R (2007) http://environment.research.yale.edu/files/biblio/YaleFES-00000260.pdf. [United States of America]	Rejected - This discussion is very relevant but it was decided to put it in a box in chapter 2 and to concentrate here on the enabling conditions of short-term action
984	80	41	80	43	injectingliquidityintothelow-carbontransition via investment in the previouslyunderinvestedinfrastructuresectors. This could haveapotentialrippleeffect,largeenoughtotriggeranewgrowthcycle SPACING [Robert Shapiro, United States of America]	Editorial
7124	80	41	80	44	Spaces are needed between words [Jose Di Bella, Canada]	Editorial
28712	80	41	80	41	Unclear what "they" refers to in this context. [Germany]	Editorial
30680	80	41	80	43	Formatting [France]	Editorial
29	80	42	80	43	Spacing between letters and words is off. Please fix. [Jesse Keenan, United States of America]	Editorial
13244	80	43	80	44	Delete the text "This could, if managed appropriately, assist in lowering the systemic risk of stranded assets and green financial bubbles (Safarzy?ska and van den Bergh, 2017).". [Eleni Kaditi, Austria]	Rejected - The IPCC indeed reports on existing literature and cannot decide not to quote it unless the papers are evidently flawed.
14230	80	46	80	47	The sentence is inconclusive because more explanation on the terms 'short and long term' are needed. Did the author meant short and long term goals? Also shifting from where to where? The sentence is not clear. [United Republic of Tanzania]	Accepted - We hope that the new phrasing will be clearer
28714	80	46	80	49	The terms "production frontier", "propensity to save", "propensity to invest" and "fault lines" need further explanations. In addition the alignment of the 1.5°C world and the SDGs should be better explained. [Germany]	Accepted - Although for reasons of space limits we cannot develop extensively the definition of each concept and we think that "propensity to invest" and "fault lines" are intuitively understandable even for non economist readers
8016	81				Section 4.5 "Integrating and enabling transformation" is good [Christopher Bataille, Canada]	Thank you.
21560	81	1	84	49	Any reference? There is no reference in those pages [Nathalie HILMI, France]	Noted. This is a synthesis section that refers to previous sections and Supplementary material. See revisions in 4.5
47992	81	1	88	38	Kindly check: there are not a single references in this section. [Sarah Connors, France]	Noted. This is a synthesis section that refers to previous sections and Supplementary material. See revisions in 4.5
3948	81	3	83	32	A gap not mentioned is literature considering the role of culture, values and worldviews in a 1.5 degree transition. (This is discussed in Leyshon, C. (2014) Critical issues in social science climate change research. Contemporary Social Science, 9, 4, 359-373; Driessen, P. Behagel, J. hegger, D et al (2013) Societal transformations in the face of climate change: Research priorities for the next decade. Paper prepared for Joint Programming Initiative 'Connecting climate knowledge for Europe') [Emily Tyler, South Africa]	Accepted, we included text in the table under 'Lifestyle and behavioural change', including: 'Whereas mitigation pathways studies address (implicitly or explicitly) the reduction or elimination of market failures (e.g., external costs, information asymmetries) via climate or energy policies, no study addresses behavioural change strategies in the relationship with mitigation and adaptation actions in the 1.5°C context and "Knowledge gaps on factors enabling adaptation behaviour, except for behaviour in agriculture". Values, culture and worldviews are among the factors being discussed in this section (4.4.3).

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6136	81	3			Interesting section that pulls together the information from the preceding sections and identifies knowledge gaps. It highlights the general lack of 1.5 degree specific literature with specific gaps in terms of knowledge related to how much climate change damage would be reduced by going from 2 to 1.5 degrees and how much adaptation investments that could be avoided. However, the section does not summarise the areas in which there is some general agreement such as differences in sea level rise and impacts on coral reefs. The summarising and discussing nature of the section means that no references are made. It would be advisable to at least insert cross-section references in this and the sub-sequent subsections. [Anne Olhoff, Denmark]	Taken into account - the section has been changed into a table format with comments ordered directly corresponding to section cross-references. Areas of high agreement are not featured in the knowledge gaps section, however, but in the respective sections.
18662	81	3			Interesting section that pulls together the information from the preceding sections and identifies knowledge gaps. It highlights the general lack of 1.5 degree specific literature with specific gaps in terms of knowledge related to how much climate change damage would be reduced by going from 2 to 1.5 degrees and how much adaptation investments that could be avoided. However, the section does not summarise the areas in which there is some general agreement such as differences in sea level rise and impacts on coral reefs. The summarising and discussing nature of the section means that no references are made. It would be advisable to at least insert cross-section references in this and the sub-sequent subsections. [Andrea TILCHE, Belgium]	Taken into account - the section has been changed into a table format with comments ordered directly corresponding to section cross-references. Areas of high agreement are not featured in the knowledge gaps section, however, but in the respective sections.
24388	81	3	83	32	This text lacks line of sight to literature and crossreferences to other parts of the chapter or report. It would be good to remediate this issue and provide evidence for all statements made in this section. [Joeri ROGELJ, Austria]	Taken into account - we decided for cross-references, as due to lack of space references from the sections couldn't be reproduced.
35554	81	3	81	3	Is there sufficient literature available on the cultural/political aspects around reduction of consumption among different kinds of affluent societies? Since that could/should be an important tool for mitigation, that should be cited as a gap if such literature does not exist, or it should be cited and discussed if it exists. [Ashok Sreenivas, India]	Noted. We indicate a lack of 1.5C literature on implementation of options to mitigate and adapt, for example on institutions, which includes political aspects. Also, we indicate that most research has been done in Western cultures, which implies that little is known about potential cultural differences.
55120	81	3	83	32	This section is a bit repetitive to what has been said before, but because it is a cross cutting issue, it deserves to be maintained there. To reduce the redundancy and streamline the chapter, I suggest that previous references to knowledge gap are moved and merged with this section. [Yamide Dagnet, United States of America]	Accepted
57384	81	3			This section includes many statements without references. Cite either literature or refer to specific previous sections. [Hans Poertner, Germany]	Accepted - the section has been changed into a table format with comments ordered directly corresponding to section cross-references.
62026	81	3	83	43	I suggest to place the section on knowledge gaps and key uncertainties at the very end of the chapter, not at the beginning of an integration section. Some aspects read as quite prescriptive for future research directions ("additional work is required…"). The link between this subsection and the next ones is not obvious (what could not be assessed etc). [Valérie Masson-Delmotte, France]	Accepted. Implemented
30682	81	5	81	6	add "[more rapid pace] than 2°C" ? [France]	Noted - however, this part of the text is gone due to shortening of the section
10126	81	14	81	24	This paragraph highlight important aspects of the knowledge gap related to 1.5c that needs to be brought to the attention of decision makers to inform them on the comparison of 1.5c to 2c warming levels. So these need to be reflected in the executive summary and the SPM. [Saudi Arabia]	Noted - however, climate impacts are now exclusively assessed in chapter 3 and there is actually evidence of incremental damage, which has also been elevated to the SPM.
61212	81	14	81	18	These two sentences are critical to the framing of the entire report and contextualizing its findings and should be featured prominently in both the SPM and the Executive Summary of Chapter 4: "For impacts and adaptation, large literature gaps remain with respect to the assessment of incremental economic and climate impacts between end-of-century warming levels of 1.5 and 2°C, especially during mid-century overshoot. There is a lack of knowledge on how much climate damage is reduced globally as a result of being more ambitious and no information on avoided adaptation investments associated with keeping warming to 1.5°C compared to business-as-usual or 2°C." [United States of America]	Noted - however, climate impacts are now exclusively assessed in chapter 3 and there is actually evidence of incremental damage, which has also been elevated to the SPM.
61224	81	14	81	24	This discussion of literature gaps with respect to the incremental difference between 1.5 and 2°C is important and should be cross-checked with Chapter 3. It would also be worth pulling this point into the chapter summary and perhaps into the SPM. [United States of America]	Noted - however, climate impacts are now exclusively assessed in chapter 3 and there is actually evidence of incremental damage, which has also been elevated to the SPM.
32294	81	20	81	21	I don't think the statement is accurate. In my estimation, there has been a fairly large and growing body of literature on adaptation options and limits to those adaptation pathways since the AR5 (certainly within the LAC region). I do however, agree that literature on 1.5C is generally lacking. See for example: Gerlak, A. et al. 2017. Building a framework for process-oriented evaluation of Regional Climate Outlook Forums, Weather, Climate and Society; . The Guido, Z. et al. 2017. The stresses and dynamics of smallholder coffee systems in Jamaica's Blue Mountains: A case for the potential role of climate services, Climatic Change https://doi.org/10.1007/s10584-017-2125-7; Tomlinson J. and Rhiney, K. 2018. Assessing the role of Farmer Field Schools in promoting pro-adaptive behaviour and attitude toward climate change in Jamaica, Journal of Environmental Studies and Sciences 8(1): 86-98; Sheller, M. and Leon, YM. 2016. Uneven socio-ecologies of Hispaniola: Assymettric capabilities for climate adaptation in Haiti and the Dominican Republic, Geoforum 73(2016): 32-46 [Jamaica]	Taken into account - the section has been completely rewritten and reformatted to match the exact gaps identified by the feasibility assessment of the mitigation and adaptation options. Inaccuracies have been removed and knowledge gaps are more 1.5°C-specific, as recommended by the reviewer.
55876	81	26	81	26	Add industry: energy and industry [Debora Ley, Guatemala]	Noted - However, this text is gone due to cutting.
57386	81	26	81	26	Also ocean has been discussed [Hans Poertner, Germany]	Noted - However, this text is gone due to cutting. We added therefore later on "includes Ocean-based options will be assessed in depth in the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC)."
63272	81	26	81	26	I remain incredulous that the ocean, 70% of the Earth's surface, is unrepresented here and in many places in this report that presumes to discuss global problems and global solutions! Please see my additions in the CDR section and these references: Rau GH (2014) Enhancing the ocean's role in CO2 mitigation. In: Global environmental change. Springer Netherlands, Dordrecht, pp 817–824. Rau G. H., McLeod E. L. & Hoegh-Guldberg O., 2012. The need for new ocean conservation strategies in a high-carbon dioxide world. Nature Climate Change 2:720-724. Keller, D. 2018. Marine Climate Engineering. in: M. Salomon, T. Markus (eds.), Handbook on Marine Environment Protection, Chapter 13. Springer International, Cham, Switzerland. https://doi.org/10.1007/978-3-319-60156-4_13 [Greg Rau, United States of America]	Accepted - we added "includes Ocean-based options will be assessed in depth in the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC)."
47182	81	31	81	31	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted
47210	81	33	81	33	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted
7126	81	34	81	35	And those among economic actors, such as small and medium enterprises in the private sector, co design and co production a the practice level. [Jose Di Bella, Canada]	Accepted
49652	81	43	81	50	More specific information on land-based information (maps) can be found here: Erb et al., 2016 doi 10.1111/gcb.13443, Pongratz 2018 doi 10.1111/gcb.13988, Kuemmerle 2013 doi Current Opinion in Environmental Sustainability). Note that hybrid approaches are not emerging right now, but have an old tradition, see eg. Ramankutty & Foley 1999 GBC, Klein Goldewijk et al., 2007 JLUS, Erb et al., 2007 JLUS). [Karlheinz ERB, Austria]	Taken into account - Reference to Erb et al 2016 taken up in 4.3.7 and knowledge gap description toned down.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
58370	81	53	81	54	Could add: "Fortunately, new analysis shows that providing universal energy access by 2030 (in line with SDG 7) can be achieved without impacting on climate change objectives (IEA, 2017b, Energy Access Outlook). However, limiting energy demand growth and decarbonising the sector will be very challenging under a 1.5 C world" [Andrew Prag, France]	Noted -however, this sentence needed to be cut, as the text was bulletized and transferred to a table.
56392	81	54	81	55	Suggestion: add behavioral patterns to the sentence: "...combinations of new smart technologies, sustainable design and behavioral patterns are showing..." [Nuno Bento, Portugal]	Accepted, but changed into behaviour change: "Knowledge gaps in the application and scale-up of combinations of new smart technologies, sustainable design, advanced construction techniques and new insulation materials, renewable energy and behaviour change in urban settlements."
39280	82	1	84	13	It would help for policy makers to have a visual graph. For example, the effectiveness if citizens were to follow each behavioral change, how much would this help, etc. This gives needed perspective to engage with industry pressures that can be counter-productive. [Lindsey Cook, Germany]	Noted. This is a synthesis section that refers to previous sections and Supplementary material. See revisions in 4.5
61226	82	1	82	1	Is it really true that we don't know how to apply sustainable design and smart technologies at scale? This seems to be a rather sweeping and questionable statement. [United States of America]	Taken into account - Modified to: "Knowledge gaps in the application and scale-up of combinations of new smart technologies, sustainable design, advanced construction techniques and new insulation materials, renewable energy and behaviour change in urban settlements."
13354	82	7	82	8	Uncertainty about the feasibility of timely upscaling of CCS relates more to the historic failure and on-going near-complete lack of regulatory requirement/business model support than to "safety of storage", and the need for co-development of considerable CO2 transport and storage infrastructures. See Stewart et al 2014 The feasibility of a European?wide integrated CO2 transport network, GHG Sci. & Tech. http://onlinelibrary.wiley.com/doi/10.1002/ghg.1410/full; Alcade et al Quantifying geological CO2 storage security to deliver on climate mitigation (accepted) Nature Communications - preprint https://eartharxiv.org/x59qg/ ; Haszeldine et al (in review) Phil Trans R Soc - Negative emissions technologies and carbon capture and storage to achieve the Paris Agreement commitments. ; Scott et al 2015 Fossil Fuels in a trillion tonne world https://www.nature.com/articles/nclimate2578 [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - lack of regulatory requirement taken up as main bottleneck for uncertainty about CCS feasibility.
62214	82	7	82	7	CCS should be treated in a separate line, because it is not industrialized as the previous items. [Antoine Bonduelle, France]	Accepted
37214	82	8	82	8	The statement about "timely upscaling of CCS" is incorrect. The IEAGHG using industrial analogues found that the the build-out of industry analogues (to CCS) has been comparable to the projected scale of deployment anticipated for CCS (IEAGHG CCS Industry Build-Out Rates - Compaison with Industry Analogues, 2014/TR6, june 2017). [John Scowcroft, Belgium]	Noted - we now tie this statement explicitly to the absence of a regulatory requirement, so that it doesn't look like this is technically not possible.
37216	82	8	82	8	The statement that CCS suffers mostly from uncertainty of safe storage is incorrect as it infers that CO2 cannot be safely stored. CO2 has been injected and stored since 1972 and over 220 million tonnes of anthropogenic CO2 has been injected without a major incident as to stop an operation permanently (Global CCS Institute, 2017). The IPCC (2005) concluded that it is likely the fraction of stored CO2 retained is more than 99% over the first 1,000 years. This is not uncertainty. [John Scowcroft, Belgium]	Noted - we now tie this statement explicitly to the absence of a regulatory requirement, so that it doesn't look like this is technically not possible.
33994	82	11	82	13	Various ZEP reports also states that in order to increase the speed of deployment of CCS, we have to move on from ‘additional studies’ to ‘doing the job’. To demonstrate the technology at full scale, we need to increase the learning-by-doing and use the infrastructure of the first projects as ‘stepping stones’ for the next. PLease consider to include these reflections. [Norway]	Noted - we now tie this statement explicitly to the absence of a regulatory requirement, so that it doesn't look like this is technically not possible.
54066	82	16	82	17	Delete the sentence starting with "in addition" until "generation is needed". Why would IPCC call for more research on geoengineering proposals such as DAC? If IPCC calls for more research, it should be on non-controversial and widely affordable options such as peasant agroecological food systems, that are strongly under-represented in this report, despite the fact that it is the most powerful alternative at hand to address the root causes of climate change. DAC is an expensive risk technology that only benefits those who have economic control over it. [Elenita Daño, Philippines]	Taken into account - reformulated from "research need" to a description of knowledge gaps.
42828	82	20	82	27	Regional undertakings, like through the Arctic Council, can develop specialized analysis to determine sources and best mitigation solutions. Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017. [Kristin Campbell, United States of America]	Noted - however, due to lack of space, we can only briefly list the knowledge gaps here and not give any recommendations as to how to solve them. In addition, this might be perceived as policy prescriptive.
43076	82	20	82	27	There is strong evidence that reducing BC improves public health. Janssen N., et al. (2012) Health effects of black carbon, WHO, 87 (“Black carbon (BC) is an indicator of combustion-related air pollution and was recently recognized as one of the short-lived climate-forcers. This report presents the results of a systematic review of evidence of the health effects of BC in ambient air. It concludes that epidemiological studies provide sufficient evidence of the association of cardiopulmonary morbidity and mortality with BC exposure. The review of the toxicological studies suggested that BC may not be a major directly toxic component of fine particulate matter (PM2.5), but it may operate as a universal carrier of a wide variety of chemicals of varying toxicity to the human body. A reduction in exposure to PM2.5 containing BC and other combustion-related particulate material for which BC is an indirect indicator should lead to a reduction in the health effects associated with PM and simultaneously contribute to the mitigation of climate change.”); see also Smith K. R., et al. (2009) Public health benefits of strategies to reduce greenhouse-gas emissions: health implications of short-lived greenhouse pollutants, The Lancet 274(9707):2091–2103, 2095 (“Our systematic review and meta-analysis of short-term exposure time-series studies of black smoke and daily mortality detected significant, positive associations with all-cause, cardiovascular, and respiratory mortality.”). Regional undertakings, like through the Arctic Council and the CCAC, have developed specialized analysis to determine sources and best mitigation solutions. Arctic Council Secretariat (2017) EXPERT GROUP ON BLACK CARBON AND METHANE: SUMMARY OF PROGRESS AND RECOMMENDATIONS 2017. [Durwood Zaelke, United States of America]	Noted - we phrased this point more generally in the revision and explicitly talk about health co-benefits acknowledging that the relationship is unarguably positive. However, we still think that more research could be done to improve the knowledge base on the health co-benefits and flag this as well.
13988	82	21	82	27	Reducing SLCPs could be one way to reduce the reliance on negative emissions in a 1.5°C pathway, but in the absence of economic incentives, more evidence is needed, particularly from developing countries, to support the argument that targeting SLCP reduction also generates significant co-benefits (e.g., better health outcomes, agricultural productivity improvements). New research that helps articulate how SLCP reduction polices can be aligned with concerns at scale would facilitate such an integration. Frameworks are needed that help integrate SLCPs into emissions accounting and reporting mechanisms at international level and a better understanding of the links between Black carbon, air pollution, climate change and agricultural productivity must be achieved. Again, please mention that if you target BC or air quality, you are likey to make climate worse, as in the net, aerosols cool the planet and are likely to represent a bigger source of warming than co2, if we stay on a low co2 profile (e.g. Kloster et al., 2009' or just cite Myhre et al., 2013) Kloster, S., Dentener, F., Feichter, J., Raes, F., Aardenne, J. van, Roeckner, E., … Swart, R. (2008). Influence of future air pollution mitigation strategies on total aerosol radiative forcing. Atmospheric Chemistry and Physics Discussions, 8, 556305627. [Natalie MAHOWALD, United States of America]	Noted - however, this point is not a knowledge gap and thus addressed in the assessment in 4.3.6.
32296	82	24			typo: should be 'policies' not polices [Jamaica]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
47116	82	24	82	27	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted - wherever "need" still occurs it has been put into a context, e.g. to do X, one would need to know about Y.
61228	82	29	82	32	You called SRM RRM before. Be consistent [United States of America]	Accepted - we decided to keep SRM acronym, but "M" is Modification, but not Management. SRM consistently used through the report
61230	82	32	82	32	What is "objectionable mitigation obstruction"? [United States of America]	Accepted - we revised text here
31878	82	34	82	52	Importantly, the 'knowledge gaps' section recognises that there is "a lack of 1.5°– specific literature... on lifestyle and behavioural change". I suggest it is important to stress here that the types of behaviour and lifestyle change that would likely be associated with meeting 1.5C - e.g. large reductions in consumption of goods and services (embodied emissions), changes to diet, changes to mobility, etc. - are critically under-researched and poorly acknowledged, both in terms of their determinants and interventions or policies designed to influence them. This is covered in DOI: 10.1080/17583004.2015.1020011 [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Noted, examples of relevant behavioural options are presented in Table 4.8 and Figure 4.3 in section 4.4.3
61232	82	45	82	51	There are several strong and important points made here about what is and is not known/well-researched for adaptation. Recommend that these concepts be worked in earlier in the chapter as well, page 58 line 20 through page 65 line 46. [United States of America]	Rejected - the proposed section in question is 4.4.3 which provides an overview of what we do know, not what knowledge is needed.
57388	82	49	82	51	This western-centric limitation needs to be adressed already earlier, in the respective sections where the literature is assessed. [Hans Poertner, Germany]	Noted, as this is a general observation, we prefer to discuss it in the knowledge gaps sections
7128	82	50	82	51	A term missing is - business models. Adaptation axctions driven by business models in the private sector, as these are the ways in which firms are mobilizing resources, reconfiguring risk and reorganizing supply chains. How are these changing? These will have more focus on economic drivers, than solely organizational changes that might focus on processes. [Jose Di Bella, Canada]	Noted - in the newly organized section, this point is under "enabling conditions", distributed between "governance" and "institutions" and applying as well to mitigation.
55122	83	3	83	7	I suggest referencing Dagnet et Al. 2016 (Dagnet, Y., D. Waskow, C. Elliott, E. Northrop, J. Thwaites, K. Mogelgaard, M. Krnjaic, K. Levin, and H. McGray. 2016. “Staying on Track from Paris: Advancing the Key Elements of the Paris Agreement.” Working Paper.Washington, DC: World Resources Institute. Available online at http//www.wri.org/ontrackfromparis). In this paper the authors show that in line with the elevated status of adaptation in the Paris Agreement, the associated transparency provisions convey a willingness to create more parity between mitigation and adaptation actions. However, the requirements for enhancing transparency of adaptation actions remain quite generic and elusive. It is not clear how the reporting requirements under the transparency provisions differ from the requirements to communicate adaptation efforts or to inform on the national planning process, as outlined under the adaptation provisions. Guidance will be required from adaptation experts and the Adaptation Committee on how monitoring and evaluation of adaptation action can be further advanced and reflected in the revised reporting requirements. [Yamide Dagnet, United States of America]	Taken into account - even though we couldn't take up more non-peer-reviewed literature and also don't cite additional literature in the knowledge gaps section, we have added an extended point on monitoring and evaluation, not only for adaptation, but also for mitigation, as we think this is a good point.
61234	83	9	83	19	This paragraph could be combined with the one beginning at line 34 on page 82. [United States of America]	Noted - this is a good suggestion. However, a complete restructuring of this section into a table means that we couldn't apply this here.
61236	83	14	83	19	There are several strong and important points made here about what is and is not known/well-researched for adaptation. Recommend that these concepts be worked in earlier in the chapter as well, page 58 line 20 through page 65 line 46. [United States of America]	Rejected - the proposed section in question is 4.4.3 which provides an overview of what we do know, not what knowledge is needed.
47184	83	16	83	16	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted - wherever "need" still occurs it has been put into a context, e.g. to do X, one would need to know about Y.
13238	83	32	83	32	Delete the text "and the risks of lock-in". [Eleni Kaditi, Austria]	Accepted
6138	83	35			The categorisation, while useful for communication purposes, runs the risk of comparing apples and pears, or coming across as biased/arbitrary, as, for example, solar PV and CCS in the power sector are both categorised as medium in terms of technical and economic feasibility, and bioenergy is the only option with three red categories. Also the timeframe considered is not made explicit. It would make sense to indicate whether immediate feasibility is considered and whether the timeframe applied is the same for all mitigation options. Also, the section does not go into any discussion of regional differences or differences in feasibility across major groups of countries. [Anne Olhoff, Denmark]	Accept. We have improved the robustness of the assessment in the following way: • We have made the assessment much more robust and transparent than in the SOD. The assessment at the indicator level is backed up by literature sources (tables in the supplementary material). Three people have independently looked at it. If we don't feel an assessment is robust, we exclude the option from the table. • We include an evidence and agreement statement on each option that is assessed • We include caveats that this is illustrative and context-dependent in captions and text. • We will avoid the traffic light colours, as they are perceived as judgmental, and replace them with shading • We will add a column with a few words illustrating what the main contextuality is of that option: what contextual factors are affecting the feasibility of this mitigation or adaptation option. These can be technical or geographical, but also related to capabilities or so. • We have added categories NA (not applicable) and NE (No evidence) or LE (low evidence). If many of the indicators in a specific feasibility dimension (see the current 4.5.1 for those indicators) We link the NE and LE with the Knowledge Gaps section.
18664	83	35			The categorisation, while useful for communication purposes, runs the risk of comparing apples and pears, or coming across as biased/arbitrary, as, for example, solar PV and CCS in the power sector are both categorised as medium in terms of technical and economic feasibility, and bioenergy is the only option with three red categories. Also the timeframe considered is not made explicit. It would make sense to indicate whether immediate feasibility is considered and whether the timeframe applied is the same for all mitigation options. Also, the section does not go into any discussion of regional differences or differences in feasibility across major groups of countries. [Andrea TILCHE, Belgium]	Accept. We have improved the robustness of the assessment in the following way: • We have made the assessment much more robust and transparent than in the SOD. The assessment at the indicator level is backed up by literature sources (tables in the supplementary material). Three people have independently looked at it. If we don't feel an assessment is robust, we exclude the option from the table. • We include an evidence and agreement statement on each option that is assessed • We include caveats that this is illustrative and context-dependent in captions and text. • We will avoid the traffic light colours, as they are perceived as judgmental, and replace them with shading • We will add a column with a few words illustrating what the main contextuality is of that option: what contextual factors are affecting the feasibility of this mitigation or adaptation option. These can be technical or geographical, but also related to capabilities or so. • We have added categories NA (not applicable) and NE (No evidence) or LE (low evidence). If many of the indicators in a specific feasibility dimension (see the current 4.5.1 for those indicators) We link the NE and LE with the Knowledge Gaps section.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
54098	83	35	88	38	This section presumably uses 'institutional' or 'socio-cultural' partly as a euphemism for 'political'. Making the political tensions explicit several of the feasibility aspects - nicely summarised in the colour coding - could be critically discussed. On-shore wind is a case in point. It may be institutionally feasible (because all mechanisms to implement it exists) but at the same time it may encounter serious political opposition that in some cases may bring it close to the social 'non-feasibility' of nuclear. And vice versa - in some countries political feasibility of nuclear energy may still be very high (Russia as an example, even Finland to a degree) [Mikael Hildén, Finland]	Accept. We tried to accommodate this by the contextuality column.
50098	83	35	84	48	This discussion of feasibility of mitigation options is very superficial and intransparent. As this is essentially based on expert judgement, a much more elaboarte explanation of the considerations of the different criteria for each of the options and the weight factors used for the various criteria should be used. Figure 4.5 shows how useless the current exercise is, as most options end up as moderately feasible and "good" or "bad" judgements are raising questions. Repairing these deficiencies would require a lot of work and can essentially not be reviewed anymore, as this is already the second order draft. In light of my comments on section 4.3, it is therefore questionable whether this section (and section 4.3) should be retained. [Bert Metz, Netherlands]	Accept. We have improved the robustness of the assessment in the following way: • We have made the assessment much more robust and transparent than in the SOD. The assessment at the indicator level is backed up by literature sources (tables will go in the supplementary material). Three people have independently seen it. If we don't feel an assessment is robust, we exclude the option from the table. • We will include an evidence and agreement statement on each option that is assessed • We will include caveats that this is illustrative, context-dependent, and not all imaginable options (we'll make up better wording) in captions and text. • We will avoid the traffic light colours, as they are perceived as judgmental, and replace them with shading • We will add a column with a few words illustrating what the main contextuality is of that option: what contextual factors are affecting the feasibility of this mitigation or adaptation option. These can be technical or geographical, but also related to capabilities or so. • We have added categories NA (not applicable) and NE (No evidence) or LE (low evidence). If many of the indicators in a specific feasibility dimension (see the current 4.5.1 for those indicators) We link the NE and LE with the Knowledge Gaps section.
30694	83	38	83	39	Is there a more recent estimation ? [France]	Noted. Not sure what the comment is about. In any case, the text was removed for reasons of page limitations.
10128	83	41	83	43	The feasibility question for this special report was meant to address the feasibility of 1.5c warming. The assessment here as summarized by the text in this subsection, the figures, and the box does not seem to be 1.5c -specific but rather a general characterization. The critical question that need to be answered is not how feasible these mitigation options per se but rather how feasible their scale up and potentials to transit from 2c to 1.5c (i.e., incremental)?. This question remains not answered yet by the analysis provided in this section and the whole chapter. [Saudi Arabia]	Taken into account. The approach to the 1.5C and feasibility questions is discussed in cross-chapter box 1.3, in chapter 2 and in 4.2. The options assessment is intended as an indication of where barriers to speedy upscaling are.
28716	83	41	86	5	Suggest deletion of this whole section. It is very unclear what method was used to establish these feasibility categories and what thresholds of a particular indicator determine if it is scored a 1,2 or 3. Box 4.1 does not sufficiently describe the method. Particularly the Figure 4.5 seems overly simplified and subjective. Please see also our general comment regarding this issue on the entire chapter. [Germany]	Reject, but we have taken this and other comments very seriously. We also got comments that such an assessment has value. We therefore have improved the assessment in the following way,: • We have made the assessment much more robust and transparent than in the SOD. The assessment at the indicator level is backed up by literature sources (tables will go in the supplementary material). Three people have independently seen it. If we don't feel an assessment is robust, we exclude the option from the table. • We will include an evidence and agreement statement on each option that is assessed • We will include caveats that this is illustrative, context-dependent, and not all imaginable options (we'll make up better wording) in captions and text. • We will avoid the traffic light colours, as they are perceived as judgmental, and replace them with shading • We will add a column with a few words illustrating what the main contextuality is of that option: what contextual factors are affecting the feasibility of this mitigation or adaptation option. These can be technical or geographical, but also related to capabilities or so. • We have added categories NA (not applicable) and NE (No evidence) or LE (low evidence). If many of the indicators in a specific feasibility dimension (see the current 4.5.1 for those indicators) We link the NE and LE with the Knowledge Gaps section.
3950	83	45	84	2	The political economy feasibility of energy transitions is not raised in this paragraph. This may be the energy sector's biggest feasibility threat. (See Baker, L., Burton, J., Godinho, C et al (2015) The political economy of decarbonisation: Exploring the dynamics of South Africa's electricity sector. Energy Research Centre working paper. and Baker, L. (2012) Power shifts? The political economy of socio-technical transitions in South AFrica's electricity sector. [Doctoral Thesis, University of East Anglia]. [Emily Tyler, South Africa]	Taken into account. This is part of section 4.4.1.
7780	83	45			The narrative lists disparate elements of energy system transitions but does not properly convey the unprecedented speed, depth, and interactivity of the expanding-returns revolutions in a wide range of interlocking technologies from disparate industrial sectors. The big story is far richer than is conveyed here. The innovation now transforming the competitive landscape is as much from design and new business models as it is from technology and policy. For example, design and business-model innovations assembled by a recent RMI industry charrette can reduce the unsubsidized levelized cost of PV power from a ~0.5–1-MWe distribution-connected community power block to ~USD20/MWh. Similar techniques can cut the cost of African PV minigrids to half the current best or one-fourth the current average: J. Agenbroad et al., Energy Within Reach, Rocky Mountain Institute, 2017, https://www.rmi.org/insights/reports/energy-within-reach/. Emphasis largely on technology and policy misses much of the story. [Amory Lovins, United States of America]	Taken into account. This is done in section 4.2.
12952	83	45	87	18	This section has no citations and makes it difficult to determine the source of the analysis and unclear why all energy system for technical and economical are medium feasiblity when PV deployment has increased significantly . [Saint Kitts and Nevis]	Accept. See response to comment 28716
32198	83	45	87	18	This section has no citations and makes it difficult to determine the source of the analysis and unclear why all energy system for technical and economical are medium feasiblity when PV deployment has increased significantly . [Jamaica]	Accept. See response to comment 28716
36564	83	45	87	18	This section has no citations and makes it difficult to determine the source of the analysis and unclear why all energy system for technical and economical are medium feasiblity when PV deployment has increased significantly . [Snaliah Mahal, Saint Lucia]	Accept. See response to comment 28716
58630	83	45	87	18	This section has no citations and makes it difficult to determine the source of the analysis and unclear why all energy system for technical and economical are medium feasiblity when PV deployment has increased significantly . [Donovan CAMPBELL, Jamaica]	Accept. See response to comment 28716
8092	83	46	83	46	options assessed: what about offshore wind and EV? Costs are dropping quickly. [Quentin Perrier, France]	Taken into account in the figure.
30684	83	46	83	47	What about offshore wind and EV? Costs are dropping quickly. [France]	See response to 8092

Comment No	From Page	From Line	To Page	To Line	Comment	Response
36724	83	46	83	47	The exclusion of offshore wind and geothermal energy from the energy transition scenarios is a major limitation that should be acknowledged more explicitly in this section and other parts of the report. These technologies could make significant contributions to 1.5 C emission reduction scenarios [Steve Clemmer, United States of America]	Taken into account. This is addressed at the start of 4.3, and in 4.5.1.
61238	83	46	83	47	Why are these the only options assessed? The 1.5°C pathways have others (e.g., hydrogen, biofuels, demand-side changes). [United States of America]	See response to 36724.
17670	83	47	83	49	Renewables such as wind and solar should not be in the same category/classification of CCS, given the rapid growth in renewables in recent years (UNEP report: Global Trends in Renewable Energy Investment 2017: http://web.unep.org/technology/global-trends-renewable-energy-investment-2017) and the fact that CCS development is still facing many constraints (Section 4.3.2.3). While renewables deserve a higher category/classification than "medium feasibility", CCS cannot be considered on its way to scalability and maturity according to the assessment in Section 4.3.2.3. [Sai Ming Lee, China]	Taken into account. See response to comment 6138 about the methodology. Although the barriers and feasibility assessment of these options is different, based on the literature, we arrive at these figures.
32116	83	50	83	51	The statement that "all options in the energy systems still need techon-economic support before they can be widely implemented" is unsubstantiated and needs to be deleted. [Jamaica]	Accept. Text removed.
36482	83	50	83	51	The statement that "all options in the energy systems still need techon-economic support before they can be widely implemented" is unsubstantiated and needs to be deleted. [Snaliah Mahal, Saint Lucia]	Accept. Text removed.
47186	83	50	83	50	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accept. Text modified to "would need to". In any case, the text was removed for reasons of page limitations.
8094	83	55	83	55	For nuclear, there is also a risk of incident/accident with severe consequences on the environment (cf. Fukushima) [Quentin Perrier, France]	Taken into account. We don't have space to address this in this much detail, but it's addressed in section 4.3.1.
52250	83	55	84	1	It is grossly inaccurate to characterize the state of nuclear waste disposal in this way. Review, for example, the NWMO's 'choosing a path forward': https://www.nwmo.ca/~/media/Site/Reports/2015/11/11/06/53/342_NWMO_Final_Study_Summary_E.ashx?la=en and https://www.iaea.org/OurWork/ST/NE/NEFW/Technical-Areas/WTS/disposal.html. Nuclear waste becomes less hot with age, this means that nuclear waste must be stored above ground for decades before burying it. Nuclear power is now of an age where we can start looking at burying the waste. To start burying waste before 2020 would always have been irresponsible. The nuclear industries in the 30 different countries with nuclear waste have all come up with almost exactly the same plan for disposing of nuclear waste: store it safely above ground and then bury it deep underground. They're doing it safely and economically. The waste disposal has been paid for, the plans are going forward. In Canada there are several host communities that are all fighting desperately to try to get nuclear waste buried in their backyards. They absolutely want, demand and are even competing for the right to have spent fuel being buried in their backyards. This report is grossly mis-characterizing the state of affairs and I implore you to speak with actual experts on the subject, like the IAEA, before making such egregiously defaming statements. [Jason Donev, Canada]	Noted. Since we are not aware of new developments since AR5 on waste disposal, we are relying for the assessment on AR5. It's not unfair to indicate that storing nuclear waste for very long times entails an environmental risk.
62216	83	55	83	55	Solar PV in its large majority (silicium cristals) does not imply toxic waste. Only exotic kings of modules do. This sentence should be modified. In the case of offshore wind power the environment impacts seem not higher than onshore. [Antoine Bonduelle, France]	Taken into account in the feasibility assessment, conforming to what the literature indicates.
13356	84	1	84	45	Again, excessive weight is perhaps placed on public acceptability and CO2 storage risks issues for CCS, as opposed to instutitional opposition from emitters and underwhelming commitment by government to deliver (through appropriate regulation/funding) on stated intentions such as G8 2008 and subsequent national and EU CCS demonstration objectives. [Scott Vivian, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We have made an assessment of the literature in section 4.3 (on CCS in power and industry). In any case, the text was removed for reasons of page limitations.
52252	84	1	84	1	Please cite the innacurate claim that nuclear waste has no plans going on. Please find an authoratitive source when doing so. [Jason Donev, Canada]	Unclear. Not sure what this comment refers to. In any case, the text was removed for reasons of page limitations. Nuclear energy is discussed in section 4.3.1.
62028	84	1	88	37	This whole section has no reference and no use of the calibrated IPCC language and is not linked to earlier sections. Difficult to find traceable accounts. [Valérie Masson-Delmotte, France]	Accept. See response to comment 6138.
28718	84	7	84	7	Please consider to delete "(political support") or subsume it under socio-cultural factors. Institutional factors refer mainly to political factors (e.g. rules and governance capacities to enforce those rules). [Germany]	Accept. Words removed. In any case, the text was removed for reasons of page limitations.
53242	84	7	84	10	relevant to *Bioenergy carbon impacts* This section betrays the incorrect assumption by the authors that bioenergy is assumed to be carbon neutral if biomass is sustainably harvested. The section states, "It is clear that bioenergy has feasibility challenges along institutional (how to make sure the biomass is sustainably grown), socio-cultural (social co-benefits and public perception), as well as environmental (biodiversity, water use) characteristics" Of course, this is a fallacy – to begin with, "sustainable" biomass is not defined, and even if it taken in its strictest sense, whereby harvesting levels remain lower than new growth, any increase in harvesting still represents a net transfer of carbon to the atmosphere unless growth rates increase commensurately. Also, the report never discusses anywhere the fact that many forms of bioenergy have large net emissions impacts that persist for decades to more than a century, even when feedstocks are assumed to grow back. Given that Sabine Fuss is a co-author on both chapters 2 and 4, we don't understand why the report doesn't do a better job of including material that is in the paper submitted by Fuss et al. that is cited elsewhere in the report. For instance, Fuss et al (submitted) shows that the authors understand that for bioenergy to produce a carbon benefit, biomass used with BECCS must be ADDITIONAL - "The concept of BECCS rests on the premise that bioenergy can be provided with zero or at least low carbon emissions, i.e. about as much additional CO2 is sequestered above baseline when growing additional biomass as feedstock, as is released during its combustion or other energy conversion processes." Currently, in real life, biomass is generally not sourced from "additional" feedstocks that were planted to provide fuel and "pre-sequester" CO2. Instead, new bioenergy capacity is being met with fuel from native forests and existing plantation forests that were planted for pulp but have been allocated to bioenergy (so that the pulp and paper industry then has to look elsewhere, including native forests, for feedstock). The report needs to do a better job of explaining the concept of additionality and the assumptions it entails. [Mary Booth, United States of America]	Partially accept. See the assessment in 4.3.1, and in the Supplementary material. In any case, the text was removed for reasons of page limitations.
61240	84	10	84	11	It wasn't clear at all from section 4.3.3 that bioenergy is "contested". [United States of America]	Taken into account. The text on this (now in 4.3.1) and is fairly clear that there is a degree of contestation going on around bioenergy. The assessment in the supplementary material has much literature describing the origin.
28720	84	11	84	13	This is unclear: why should certification (audit for compliance of management with a set of guidelines) be limiting? The application of a certain management does not rely on the audit. [Germany]	Accept. Removed.
30686	84	15			We suggest to rename it to better emphasize buildings. [France]	Reject. We have consistently used urban transitions as taking a more systemic perspective. However, in any case, the text was removed for reasons of page limitations.
16536	84	16	84	16	This section should consider the need for changes in urban water infrastructure to address water availability consistent with section 4.3.4.7 and Table 4.10. [Australia]	Taken into account in section 4.3.2 and in in the adaptation section (4.5.3). The text here was removed for page limitation reasons.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
53152	84	16	84	16	The section should acknowledge that Evs' environmental benefits are also dependent on the carbon intensity of the electricity grid. If the grid is "dirty" (i.e. above 600 tCO2/GWh), then EV's will not bring about net reductions in CO2. [Westphal Michael, United States of America]	Taken into account in the context of the feasibility table.
56394	84	21	84	23	This sentence is speculative. It seems oversupportive of fuel cell vehicles (I have been following the advances on hydrogen fuel cell vehicles for more of a decade). Fuel cell vehicles also use rare resources (even if the platinum content of fuel cells has been reduced recently) and have the infrastructure issue. Moreover, there have also been advances on the materials of batteries. I advice to refrain saying fuel cell vehicles "are more feasible". This sentence is also not consistent with Figure 4.5, comparing lines "Electric transport" and "Fuel cell vehicles". [Nuno Bento, Portugal]	Accept. FCV removed. In any case, the text was removed for reasons of page limitations.
52254	84	22	84	25	These claims are easy to make, but need to be cited. Are they 'what everyone knows' or have they been looked at carefully? [Jason Donev, Canada]	Noted. The citations are in the Supplementary Material.
7782	84	23			Lithium is not rare and (like cobalt) is not necessary. Please see my comments above on 4-17:22–35 and my FOD comment on 4-20:2. [Amory Lovins, United States of America]	Taken into account. Not all batteries are Li-ion ones. In any case, the text was removed for reasons of page limitations.
56396	84	24	84	25	Even though there is little literature on consumer goods, it does not reduce their importance and potential for emissions reduction. A recent calculation (publication forthcoming) shows that energy consumption per capita is actually higher in consumer goods than for other energy services such as mobility or thermal comfort. The big question is how fast the stock of appliances convert to the highest energy efficiency standards (including the reduction in the wasted energy in stand-by) in developed countries and how short can be the time lag for the adoption of highly efficient devices in developing countries. Reference can be (for now) Ürge-Vorsatz, D. et al. in Global Energy Assessment - Toward a Sustainable Future 649-760 (Cambridge University Press, and the International Institute for Applied Systems Analysis (IIASA), 2012). and Cabeza, L. F., Urge-Vorsatz, D., McNeil, M. A., Barreneche, C. & Serrano, S. Investigating greenhouse challenge from growing trends of electricity consumption through home appliances in buildings. Renewable and Sustainable Energy Reviews 36, 188-193 (2014). [Nuno Bento, Portugal]	Noted. The text was removed so the comment has become obsolete.
30688	84	27	84	29	It should be underscored that investment costs are too high in the short term [France]	Accept. Text added. However, the text was removed for reasons of page limitations.
62218	84	29	84	29	low and zero energy buildings are mandatory by law for new buidings in France, in Germany, Switzerland and Scandinavia. It is thus not "under development". This part of the sentence should be at the least: "for many consumers the cost remain high although they are now being implemented in several countries"... [Antoine Bonduelle, France]	Accept. Some text added. However, the text was removed for reasons of page limitations.
33140	84	31	84	38	this section on industrial transitions needs to make reference to the literature on just transition. [Tara Shine, Ireland]	Noted. This is a developing field that is not yet firmly discussed in the peer-reviewed literature. To be taken up in AR6.
45970	84	31	84	31	Please also add solar thermal process heating for low to medium temperature heat. [Deger Saygin, Turkey]	Noted. This is relevant but we did not assess it, see section 4.3.
11064	84	33	84	34	bio-based, electrification, hydrogen and CCS are needed. [Wilfried Maas, Netherlands]	Accept. Text revised. However, the text was later removed for reasons of page limitations.
6430	84	34	84	37	Both judgements on the economics of CCS (positive) and of renewable-based electricity or hydrogen are way too general to be true. To capture most of emissions from steel making you need many capture systems. Conversely, renewables-based electricity can at some times be cheap, or be used with very efficient devices (e.g. mechanical recompression of vapour). In areas with good resources the production of green ammonia from renewables can now compete with NG reforming, etc. (Philibert, 2017). Please reconsider wording. [Cedric Philibert, France]	Noted. The text was removed so the comment has become obsolete.
37218	84	34	84	34	The statement that "some cases, CCS, are needed" is misleading. IEA ETP has identified CCS as the major technology to reduce emissions in industry. The current statement implies that CCS will not be widely deployed and instead hydrogen, bioenergy and electrification has more applicability. Yet the latter three in fact have lower applicability in high emisison industries such as natural gas processing, fertiliser production, cement, steel etc. [John Scowcroft, Belgium]	Accept. Text revised. However, the text was later removed for reasons of page limitations.
39282	84	41	84	44	Please ensure clarification that challenges with CO2 storage and bioenergy are physical and not just 'public perception'. This is misleading to the reader. [Lindsey Cook, Germany]	Reject. This is not consistent with the literature, and no references are given. .
63274	84	41	87	8	The issue here is not just about feasibility, it is also about capacity. Are those methods deemed most feasible collectively capable of limiting warming to 1.5degC or not, and if not what fraction of this goal presently appears infeasible? Table 4.5 may identify feasible actions (with considerbale uncertainty), but the burning question is are these implied preferred actions together sufficient and with what level of certainty? What trade-offs and sacrifices then will ultimately be required to stabilize at 1.5degC warming? [Greg Rau, United States of America]	Noted. This is what is intended in the scale vs speed figures (fig 4.6).

Comment No	From Page	From Line	To Page	To Line	Comment	Response
53246	84	41	84	48	Relevant to *Modeling assumptions about bioenergy that undercount emissions impacts* This section on feasibility could be adapted in a general section about BECCS to explain the big gap that exists between models and reality. Critical to discuss, for instance, is the fact that many of the models that propose BECCS as a "feasible" technology ignore LUC emissions, even though bioenergy can emit carbon from land-use change. For example, (Rose, Kriegler et al. 2013) looked at 15 models. Only 6 and 3 reported land-use CO2 and N2O emissions, respectively. To justify failure to count bioenergy carbon, or, to justify it being counted in a certain way, models make assumptions about bioenergy that may not be borne out in reality. The following observations are taken from supplementary material from Popp et al 2014, (Popp, Rose et al. 2014), which looks at three models and the assumptions they make around bioenergy and land-use change. a. GCAM only looks at changes in carbon stocks when there's been a change in land-use. But in fact, cutting trees for energy has substantial and long-lasting carbon emissions. And, even using residues has net emissions. E.g., (Booth 2018) finds substantial net emissions from wood residues; and (Whitman, Yanni et al. 2011, Liska, Yang et al. 2014) found that there can be substantial depletion of soil carbon when crop residues are removed as biomass fuel. This loss of carbon may have an especially intensive effect on greenhouse gas emissions to the extent that soils depleted in carbon do not retain nitrogen fertilizers; there can be increased net nitrification (Booth, Stark et al. 2005, Booth, Stark et al. 2006) and N2O loss from C-depleted soils. b. MAgPIE assumes bioenergy is supplied from "specialized grassy and woody bioenergy crops, i.e. Miscanthus, poplar and eucalyptus"- but these aren't the fuels that are being burned now. What's being burned now is native forest wood. Further, as stated in the SupplnfO, "In MAgPIE, the energy and associated emissions to dry cellulosic biomass for energy production is not considered." Yet, emissions associated with harvest, baling, transport, drying, palletization and storage can be significant, amounting to another 30% carbon emissions on top of the carbon inherent in the fuel and potentially more. c. IMAGE makes a number of assumptions about bioenergy – utilizing crops, but only on abandoned agricultural lands and non-forest lands, which holds down emissions from land conversion, and utilizing residues and woody bioenergy, but not counting lifecycle emissions from drying biomass, a large omission. Again, this means that actual emissions are likely to be at least 30% higher than the carbon inherent in the fuel itself, which in any case does not appear to be counted. Klein et al (supplementary information) state that in the ReMIND model, "Land use is not modeled explicitly (see manuscript Section 2.3 and 2.4 and SI Figure S4). The bioenergy supply curve is based on MAgPIE data. A marginal abatement cost curve for REDD is included in the model. The option of afforestation is not represented. Interactions between deforestation and bioenergy use are not explicitly captured, but bioenergy use is capped at 300 EJ/yr or 100 EJ/yr depending on the scenario. This limit applies to modern second-generation biomass including residues, but not including the traditional use of biomass" (Klein, Luderer et al. 2014). These are huge caveats that *significantly influence* the ability of models to represent the real carbon impacts of bioenergy. The report must do a better job of explaining the ways that models fall short, and why their conclusions may be limited. [Mary Booth, United States of America]	Taken into account. We could not include all issues mentioned in the comment but our assessment contrasts the IAM results on BECCS, as noted in the SPM. In any case, this text was later removed for reasons of page limitations.
17672	84	42	84	42	CCS should be put into a lower category/classification than "medium feasibility" according to the assessment in Section 4.3.2.3. [Sai Ming Lee, China]	Taken into account. We have revised the text and assessment and it should now be clear from the assessment table. However, the text was later removed for reasons of page limitations.
24390	84	42	84	43	The feasibility assessment has to be more granular and transparent. Currently, BECCS has the same assessment as renewables, yet the discussion of them in the text is entirely different. [Joeri ROGELJ, Austria]	See response to comment 6138
61242	84	42	84	42	It isn't clear from section 4.3 that BECCS only has "medium feasibilty". [United States of America]	Taken into account. We have revised the text and assessment and it should now be clear from the assessment table.
53918	85		91		I liked the feasibility figures a lot. I wonder if the colour tables and how to read figures could be put into a technical annex? [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accept. This is taken care of in a new version.
58374	85		87		The analysis behind the mitigation assessment indicators could be made clearer. Is the traffic-light system explicitly linked to what is needed for 1.5, or just an assessment of current feasibility? What is behind the results for each technology? Some of the ratings are quite surprising, especially when transferred to the graphical charts in fig 4.6. How are the contributions to scale and speed calculated? Are we talking about scale and speed for 1.5 specifically, or in general? Suggest either making the basis for this analysis much clearer, or removing the indicators. [Andrew Prag, France]	Accept. See response to comment 6138.
31554	85	1	87	18	Given IPCC rule, the IPCC works by assessing published literature and it does not conduct its own scientific research. Therefore, each element of the figures and tables must be supported by a sufficient number of literature. However, some elements are based upon either very limited number and diversity of literature or subjective judgement of the authors without detailed explanation. However, the supportive sentences for the assessments of nuclear regarding these figures are just two paragraphs in 4.3.2.6. For examples, the reason for following questions and so forth are obscure. - why the socio-cultural of nuclear is classified as low. ?See "An international comparative analysis of public acceptance of nuclear energy, Energy Policy" (Kim, Y., et al. 2014)? - why PV is more scalable than nuclear - Geophysical feasibility of dietary shift On the above reason, we would request to revise Figure 4.5, Figure 4.6, and Box 4.10 as follow. Figure 4.5, please indicate the number of articles assessed, the level of agreement as well as evidence with scale of confidence to each cell. The same comments are applicable to Figure 4.6, especially ""scalability" and ""speed" in solar snowflake and ""scalability"" in nuclear snowflake. Box 4.10 only tells how to read Fig 4.5 and Fig 4.6 and does not provide any foundations to prove the contents. As this is the very final moment of the government review process and there is no more opportunity to entirely review this special report as a whole, we would be pleased if you can modify it based on the above points. [Japan]	Accept. See response to comment 6138. We hope that we managed to make the assessment more robust than before. The nuclear energy assessment in particular has been supported by more literature than in the SOD.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12532	85	3	86	5	The authors are to be applauded for aiming to summarise all the various elements of feasibility into an easy-to-read Figure, but Figure 4.5 needs some important improvements/clarifications. First, what is "feasibility" measured relative to? Current trends or a 2C pathway, for instance? It would be interesting to see the equivalent table for 2C in any case. Second, I suspect feasiblity can vary strongly with geography and demography, and so there are risks in presenting a single result. As an example, use of bioenergy seems to enjoy fairly longstanding support in the UK - see https://www.gov.uk/government/statistics/energy-and-climate-change-public-attitudes-tracker-wave-23. Third, some of the terms need clearer explanation, such as "International transport" [United Kingdom (of Great Britain and Northern Ireland)]	Accept. See response to comment 6138.
24392	85	12	85	13	green and red are indistinguishable for people with colourblindness. [Joeri ROGELJ, Austria]	Accept. This is taken care of in a new version.
24406	85	19	85	19	There is literature showing that SLCP measures are not as effective as their technical potentials might suggest and have had disappointing results over time, and also some literature that in some contexts these disappointments might be avoided. I think this literature should be reflected in the feasibility assessment of these options. (1) Aggarwal, R.K. and Chandel, S.S. (2004) 'Review of Improved Cookstoves Programme in Western Himalayan State of India'. Biomass and Bioenergy, 27(2):131–144. (2) Pine, K., Edwards, R., Masera, O., Schilmann, A., Marrón-Mares, A. and Riojas-Rodríguez, H., (2011) 'Adoption and use of improved biomass stoves in Rural Mexico'. Energy for Sustainable Development, 15(2):176–183. (3) Ruiz-Mercado, I., Masera, O., Zamora, H. and Smith, K.R. (2011) 'Adoption and sustained use of improved cookstoves'. Energy Policy, 39:7557–7566. (4) Venkataraman, C., Sagar, A.D., Habib, G. and Smith, K.R. (2010) 'The Indian National Initiative for Advanced Biomass Cookstoves: The benefits of clean combustion'. Energy for Sustainable Development, 14:63-72. (5) Wickramasinghe, A. (2011). 'Energy access and transition to cleaner cooking fuels and technologies in Sri Lanka: Issues and policy limitations'. Energy Policy, 39:7567-7574. (6) Thomas, E., Wickramasinghe, K., Mendis, S., Roberts, N. and Foster, C. (2015) 'Improved stove interventions to reduce household air pollution in low and middle income countries: a descriptive systematic review'. BMC Public Health, 15:650. [Joeri ROGELJ, Austria]	Noted. Thank you very much for the suggestions. Most of these are pre-AR5 references; we're trying to restrict ourselves to post-AR5 ones.
10130	85	23	85	27	Box 4.10: The assessment of the speed and scale in the associated figures of feasibility seems to bel largely subjective. It is unclear how comparability across the various technologies and their options may be achieved given that different authors have to place their assessed mitigation options within the same speed-scale dimension based on their own subjective understanding of the literature and judgement of potentials and scalability compared to other options. [Saudi Arabia]	Accept. Figures are removed.
54068	85	36			In the box, CCS is by far not proven to be "green" in geophysical terms, as in the scale needed to deploy, there may not even be sufficient safe spaces. In landsystems, it should be "efficient, sustainable and just food systems" at the least; bionenergy has lots of geophysical constraints. IN CDR, BECCS should be red in Geophysical and socio-cultural columns, DACSS also (and definitely NOT green, as it is not even proved and tested, and the demand on energy could wake a strong socio-cultural opposition, biochar and its demand of monoculture plantations is not NOT green in any field, and must be red in socio-cultural, evnironmental and geophysical, as well as Enhanced Weathering, shpuld be red in economy, and in socio cultural, evnironmental and geophysical because of the large demand on energy and massive mining needed. See, among others: https://www.boell.de/en/2017/12/01/big-bad-fix-case-against-geoengineering [Elenita Daño, Philippines]	Accept. See response to comment 6138.
17912	86				Figure 4.5. seems to be very questionable. Which method is exactly behind the colors? Was this done by a single researcher? Is it based on a thorough assessment? How can this figure ever be updated? The method must be made much clearer, otherwise this is just an arbitrary assessment. [Brigitte Knopf, Germany]	Accept. See response to comment 6138.
7784	86				I can understand if you don't wish to engage on this issue, but nuclear newbuild has no business case anywhere and has never been the subject of competitive bidding into the power markets now widely prevalent. It works rather by private negotiation between exporting and importing governments, involving generally public funds and carefully shielded from market forces that it could not withstand. I would therefore colour its economics column red not yellow. See Schneider et al 2017. Conversely, the same economic forces that made electrification in primary metallurgy so successful in countries with cheap hydropower are now becoming widely available thanks to cheap windpower and even solar power, so under Industrial transition, I'd change that entry's economics column from red to yellow. [I was unable to review the rest of the report after this point.] [Amory Lovins, United States of America]	Accept. See response to comment 6138. The nuclear energy assessment in particular has been supported by more literature than in the SOD.
46994	86		86		Colourblind check for this figure. Please avoid using greens and reds together in figures as they are hard to distinguish between. [Sarah Connors, France]	Accept. This is taken care of in a new version.
54718	86				Fig 4.5 not at all readable [Qudsia Zafar, Pakistan]	Accept. This is taken care of in a new version.
11034	86	1	86	1	Consider Red for DACCS for technical given significant challenges related to the air volumes which need to be contacted for material (x00MT/a CO2) scale. Green for CCS technological (Technology is available at scale with cost reduction potential) [Wilfried Maas, Netherlands]	Noted. We have based our assessment on literature and assigning an assessment for sub-categories, supported by literature. The assessment has changed, but these suggestions did not emerge as a result.
13990	86	1	86	1	Given the new data on how much induced seismicity there can be in regions that were considered stable beforehand, is it really fair to rate CCS so positviely geophysically? Please make sure induced seismicity is discussed in more detail in the chapter. [Natalie MAHOWALD, United States of America]	Taken into account. There is much more literature indicating that it is feasible in that sense.
19176	86	1	86	30	Figure 4.5 needs revision. - firstly because the red colour implies that a number of technologies are infeasible. While difficulties regarding implementation are important, these should be framed as challenges to address (in a sustainable manner) rather than show-stoppers; - similarly the diagram needs (somehow) to incorporate another dimension, combining the existing feasibility insights with an indication of how important each technology is for achieving a 1.5°C (&/or 2°C) pathway. This should be possible given the extensive scenario comparison undertaken in Ch2. [Andrea TILCHE, Belgium]	Accept. See response to comment 6138 and to comment 31736.
24394	86	1	86	5	Each of the boxes in this figure needs a line of sight to the underlying evidence. The way it is presented now it appears to be baseless. Where insufficient scientific or other evidence is available, this should be clearly indicated, ,for example by empty or shaded boxes. [Joeri ROGELJ, Austria]	Accept. See response to comment 6138.
30690	86	1	86	5	Figure 4.5 : the criteria are unclear, and seem somewhat quite arbitrary and subjective. The use of only three level, for example, might be misleading as many technologies are yellow, although they have significant differences. Minor remark: the color are not adapted for Black-and-White printing. [France]	Accept. See response to comment 6138 and to comment 31736.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
31556	86	1	86	5	Each of feasibility scores of Figure 4.5 needs to specify the basis of literature. Please indicate how many articles have been assessed and put the number of literature to each cell or state the level of evidence, agreement, and confidence such as "limited evidence, low agreement" etc. based on literature to each cell. In figure 4.5, while?there are three low feasibility categories for bioenergy in terms of land and ecosystem transitions, there is no low feasibility for BECCS. BECCS is combination of bioenergy and CCS. We would appreciate further explanation. [Japan]	Accept. See response to comment 6138
31736	86	1	86	1	The text size in Figure 4.5 may need to be increased for legibility [Michael SUTHERLAND, Trinidad and Tobago]	Accept. This is taken care of in a new version.
35556	86	1	86	5	Many rows seem to be more ambitious than warranted. E.g. the rows for industrial energy efficiency, public and non-motorized transport, food wastage etc. [Ashok Sreenivas, India]	Noted. Not sure what is meant with the comment, as the table does not express ambition.
37098	86	1	86	5	IPCC report is supposed to be written assessing published literature, not conducting its own scientific research, Box 4.10 states that Figure 4.5 is based on literature assessment in Section 4-3 and expert judgement. However, it is not at all clear how many articles have been assessed, how expert judgement has been applied and what is the level of agreement and confidence in defining low/medium/high for each option and feasibility characteristics. In the case of nuclear section in 4.3.2,6,, there is a strong doubt that literature assessment is limited and biased to nuclear sceptic. In addition, since each technology/option has unique strength/weakness in terms of economic, technological, institutional, socio-cultural, environmental and geographical characteristic, it is doubtful whether objective comparison could be done across 32 mitigation options. For the above reason, it is advisable to delete Figure 4.5 and Box 4.10 altogether. If Figure 4.5 is maintained, the number of assessed articles, level of evidence and agreement should be put in each cell (e.g., 5 articles, limited evidence, low agreement). In addition, since this Figure could be quoted without Box 4.10, there should be a clear reference that this Figure is largely based on expert judgement immediately after the title Figure 4.5. Box 4.10 should also be entirely revised with thorough presentation on the number of articles, confidence of evidence and level of agreement for each mitigation option and feasibility characteristic. [Jun Arima, Japan]	Accept. See response to comment 6138
52256	86	1	86	1	How are nuclear 'medium feasibility' for geophysical and technical? There is a tremendous amount of uranium ore in the ground, there's much nuclear power that could come from advanced, generation IV reactors without mining any more uranium. [Jason Donev, Canada]	Taken into account. We refer to our underlying assessment, which is in the Suppl Mat of the FGD.
52258	86	1	86	1	How is CCS economically 'medium feasibility'?? This has never been shown at anything like large scale. [Jason Donev, Canada]	Taken into account. We refer to our underlying assessment, which is in the Suppl Mat of the FGD.
52260	86	1	86	1	How is grid storage economically 'medium feasibility'?? This has never been shown at anything like large scale. [Jason Donev, Canada]	Taken into account. We refer to our underlying assessment, which is in the Suppl Mat of the FGD.
61244	86	1	86	5	Could you structure section 4.3 around this table? [United States of America]	Accept. We tried to, see the structure of 4.3
61246	86	1	86	5	While the concept of this figure is quite useful, these feasibility assessments are not well introduced or justified in the chapter. For example, what does "efficient food production" constitute? A number of the assessments appear to overstate aspects of the feasibility of these measures: economic feasibility of urban planning, public transport, efficient appliances, industrial efficiency, and CCUS. If these were highly economically feasible (in other words, few economic constraints), would they not have been adopted already? The institutional feasibility of industrial efficiency and reducing food waste may only be medium, as institutional constraints are observed. The socio-cultural feasibility of reducing food waste, efficient food production, land use planning, urban planning public transport, and non-motorized transport is not uniformly high; in some communities, resistance to these approaches is encountered. In some cases, there may be geophysical constraints to urban planning due to topographic constraints. Finally, why is the technological feasibility of reducing food waste only medium and not high? [United States of America]	Accept. See response to comment 6138
62220	86	1	86	1	In the table there should be mention of offshore wind, wich has now a high degree of industrialization with over 10 000 MW installed in the North Sea and whole industries supplying it. [Antoine Bonduelle, France]	Accept. We have added offshore wind, but together with onshore wind as the assessment was broadly similar.
62222	86	1	86	1	In the table nuclear power should be in the red for economics and environment. [Antoine Bonduelle, France]	Taken into account. We refer to our underlying assessment, which is in the Suppl Mat of the FGD.
45538	86	3	86	3	This type of table has high potential, but it is not clear where the "expert judgment" comes from and how much of it is the authors opinions. Anybody (including me) could look at individual elements and disagree. It is difficuelt to reconcile with uncertainty guidance. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accept. See response to comment 6138
53154	86	38			While I applaud the approach to look at 6 dimensions of feasibility in Figure 4.5, some of the scoring seems arbitrary and not consistent with the previous assessment of mitigation options. For example, CCS is scored as either high or medium feasibility. However, 4.3.2.3 mentions the low social acceptance of CCS and the fact that several plants have been canceled in recent years due to costs. How then can the economic and socio-cultural feasibility be rated as medium? Moreover, only 2.4 MtCO3 are sequestered in the power sector today. While the geological sequestration potential may be there, how feasible is it to scale CCS to the levels needed? Bioenergy is given a low feasibility across 3 dimensions, but why not BECCS? Its environment impact is large - both in terms of food production and on emissions. 4.3.8 states that to be on a 2-degree pathway, BECCS requires 25 - 46% of arable land, which will have deleterious effects on food production and biovdiversity that can only likely be marginally offset by using degraded land. Moreover, the carbon neutrality of bioenergy is in dispute. [Westphal Michael, United States of America]	Accept. See response to comment 6138.
53156	87		87		Figure 4.6, which seems quite important to the chapter, is illegible, unreadable, and thus, unreviewable. [Westphal Michael, United States of America]	Accept. Figure is removed.
54720	87				Fig 4.6 not at all readable [Qudsia Zafar, Pakistan]	Accept. Figure is removed.
55910	87		87		Figure 4.6 Perhaps put the graphs one on top of the other, or separately, so they are bigger and can be read better [Debora Ley, Guatemala]	Accept. Figure is removed.
5382	87		87		Picture and text seems shadowing. Suggest to increase the contrast and change text colour to black [Sulistyawati Sulistyawati, Indonesia]	Accept. Figure is removed.
31558	87		87		Each judgement of Figure 4.6 needs to specify the basis of literature given IPCC rule. Please indicate how much literature has been assessed to judge ""scalability" and ""speed" in solar snowflake and ""scalability"" in nuclear snowflake and put the number of literature to each flake or state the level of evidence, agreement, and confidence such as "Much evidence, low agreement" etc. [Japan]	Accept. Assessment is improved (see response to comment 6138) and this figure is removed.
6140	87	1	87	18	Figure 4.6 is very relevant, but difficult to read in its current version. Would make sense to simplify it by providing less information (dropping the spidergrams) for each of the mitigation options. [Anne Olhoff, Denmark]	Taken into account. Because it was too subjective, the figure was removed.
8014	87	1	87	18	Fiugre 4.6 is basically unreadable, fuzzy [Christopher Bataille, Canada]	Accept. Figure is removed.
10592	87	1	87	2	Figure 4.6 and Figure 4.8 are not readable. [Hong Yang, Switzerland]	Accept. Figure is removed.
18666	87	1	87	18	Figure 4.6 is very relevant, but difficult to read in its current version. Would make sense to simplify it by providing less information (dropping the spidergrams) for each of the mitigation options. [Andrea TILCHE, Belgium]	Taken into account. Because it was too subjective, the figure was removed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
30692	87	1	87	18	The polygons are redundant with the previous figure. The scale give the wrong impression of being the same The figures and names are too small. We would advice removing this figure [France]	Accept. Figure is removed.
31738	87	1	87	1	Figure 4.6 is too small to be of any utility [Michael SUTHERLAND, Trinidad and Tobago]	Accept. Figure is removed.
52262	87	1	87	1	This picture looks fuzzy, please use a higher resolution image. [Jason Donev, Canada]	Accept. Figure is removed.
57706	87	1	18		figure 4.6 intuitive access and readability should be improved to the extent possible. [Hans Poertner, Germany]	Accept. Figure is removed.
36146	87	3	87	4	The basis for 'feasibility assessment' may be added - Is this qualitative, a review of the literature and citations. [India]	Accept. See response to comment 6138.
45540	87	3	87	3	This is very promising but needs good explanation. "Speed" and "scale" need to be defined carefully. If an option scores high on both scales does it mean that if achieved (along with other options) 15 is feasible? Or does the feasibility refer to individual options [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Figure is removed.
37100	87	3	87	18	Figure 4.6 presenting feasibility of 27 options in terms of speed and scale has the same problem with Figure 4.5. Again, it is not at all clear how many articles have been assessed, how expert judgement has been applied and what is the level of agreement and confidence in plotting each option based on speed and scale. There seems to be arbitrary judgement. Box 4.10 gives very little explanation. For the same reason as above, Figure 4.6 and Box 4.10 should be removed altogether. Alternatively, Figure 4.6 and Box 4.10 should be entirely revised presenting the number of assessed articles and level of agreement and evidence with scale of confidence for each spider diagram for each option and its speed and scale. In addition, since this Figure could be quoted without Box 4.10, there should be a clear reference that this Figure is largely based on expert judgement immediately after the title Figure 4.6. If that is the case, Figure 4.6. A-D should be magnified since current one is completely illegible. [Jun Arima, Japan]	Accept. See response to comment 6138.
61248	87	3	87	18	Figure 4.6 is very hard to read. [United States of America]	Accept. Figure is removed.
52264	87	17	87	17	Global North and Global South are somewhat offensive terms (China and India are very definitely in the Northern hemisphere, Autralia and New Zealand are clearly not). It takes a very European and US centric view of the globe. These terms are not widely used in this report and are inappropriate for what they mean. [Jason Donev, Canada]	Accept. Term removed.
57390	88	1			I would expect more specific links between the various elements under the feasibility assessment with the factors that influence implementation – i.e. how to implement the most feasible, fast, and large scale mitigation options? How does the knowledge on behaviour, barriers and enablers help for the specific options adressed here? [Hans Poertner, Germany]	Accept. This is done in this next section and in the contextuality column that we will add to the table.
31880	88	8	88	9	In drawing attention to the need for governance to engage multiple actors, it would be good to recognise the commitment to doing so in the Paris Agreeement, article 12: "Parties shall cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions under this Agreement." [Stuart Capstick, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Good point, but we are not supposed to give an assessment of the Paris Agreement's articles here, nor are we supposed to interpret them.
54436	88	8	88	8	Consider beginning this list with the following: 'political leadership and the preferences of political leaders will be central to achieving 1.5C'. This is supported by research that you refer to in section 4.4 and by additional citations that I have suggested in my comments. [Conor Little, Ireland]	Reject. This would be considered policy-prescriptive, and the point is, more carefully made elsewhere, if literature is available.
63276	88	8	88	9	How about adding that governance also needs to be efficient and not be an impediment to the rapid, safe and acceptible technical and societal transistions demanded by a 1.5degC target???? [Greg Rau, United States of America]	Accept. Efficiency added.
39284	88	21	88	32	These are important policy findings. Please highlight in SPM. [Lindsey Cook, Germany]	Noted.
52266	88	25	88	32	I am leery of this statement being 'high confidence', especially since there are no citations to it. I don't disagree with the claim, but it's not supported properly. [Jason Donev, Canada]	Taken into account. It's based on 4.4.5 and the references are found there. This is made clearer at the start of this section.
40476	88	25	88	28	“Policy instrumentation on the part of governments would benefit from carbon pricing.... However, there is high confidence that pricing alone is insufficient..”. This is not a fact but, at best, a prediction of a model with high levels of uncertainty and alternative modelling options. All these alternatives options, results, views and limitations should be mentioned when talking about carbon pricing. Extreme care needs to be taken always when generalising model projections. Additionally, uncertainty levels should be stated. [Pedro Alfredo Borges Landaez, Venezuela]	Reject. This is not the result of modelling (which usually only models a carbon price, not policy mixes, and thinks that a carbon price is sufficient) but of a rich body of economic literature, both theoretical and empirical. See section 4.4.5.
7494	88	28	88	29	Revise after "… is insufficient" as follows: "at the current levels of prices reflecting limited political will. If the political will was sufficient to implement carbon prices of several hundred $, carbon pricing would play a key role in the system change needed for staying below 1.5°C." Reason: The other policy instruments are also insufficient - where do you see the political will to introduce regulation consistent with 1.5°? [Axel Michaelowa, Switzerland]	Accept. We have removed this text altogether so this sentence has become obsolete.
28722	88	28	88	28	Insert after "incremental change but" "to current price level insufficient to" "provide….", Reference: Stiglitz et all, 2017 [Germany]	Taken into account. This section is intended as a synthesis, hence the absence of references. This is made clear in the chapeau now. Stiglitz 2017 is referenced in section 4.4.5.
7496	88	29	88	29	Insert after "below 1.5°": "International carbon markets are important to mobilize the lowest cost reductions available at any point in time and thus reduce political opposition against more ambitious mitigation targets." [Axel Michaelowa, Switzerland]	Reject. This would introduce prescriptive language. Besides, carbon pricing itself raises political opposition, especially as prices would get very high.
28724	88	29	88	29	Please insert after "1.5 °C": "International carbon markets are important to reduce the costs for mitigation and enhance the capacity of countries to raise ambition." Cf. e.g. State and trends of Carbon Pricing, 2016 (Ch 4), see also our comment for p6 ln 31/32. [Germany]	See response to 7496
986	88	31	88	31	which could be organised by' should be 'it could be organised by' [Robert Shapiro, United States of America]	Accept. Edit made.
61250	88	31	88	32	Incomplete sentence. [United States of America]	Accept. Sentence revised, thank you for the comment.
6142	88	41			While the caveats of this section's findings are made clear, it also renders the section open to queries regarding its overall relevance. It is particularly striking that there is no discussion of how the feasibility under 1.5 compares to feasibility under higher warming scenarios. As in the mitigation section, there is no discussion of the timeline assumed and the timeline in which the respective adaptation options would become more pressing. [Anne Olhoff, Denmark]	Noted. Unfortunately, there is no literature that we know of that addresses this important question.
18668	88	41			While the caveats of this section's findings are made clear, it also renders the section open to queries regarding its overall relevance. It is particularly striking that there is no discussion of how the feasibility under 1.5 compares to feasibility under higher warming scenarios. As in the mitigation section, there is no discussion of the timeline assumed and the timeline in which the respective adaptation options would become more pressing. [Andrea TILCHE, Belgium]	Noted. Unfortunately, there is no literature that we know of that addresses this important question.
49052	88	41	88	54	This section should address the need for transformational adaptation more fully, particularly given the potential need to address how to shift livelihoods, crop types, and even locations of communities. It should also address the need for planning that assesses and responds to climate impacts in long-term time horizons. [David Waskow, United States of America]	Accepted - Transformational adaptation is addressed here and in Section 4.2

Comment No	From Page	From Line	To Page	To Line	Comment	Response
54100	88	41	94	9	See previous comment on the need to explicit consider political feasibility. Because political feasibility depends on windows of opportunity it is probably not possible to enter it as a category in the colour coded table, but the text should refer to its often overriding importance. [Mikael Hildén, Finland]	Accepted - definition provided in the text
63278	88	41	91	70	I see no discussion of the capacity of adaptation to couner the effects of a warming world?! While there may be feasible ways to counter/endure some climate effects, the obvious question is to what degree can adaptation be effective in overcoming the impacts of a >=1.5deC warmrer world, and at what price???? [Greg Rau, United States of America]	Taken into account. Chapter 5 has a cross-chapter box on limits to adaptation.
16538	88	43	88	45	The quote "enhance adaptive capacity, stengthen resilience, and reduce vulnerability" is incorrect. It should read "enhancing adaptive capacity, strengthening resilience and reducing vulnerability". [Australia]	Accepted - text has been modified as suggested
47188	88	51	88	51	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted - text has been revised
11162	89				The font size of the texts in Figure 4.7 is too small. [mikiko Kainuma, Japan]	Accepted - text will be improved. Each assessment has a line of sight that will be included in an electronic annex and the process of the feasibility analysis is also explained in the introduction to 4.5
46996	89		89		Colourblind check for this figure. Please avoid using greens and reds together in figures as they are hard to distinguish between. [Sarah Connors, France]	Taken into account. Chapter 5 has a cross-chapter box on limits to adaptation.
53158	89		89		I don't think the case is made in previously in the document that green infra should be marked as low feasibility on the institutional level. [Westphal Michael, United States of America]	Accepted - definition provided in the text
16540	89	1	92	20	Process to determine feasibility must be explained and results justified. Many of the assessments in Table 4.9 seem surprising. [Australia]	Taken into account - assessments are being revised and the special report will have an annex with the line of sight of each assessment. Each assessment has a line of sight that will be included in an electronic annex.
16542	89	1	92	20	Sustainable land management should be included as a specific strategy. [Australia]	Accepted - definition provided in the text
19178	89	1	89	30	Same comment as applied to Figure 4.5. Figure 4.7 needs revision. - firstly because the red colour implies that a number of options are infeasible. While difficulties regarding implementation are important, these should be framed as challenges to address (in a sustainable manner) rather than show-stoppers; - similarly the diagram needs (somehow) to incorporate another dimension, combining the existing feasibility insights with an indication of how important each option is for achieving a 1.5°C (&/or 2°C) pathway. This should be possible given the impact-by-impact analysis undertaken in Ch3. [Andrea TILCHE, Belgium]	Taken into account: Figure no longer in text
61252	89	1	89	17	While the concept of this figure is quite useful, these feasibility assessments are not well introduced or justified in the Chapter. For example, what does "disruptive biotech" or "crop management" constitute? A few of the assessments appear to overstate aspects of the feasibility of these measures: economic feasibility of changing the built environment or perhaps of disaster risk reduction (depending on the specific example). Other assessments appear to understate the feasibility; for example, the economic feasibility of climate services is at least medium; the technological feasibility of community-based adaptation would seem to be high; the institutional feasibility of green infrastructure could be moderate; the sociocultural and environmental feasibility of climate services is high. [United States of America]	Accepted - text will be improved. Each assessment has a line of sight that will be included in an electronic annex and the process of the feasibility analysis is also explained in the introduction to 4.5
28726	89	2	89	8	The references to Cross-Chapter Box 1.2 are not correct, it should be 1.3. [Germany]	Accepted
21562	89	7	89	12	There is not a reliable literature review on that topic. Is it possible to advise policy-makers on suppositions, with such an amount of uncertainties? [Nathalie HILMI, France]	Taken into account - assessments are being revised and the special report will have an annex with the line of sight of each assessment. Each assessment has a line of sight that will be included in an electronic annex.
61254	89	7	89	12	While there are gaps in the literature that constrain such general assessments of feasibility, a greater attention to the grey literature (which has reported on many adaptation activities around the world) might be useful. That said, in addition to the "bottom-up nature" of most evidence, the site specificity of adaptation makes such an effort challenging. [United States of America]	Accepted - text will be improved. Each assessment has a line of sight that will be included in an electronic annex and the process of the feasibility analysis is also explained in the introduction to 4.5
1664	89	13	93	15	Infomations are dupilcated in Figure 4.7, 4.8 and Table 4.8 to Table 4.11. It is suggested to simply this section. [Wenying Chen, China]	Accepted - text will be improved. Each assessment has a line of sight that will be included in an electronic annex and the process of the feasibility analysis is also explained in the introduction to 4.5
36148	89	13	89	14	The color coding in the table may be revised. Many of the legends have got mixed up. [India]	Taken into account: Figure no longer in text
54070	89	13			In box: power infrastructure should be red in socio-cultural, environmental and geophysical, because of the impacts of power lines, dams, etc. Indigenous knowledge should be GREEN on appropriate and proven technologies. Yellow is discriminatory of indigenous technologies and has unclear basis. Coommunity based adaptation should be GREEN in all lines. Also discirminatory of local community technologies to have been marked in red. Distruptive biotech should be red in across all the lines. [Elenita Daño, Philippines]	Taken into account: Figure no longer in text
31560	89	15	89	15	Each of feasibility scores of Figure 4.7 needs to specify the basis of literature. Please indicate how much literature has been assessed and put the number of literature to each cell or state the level of evidence, agreement, and confidence such as "limited evidence, low agreement" etc. based on literature to each cell. [Japan]	Taken into account - assessments are being revised and the special report will have an annex with the line of sight of each assessment. Each assessment has a line of sight that will be included in an electronic annex.
36962	89	15	89	15	Feasibility scores of Figure 4.7 include expert judgments and is not scientific, and it is greatly debatable. Therefore, Figure 4.7 should be deleted. [Keigo Akimoto, Japan]	Taken into account - assessments are being revised and the special report will have an annex with the line of sight of each assessment. Each assessment has a line of sight that will be included in an electronic annex.
57392	89	15	89	16	Table 4.7: Some options are quite specific (e.g. efficient irrigation), while others are very generalised (e.g. energy, health). Especially regarding the latter ones, it is very difficult to understand what is meant with these options. Also regional variability in feasibility (and relevance) is not considered here. [Hans Poertner, Germany]	Taken into account: Figure no longer in text
37102	89	15	89	15	Figure 4,7 presenting feasibility of adaptation options in terms of feasibility characteristic has the same problem with Figure 4.5. and Figure 4.6. Since each technology/option has unique strength/weakness in terms of economic, technological, institutional, socio-cultural, environmental and geographical characteristic, it is doubtful whether objective comparison could be done across all adaptation options. For the above reason, it is advisable to delete Figure 4.6 and Box 4.10 altogether. If Figure 4.6 is maintained, the number of assessed articles, level of evidence and agreement should be put in each cell (e.g., 5 articles, limited evidence, low agreement). In addition, since this Figure could be quoted without Box 4.10, there should be a clear reference that this Figure is largely based on expert judgement immediately after the title Figure 4.7. Box 4.10 should also be entirely revised with thorough presentation on the number of articles, confidence of evidence and level of agreement for each mitigation option and feasibility characteristic. [Jun Arima, Japan]	Taken into account - assessments are being revised and the special report will have an annex with the line of sight of each assessment. Each assessment has a line of sight that will be included in an electronic annex.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
32878	90	1	90	40	Further details may be needed to describe the process and composition of experts / background materials/references or projects who/which have participated in the development of the feasibility assessment of adaptation options. Was only based on scientific literature or it also included authors individual judgements? (if the latter was the case, how many people were consulted in such assessments? Which was the proportion of females with respect of males consulted? How many from high-income/low income countries? How many judgement iterations were carried out? … ;these are just some examples of questions which may be considered in order to make more transparent and credible the assessment process). [J. David Tabara, Spain]	Accepted - text will be improved. Each assessment has a line of sight that will be included in an electronic annex and the process of the feasibility analysis is also explained in the introduction to 4.5
52268	90	17	90	39	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Accepted, text corrected
55878	90	17	90	17	Space between where and solid [Debora Ley, Guatemala]	Accepted, text corrected
52270	90	23	91	70	These graphs are too hard to read, the fonts are too small. Can they be put 2 to a page, rather than 4? Or even 1 to a page? These are major results. [Jason Donev, Canada]	Taken into account: Figure no longer in text
36150	90	24			Agroforestry is the most feasible option with multiple benefits and it should be shown as dark green for all the dimensions. [India]	Rejected, there is literature saying that agroforestry has been slowly implanted. See section 4.3.2.
988	90	26	90	26	arecost' SPACING [Robert Shapiro, United States of America]	Accepted, text corrected
55880	90	26	90	26	Space between are and cost [Debora Ley, Guatemala]	Accepted, text corrected
57394	90	28	90	28	Need to explain what is meant with “scalability” [Hans Poertner, Germany]	Accepted - definition provided in the text
55882	90	39	90	39	Spaces between some words are missing [Debora Ley, Guatemala]	Accepted, text corrected
11164	91				The figures in Figure 4.8 are too small. [mikiko Kainuma, Japan]	Taken into account: Figure no longer in text
46490	91		91		Colourblind check failed for this figure. The greens and reds used are hard to distinguish between. [Sarah Connors, France]	Taken into account: Figure no longer in text
55912	91		91		Figure 4.8 Perhaps put the graphs one on top of the other, or separately, so they are bigger and can be read better [Debora Ley, Guatemala]	Taken into account: Figure no longer in text
13992	91	1	91	1	I think the figures, tables and boxes summarizing all the 'feasibility' issues in this chapters are really good at convening a lot of information. [Natalie MAHOWALD, United States of America]	Taken into account: Figure no longer in text
31740	91	1	91	1	Figure 4.8 is too small to be of any utility [Michael SUTHERLAND, Trinidad and Tobago]	Taken into account: Figure no longer in text
5384	91	43	91	70	Cant saw what have written in the text on the picture. Suggest to change in black also make the text larger [Sulistyawati Sulistyawati, Indonesia]	Taken into account: Figure no longer in text
6144	91	43	91	70	Figure 4.8. Compared to figure 4.6, the time dimension (speed) is missing and would also be interesting from an adaptation perspective. Given the limited evidence on cost effectiveness of adaptation options highlighted in the rest of the chapter, the robustness may be questioned, although the caption elaborates on this. As is the case for figure 4.6, figure 4.8 is also difficult to read and the level of detail could be considered. [Anne Olhoff, Denmark]	Taken into account: Figure no longer in text
18670	91	43	91	70	Figure 4.8. Compared to figure 4.6, the time dimension (speed) is missing and would also be interesting from an adaptation perspective. Given the limited evidence on cost effectiveness of adaptation options highlighted in the rest of the chapter, the robustness may be questioned, although the caption elaborates on this. As is the case for figure 4.6, figure 4.8 is also difficult to read and the level of detail could be considered. [Andrea TILCHE, Belgium]	Taken into account: Figure no longer in text
61256	91	43	91	78	Figure 4.8 is very hard to read. [United States of America]	Taken into account: Figure no longer in text
36154	92		92		Table 4.9. Add ICT and human resource development as adaptation options [India]	Rejected - these were not part of the options assessed for feasibly.
40864	92		92		Table 4.9. Consider adding ICT and human resoure developembt as adaptation options [NARESH KUMAR SOORA, India]	Rejected - these were not part of the options assessed for feasibly.
6146	92	1			The general impression from the tables in this sub-section is that most adaptation options are quite feasible, with a predominant scoring of medium and high. Given the points made regarding the general lack of knowledge and agreement among studies, it is surprising that most options also score well in terms of 'Agreement' and 'Evidence'. How useful are the tables at the level of aggregation (global) adopted? Would it be possible to introduce some kind of regional perspective and qualifications? [Anne Olhoff, Denmark]	Taken into account - assessments are being revised. We have also added a column of differentiating contexts for each assessed option.
18672	92	1			The general impression from the tables in this sub-section is that most adaptation options are quite feasible, with a predominant scoring of medium and high. Given the points made regarding the general lack of knowledge and agreement among studies, it is surprising that most options also score well in terms of 'Agreement' and 'Evidence'. How useful are the tables at the level of aggregation (global) adopted? Would it be possible to introduce some kind of regional perspective and qualifications? [Andrea TILCHE, Belgium]	Taken into account - assessments are being revised. We have also added a column of differentiating contexts for each assessed option.
11158	92	2	92	6	It is true that Section 4.3.5 deals with industrial energy system, but not so much about adaptation measure which is the thesis of this section (implementing adaptaion). Section 4.3.5 gives business continuity management, supply chain resilience or risk management as examples, but these are not directly related to energy system. Other example given In the references in Section 4.3.5 as adaptaion measures is climate finance of UNFCCC which is again not directry related to energy system. I recommend to give more direct adaptation measures of industrial energy system or revise this paragraph so that readers understand good candidates for adaptation measures of industrial energy system. [mikiko Kainuma, Japan]	Taken into account - adaptation in Section 4.3.5 is focused on reducing energy intensity in the industrial sector. The lack of literature on adaptation in the industrial sector is documented in knowledge gaps
45542	92	7	92	7	This an similar tables are great as they integrate teh uncertainty guidance. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - thank you
61258	92	7	93	11	This comment applies to Tables 4-8 through 4-11: It is unclear what decision rule is used for assessing the composite feasibility (e.g., does three highs and three mediums = a high or medium composite?). It is also unclear how cost-effectiveness was assessed. For example, there is evidence that green infrastructure is often much more cost-effective than traditional infrastructure; yet, that option is rated as "low" in cost-effectiveness, rather than "high". In general, the assessments are poorly explained. Also, note that the order of options presented does not align with Figure 4-7. [United States of America]	Noted - feasibility assessments have been revised, with details on the methodology of feasibility assessment given along with a line of sight to illustrate how feasibility statements were derived

Comment No	From Page	From Line	To Page	To Line	Comment	Response
40070	92	10		16	One driver of biodiversity loss and a potential source for response is trade. The linkages between biodiversity and trade have not yet been sufficiently examined. While not explicitly measured to date, The consumption of imported coffee, tea, sugar, and fish in developed countries carries a hidden cot in the form of threatened species located in biodiversity-rich developing countries where these commodities are produced [Lenzen et al., 2012). On study examined trade across 170 crops in 184 ecoregions and found that 19% of total global species loss 'committed to extinction' is implicated by agricultural land use change for export-oriented production [Chaudhary and Kastner, 2016). What these studies point to is how critical biodiversity protection safeguards are to the future food system and that these protections must be explicitly incorporated into trade and land use decisions as part of any climate change adaptation actions. Cited references: Lenzen, M., D. Moran, K. Kanemoto, B. Foran, L. Lobefaro & A. Geschke. 2012. International trade drives biodiversity threats in developing nations. Nature, 486: 109-112. Chaudhary, A. & T. Kastner. 2016. Land use biodiversity impacts embodied in international food trade. Global Environmental Change, 38: 195–204. [Aziz ELBEHRI, Italy]	Rejected, this is more impact (Chapter 3) than a real option. Although it could be mentioned in the section, there is no space for specific comments in this section due to the limit of words for the section.
63280	92	10	92	21	Again, while various land management approaches my have high feasibility and cost effeciveness, the bottom line is what difference can they make in avoiding or enduring a 1.5+ degC warming???? I fear very little, but where is the evidence layed out? While indigenous knowledge is obviously useful in overcoming conventional stressors, what evidence is there that it will be effective in dealing with quite unconventional anthro climate change, while satisfying SDGs? History is littered indigenous knowledge failures; how will repeating history be avoided this time (J. Diamond. 2004. Collapse: How Societies Choose to Fail or Succeed. Viking, New York)? Where is this sobering possibility mentioned in this report, and where is the call for soliciting and testing of unconventional methods made? e.g., Rau G. H., McLeod E. L. & Hoegh-Guldberg O., 2012. The need for new ocean conservation strategies in a high-carbon dioxide world. Nature Climate Change 2:720-724 [Greg Rau, United States of America]	Noted - Indigenous knowledge is now treated in a different section. Feasibility assessments have been revised, with details on the methodology of feasibility assessment given along with a line of sight to illustrate how feasibility statements were derived
9592	92	11			What does "leveraging Indigenous knowledge" mean? [Joanna Petrasek MacDonald, Canada]	Accepted - wording changed
32976	92	15			The suggestion that conservationist farming systems, including efficient livestock management, have limited capacity of scale gain is, in our view, misleading. The ABC Plan, developed in Brazil for the agricultural sector, is based largely on the ability to gain scale in the implementation of robust technologies and, among other things, advocate efficient livestock management. Therefore, I recommend excluding the reference [but have limited scalability and cost effectiveness] and replace it by something like [has been showing promising results in countries like Brazil with the implementation of their national policy to address climate change] [Brazil]	Taken into account - Section 4.5.3 explains how the assessments were carried out. Since SOD, assessments have been revised including new literature (Until Mid-May) and some ratings have changed. There is a lack of literature at the local and regional levels, therefore, assessments are global (also detailed in the knowledge gaps section in 4.6).
36152	92	18	92	20	Table 4.9: Add a footnote - 'The feasibility of different adaptation options may vary across different countries and even within a country'. [India]	Accepted - new details added on feasibility assessment methodology and how the assessments should be interpreted
51530	92	18	92	20	Community based adaptation is given as medium in terms of feasibility, cost effectiveness and low on scalability whre as there is high agreement and evidence. The feasibility depends on forms of governance, decision making, consultation and participation (and also FPIC) at the community level, coupled with indigenous knowledge and wisdom. If there is governmental support and political will community based adaptation will be highly feasible and in that case it will be highly cost effective with minimum of external financial support. Therefore, we need to change out outlook and perhaps bring in the essential conditions in to the dleiberation when we discuss feasibility of community based adpatation. [Souparna Lahiri, India]	Noted - feasibility assessments have been revised, with details on the methodology of feasibility assessment given along with a line of sight to illustrate how feasibility statements were derived
32978	92	19			Similar adjustments should be made in table 4.9 where "LOW" references should be removed. It is curious, for instance, to verify that the cost effectiveness of agroforestry systems was considered high while conservationist farming systems were considered Medium. [Brazil]	Taken into account - Section 4.5.3 explains how the assessments were carried out. Since SOD, assessments have been revised including new literature (Until Mid-May) and some ratings have changed. There is a lack of literature at the local and regional levels, therefore, assessments are global (also detailed in the knowledge gaps section in 4.6).
39286	92	19	92	20	It is not clear what 'efficient livestock systems are, when rise in livestock consumption is driving GHG emissions. Where does 'reduction of livestock reliance' come in? [Lindsey Cook, Germany]	Noted - please refer to 4.3.2 for livestock discussion
54072	92	19			Absurd to say there is high evidence and medium agreement on disruptive biotech. This is aboslutely not true. Unproven, untested technologies that have widespread socio-cultural opposition. [Elenita Daño, Philippines]	Taken into account - Section 4.5.3 explains how the assessments were carried out. Since SOD, assessments have been revised including new literature (Until Mid-May) and some ratings have changed. There is a lack of literature at the local and regional levels, therefore, assessments are global (also detailed in the knowledge gaps section in 4.6).
990	92	24	92	24	thequality' SPACING [Robert Shapiro, United States of America]	Accepted, editorial
10132	92	25	92	27	Why building and land use adaptation options are less feasible even though they are highly cost-effective and scalable? [Saudi Arabia]	Noted - feasibility assessments have been revised, with details on the methodology of feasibility assessment given along with a line of sight to illustrate how feasibility statements were derived
53160	92	31	93	1	Given that enforcement of codes can often be a major institutional challenge, I don't think financing and codes justifiably has high feasibility. Likewise, given that green infrastructure is often much more cost effective than gray infrastructure (see NYC and the protections of its Delaware watershed which obviated the need for a now treatment plant), I don't see how green infrastructure can be rated as having a low cost effectiveness. [Westphal Michael, United States of America]	Noted - feasibility assessments have been revised, with details on the methodology of feasibility assessment given along with a line of sight to illustrate how feasibility statements were derived
63282	93	2	93	15	Ditto? While "Health, social safety nets, and DRM" may be "highly feasible", to what extent are they sufficient in adpating to climate change? e.g., Cross-Chapter Box 4.4? [Greg Rau, United States of America]	Noted - feasibility assessments have been revised, with details on the methodology of feasibility assessment given along with a line of sight to illustrate how feasibility statements were derived
47190	93	13	93	13	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted, text is being revised
47198	93	13	93	13	Section 4.5.2 not just 4.5.2 [Sarah Connors, France]	Accepted
61260	93	18	93	34	This section would benefit from some additional detail. [United States of America]	Noted - the section in question is no longer in the revised text.
61262	93	24	93	24	There are also a number of case studies of adaptation actions by Indigenous peoples based, in large part, on Indigenous knowledge. [United States of America]	Noted - box 4.2 focused specifically on case studied of Indigenous knowledge focused adaptations
992	93	32	93	32	withsustainable SPACING [Robert Shapiro, United States of America]	Accepted, editorial
7130	93	32	93	32	Spaces are needed between words [Jose Di Bella, Canada]	Accepted, editorial
49980	93	33	93	34	Monitoring and evaluation (MONEV) are key performance indicator for the government on measuring the successfulness of adaptation. Can authors elaborate more on the critical components or criteria that should be considered for the MONEV. [Perdinan Perdinan, Indonesia]	Noted - this section has changed so the comment is no longer relevant here. Text has been added elsewhere on the importance of monitoring and evaluation (e.g. NDC box, 4.4.1)

Comment No	From Page	From Line	To Page	To Line	Comment	Response
40478	93	37	93	37	"4.5.3.3 Adaptation finance" It would be very useful to see in this section the estimated difference in adaptation cost from a 1.5°C world to a 2°C world. It would definitely be useful in terms of assessing the relevance of actions to avoid exceeding 1.5°C. [Pedro Alfredo Borges Landaez, Venezuela]	Accepted - this is Section 4.4.5
28728	93	38	93	42	This paragraph is partly redundant to 4.4.6.3 lines 37-42. As argued before, if numbers are used it should be pointed out that these estimations might not be very robust. [Germany]	Taken into account. Adaptation finance is no longer discussed in this section, only in 4.4.5
46464	93	38	93	40	the adaptation costs referred to are estimates for incremental costs in "developing countries", but the text does not mention that, so the reader does not know whether the figures are global figures or specific countries. Furthermore, the heading says "adaptation finance", but the cost estimates are not complemented by the provided adaptation finance, and the gap between the two. So in order to have the paragraph reflect the title, such information should be added. UNEP's Adaptation finance gap report is a key source to add this information. Furthermore, it would be appropriate to add estimates for the costs incurred through potential loss and damage which cannot be avoided through adaptation; for example UNEP's Africa Adaptation Gap 2 Report estimates that "Even if all cost-effective adaptation is realised, Africa will still suffer large "residual" damages, which are estimated to be double the adaptation costs in the period 2030-2050." https://wedocs.unep.org/bitstream/handle/20.500.11822/9328/-Africas_adaptation_gap_2_Bridging_the_gap_%E2%80%93_mobilising_sources-2015-Africa%E2%80%99s_Adapta.pdf?sequence=2&isAllowed= [Sven Harmeling, Germany]	Taken into account. Adaptation finance is no longer discussed in this section, only in 4.4.5
61264	93	38	93	42	Should include the disclaimer that such "cost assessments" face systemic challenges in isolating "adaptation" costs from baseline development costs. [United States of America]	Taken into account. Adaptation finance is no longer discussed in this section, only in 4.4.5
53162	93	38	93	42	For another cost estimate, see Asian Development Bank. 2013. Economics of Climate Change in East Asia. M.I. Westphal, G. Hughes, J Brömmelhörster, eds. Co-lead author and editor. Across 4 countries alone, the authors found that the total cost of adaptation for East Asia over the period 2010–2050 (medium climate scenario) , the cost of adaptation was $22.9 billion per year for infrastructure, $4.2 billion for coastal protection itis $4.2 billion per year, and $9.5 billion for agriculture. It should be noted that all of these studies likely underestimate the costs of adaptation, as they don't explore extreme events (e.g. cyclone, extreme flooding) very well. Lastly, DACS certainly has cost issues (perhaps upwards of $1000 t/CO2), but I would I don't think technologically its feasibility is anywhere close to "medium", given it is fairly unproven. [Westphal Michael, United States of America]	Taken into account. Adaptation finance is no longer discussed in this section, only in 4.4.5
47994	93	39	93	39	Kindly check: UNEP's Adaptation Gap report (2016) should be 2016b (Pg 183, line 29) [Sarah Connors, France]	Taken into account. Adaptation finance is no longer discussed in this section, only in 4.4.5
47192	94	1	94	1	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted - text has been revised
61266	94	1	94	5	This paragraph illustrates an overreliance on one or two pieces of literature / authors. Should delete or round out by including other well-documented issues in the literature, such as the (often crippling) uncertainty of which adaptation actions to finance and invest in today that will most cost-effectively protect against future losses that are currently unknown and difficult to quantify. [United States of America]	Taken into account. Adaptation finance is no longer discussed in this section, only in 4.4.5
30696	94	4	94	5	Clarifications should be provided here. Financing for adaptation are already directly or indirecly used to compensate the losses of affected areas. Also, specific funding are used for loss and damages (Warsaw International Mechanism for Loss and Damage) [France]	Taken into account - Loss and Damages is discussed in cross-chapter Box 12 in Chapter 5
28730	94	7	94	9	This argument deserves further elaboration please. [Germany]	Taken into account. Adaptation finance is no longer discussed in this section, only in 4.4.5
6148	94	12	96	13	This sub-section comes across as rather superficial and it overlaps completely with chapter 5. Could be deleted. [Anne Olhoff, Denmark]	Accepted. This section has been removed from Chapter 4 and relevant crosslinks to Chapter 5 have been made throughout the text.
12534	94	12	96	13	Is section 4.5.4 necessary? It would seem to overlap a lot with the remit of Chapter 5 [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This section has been removed from Chapter 4 and relevant crosslinks to Chapter 5 have been made throughout the text.
18674	94	12	96	13	This sub-section comes across as rather superficial and it overlaps completely with chapter 5. Could be deleted. [Andrea TILCHE, Belgium]	Accepted. This section has been removed from Chapter 4 and relevant crosslinks to Chapter 5 have been made throughout the text.
45544	94	12	94	12	Doesn't this overlap woth chapter 5? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This section has been removed from Chapter 4 and relevant crosslinks to Chapter 5 have been made throughout the text.
39288	94	20	94	25	This is an important policy finding. Please highlight in SPM. [Lindsey Cook, Germany]	Noted. This section has been removed from Chapter 4. Links between climate action and SDGs are detailed in the SPM under Section D
63284	94	20	94	24	In other words "We are going to hold climate goals hostage to simultaneously achieving SGDs, regardless of the risks posed to the Earth's climate by such a dual strategy, and even though SDGs are doomed without climate stabilization(?!)" Instead, I would say: In our efforts to limit warming to 1.5degC we must do so in a way that does not jeoprodize or impede, in net, the pursuit of SDGs. That is, while there may be impacts to SDGs in achieving climate goals, those impacts and costs must be weighed against the benefits to SDGs of achieving climate stabilization by selected means. We do not yet know in sufficient detail the costs, benefits, impacts and risk of many of our climate stabilization options and additional methods are likely to emerge. Therefore, broad and sustained multinational and multidisciplinary research programs are needed to better inform decisionmakers and society as to the number, benefits, effectiveness, risks, impacts, and costs of our climate stabilization options that must also respect SDGs, and other societal and environmental interests. No? [Greg Rau, United States of America]	Noted, this section has been removed from Chapter 4 and relevant crosslinks to Chapter 5 have been made throughout the text. Links between climate action and SDGs are detailed in Chapter 5.
13228	94	22	94	22	Replace "renewable" with "modern". [Eleni Kaditi, Austria]	Noted. This section has been removed from Chapter 4. Links between climate action and SDGs are detailed in Chapter 5
57396	94	25	94	25	Where is the value-added of included the reference for Mach et al. 2017 here, when the text basically simply lists the UN SDGs? [Hans Poertner, Germany]	Accept. Removed, but so has the rest of the section.
994	94	43	94	43	examples are presented' should be 'examples presented' [Robert Shapiro, United States of America]	Noted. This section has been removed from Chapter 4.
2404	94	43	50		Based on what is presented in this chapter it suggests it seems that a 1.5 compatible world is highly improbable given the complexity, combination, scale and ambition of the responses required. Is the assessment presented (i.e. that it might be possible) not too optimistic? [Debra Roberts, South Africa]	Noted. There are considerable gaps in knowledge as recorded in 4.6. Nevertheless, this adaptation assessment is based on a clear line of sight to over 650 peer reviewed publications and reflects some of the best global evidence available
36156	94	43	94	46	Add a sentence on - 'Cost effectiveness of the mitigation options' [India]	Noted. This section has been removed from Chapter 4.
58380	94	45			Suggest to add: "The IEA's new Sustainable Development Scenario shows how multiple SDGs can be achieved in parallel with climate goals, incliuding SDG 7 on energy access and SDG 3.9 on air pollution (IEA 2017f, WEO 2017). This is encouraging for showing how sustainable development synergies could be epoited in a 1.5 C world, also." [Andrew Prag, France]	Accepted - text on SDG7 added to the text
32298	94	54			should read: "(1) rapid deployment of low-emission…" [Jamaica]	Accepted - editorial
8020	95		95		Box 4.12 If desired, Costa Rica could provide an interesting and more mainstream alternative example to Bhutan [Christopher Bataille, Canada]	Noted. Bhutan is more mainstream in terms of their GHG commitment and of great interest with their GNH index.
47996	95	27	95	27	Kindly check: COP19 (2011) is not available in the reference list. [Sarah Connors, France]	Noted. Not a reference so changed text to show this.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
2226	95	30	95	36	The carbon neutral goal of Bhutan depends also on the future carbon absorption by forest in the country. Therefore, this paragraph should refer the function of forest, or climate regulation service. Clearly, this is related to co-benefits in SDGs. [Akihiko Ito, Japan]	Accepted. The Box already suggests this but text changed to make it clearer.
14232	95	31	95	31	The year of publication for the author "Yangka" is missing [United Republic of Tanzania]	Accepted. This is because the paper was not yet published. Corrected in final draft.
36158	95	31	95	31	In reference for Yangka, year needs to be added [India]	Accepted. This is because the paper was not yet published. Corrected in final draft.
48126	95	31	95	31	Year missing [Sarah Connors, France]	Accepted. This is because the paper was not yet published. Corrected in final draft.
52272	95	31	95	31	Empty (). [Jason Donev, Canada]	Accepted. This is because the paper was not yet published. Corrected in final draft.
7498	95	35	95	35	Insert after "ADB 2013": "Michaelowa et al. (2018) describe how mitigation actions can be aligned with GNH metrics for sustainable development benefits in the case of Bhutanese cities." Reference: Michaelowa, Axel; Krey, Matthias; Wong, Samantha (2018): Synergies between mitigation and SDGs: The case of human settlements in Bhutan, in: Mitigation Talks, 2, 2018, p. 12-13 [Axel Michaelowa, Switzerland]	Accepted. Added to text.
44698	95	40	95	50	Important concrete spelling-out of components of the necessary structural change, would be good if this could find its way into the SPM. [Penny Urquhart, South Africa]	Noted This section has been removed from Chapter 4. Links between climate action and SDGs are detailed in the SPM under Section D
39290	95	41	95	42	This is an important policy finding. Please highlight in SPM. [Lindsey Cook, Germany]	Noted. Links between climate action and SDGs are detailed in the SPM under Section D
40482	95	41	95	41	Protection and incorporation of local and traditional knowledge should be included. [Pedro Alfredo Borges Landaez, Venezuela]	Noted. Box 4.12 (renumbered to Box 4.10 in final draft) focusses on synergies and trade-offs around climate action, growth (GDP), and subjective wellbeing (through Gross National Happiness). The importance of local and traditional knowledge has been discussed across Chapter 4, and most explicitly in Box 4.3 titled Indigenous Knowledge and Community Adaptation
40480	95	53	95	54	Protection and promotions of indigenous and local knowledge is a necessary enabling condition, with high levels of feasibility according to what was said before in this report. This is not mentioned in this paragraph. [Pedro Alfredo Borges Landaez, Venezuela]	Noted. Box 4.12 (renumbered to Box 4.10 in final draft) focusses on synergies and trade-offs around climate action, growth (GDP), and subjective wellbeing (through Gross National Happiness). The importance of local and traditional knowledge has been discussed across Chapter 4, and most explicitly in Box 4.3 titled Indigenous Knowledge and Community Adaptation
8018	96				Cross chapter box 4.1 "Consistency …" reads easily for a nonspecialist [Christopher Bataille, Canada]	noted, not understood which change is proposed
1072	96	1	96	1	This chapter also considers RMMs' potential effectiveness in reducing climate change. [Jesse Reynolds, Netherlands]	Accept. This was corrected but then the box was removed.
37496	96	1	96	1	This chapter also addresses RMMs' potential effectiveness in reducing or limiting climate change and its impacts. [Matthias Honegger, Germany]	Accept. This was corrected but then the box was removed.
37500	96	1	96	1	This chapter also considers RMMs' potential effectiveness in reducing climate change. [Matthias Honegger, Germany]	Accept. This was corrected but then the box was removed.
7272	96	2	96	3	Or they may directly support sustainable development measures, as is said in Cross-Chapter Box 4.2, Section A. Evidence for this claim? [Ben Kravitz, United States of America]	Noted. The text was removed.
37498	96	2	96	2	To date there is no systematic assessment of SDG-implications that SRM/RMM types could pose (Honegger et al., forthcoming policy report is the first to explore various dimensions of such implications by means of a thorough literature review) and the SRM/RMM bundle of technology imaginaries does not represent fully-fledged technologies. This statement is thus way too definitive. Replace "appear to be" with "may be". [Matthias Honegger, Germany]	Noted. The upcoming study however is not peer-reviewed in the IPCC sense of the word. In any case, the text was removed.
2150	96	3			anti-SRM bias. No justification for claiming SD -ve impacts (unless implausible over-drying used) - no-losers http://www.tandfonline.com/doi/abs/10.1080/21550085.2014.926078?src=recsys&journalCode=cepe21 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accept. The statement was one-sided. It was corrected but then the section was removed.
39292	96	7	96	8	Please articulate in 'positive outcomes' how many lives and livelihoods could be saved by holding to 1.5C, and what suffering could be avoided, if you want policy makers to care, to be touched in the heart. [Lindsey Cook, Germany]	Noted. The text however was removed.
47194	96	9	96	9	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted. The text has been checked for policy prescriptiveness.
55124	96	15	101	13	Also refer to Dagnet et Al. 2016 (Dagnet, Y., D. Waskow, C. Elliott, E. Northrop, J. Thwaites, K. Mogelgaard, M. Krnjaic, K. Levin, and H. McGray. 2016. "Staying on Track from Paris: Advancing the Key Elements of the Paris Agreement." Working Paper.Washington, DC: World Resources Institute. Available online at http//www.wri.org/ontrackfromparis). [Yamide Dagnet, United States of America]	Rejected. grey literature and position paper
45546	96	17	96	17	This x-chapter box concerns only emisison aspects of NDCs and should be titled accordingly [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Rejected The box covers also Adaptation.
62030	96	17	101	12	Is there literature related to the implication of retreat from the Paris Agreement of specific countries, and of a reduced mitigation ambition compared to the INDCs formulated in 2015? [Valérie Masson-Delmotte, France]	Rejected, no space to add this requested analysis
16544	96	35	96	35	Parties put forward their own mandatory emissions reductions limits under the Kyoto Protocoll they are not "assigned". Suggested revision "The Paris Agreement departs from the prescriptive approaoch of the Kytoto Protocol, which includes legally-binding emissions limits…" [Australia]	Noted but section deleted.
1894	96	38	96	38	replace 'increased' with 'their ambitions increased'. When changing this, the whole sentence 'subsequent NDCs…' can be deleted. [Willem Pieter Pauw, Germany]	Noted, text changed therefore not anymore relevant
30698	96	38	93	38	Replace "though" by "following [a'global stocktake'] [France]	Noted, text changed therefore not anymore relevant
61268	96	38	96	40	NDCs shall be revised and increased every five years through a 'global stock take' mechanism established by the UNFCCC, supported by a facilitative dialogue in 2018, and a first formal review in 2023. This information is inaccurate, mischaracterizing the global stock take/facilitative dialogue processes, and is not outlined in the Paris Agreement. To better characterize these processes, the sentence can be rewritten to say: "According to Article 14 of the Paris Agreement, Parties will convene a "global stock take" in 2023 and every five years thereafter to take stock of the implementation of the Agreement and to assess the collective progress towards achieving the purpose of the Agreement. The outcome of the global stock take shall inform Parties in updating and enhancing their NDCs, among other factors." [United States of America]	Noted but section deleted.
16546	96	41	96	42	The quote referenced here is missing some quotation marks. It should read: …as well as to 'pursue domestic mitigation measures' to achieve the NDC's objective (no quotation mark). [Australia]	Noted but section deleted.
47118	96	42	96	42	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Noted, text changed therefore not anymore relevant

Comment No	From Page	From Line	To Page	To Line	Comment	Response
61270	96	42	96	44	Subsequent NDCs must increase in ambition and be based on the principles of 'highest possible ambition' as well as 'common but differentiated responsibilities and respective capabilities, in the light of different national circumstances'. This line is inaccurate and, to correct, should quote directly from the Paris Agreement. The Paris Agreement does not contain a statement that "subsequent NDCs must increase ambition". It would be more accurate to quote the exact Paris Agreement, and reframe this sentence to read: "According to Article 4.3 of the Paris Agreement, each Party's successive NDC will represent a progression beyond the Party's then current NDC and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances." [United States of America]	Noted but section deleted.
1896	96	53	96	55	It would be good to add this subordinate clause to the sentence: 'even if important greenhouse gas emitting sectors like transport and agriculture are not included in most of the NDCs mitigation strategies (Pauw et al., 2017 https://link.springer.com/article/10.1007/s10584-017-2122-x). Alternatively, it could also be added to p99, lines 14-19 as an example of how more ambition can be reached through updating NDCs. [Willem Pieter Pauw, Germany]	Rejected any countries have economy wide targets for their NDCs, and are not always specific about the domestic policies how they achieve these NDC targets, and do not specify as that specific sectors like agriculture and transport are excluded. I also think this is not the right place, as this sentence is about the global aggregated impact of the full implementation of NDCs. The alternative place is about enhancing NDCs, and here we only cite one paper, whereas there is much more literature on enhancing NDCs
1898	97	5	97	7	Rodriguez and Pena-Boquete (2017) only include 5 lines about the differences of China's (intensity target) and Indonesia's (BAU target) NDC are different, but it doesn't make the link to the open format for NDC formulation. A better source would be Mbeva and Pauw (2016 - https://www.die-gdi.de/uploads/media/DP_4.2016.pdf), which analyses the limited UNFCCC guidance on INDC formulation and concludes that this resulted in NDC's diverse contents and scopes [Willem Pieter Pauw, Germany]	Rejected no space to add it
38626	97	9	97	21	I think the dependence on what happens with emissions over time (after the year given in the NDCs) should be made much more clear. "comparable action afterwards" is too vague and represents a very critical point for tht estimates. [Jan Fuglestvedt, Norway]	Accepted, "a continuation of climate action similar to that of the NDCs".
3270	97	16	97	19	It should be made clear that the 550-600GtCO2 carbon budget mentioned here is till 2100, not to be confused with the 2011-2030 carbon budget mentioned in the preceding sentence. [Vassilis Daioglou, Netherlands]	Accepted, added till 2100
53510	97	24	97	25	Holz et al 2018, also provide such an estimate: 45.1Gt CO2eq when conditional NDCs are implemented and 48.9Gt if they are not (excluding bunkers) Holz, Christian; Sivan Kartha and Tom Athanasiou (2018) "Fairly Sharing 1.5 – National Fair Shares of a 1.5°C-compliant Global Mitigation Effort" in International Environmental Agreements: Politics, Law and Economics, , 18(Special Issue: Achieving 1.5°C and Climate Justice), 117–134. [doi: 10.1007/s10784-017-9371-z] [Christian Holz, Canada]	Rejected: We will not include this new study. Arguments: It should be noted that the estimates in Holz et al. are very low compared to the estimate from the median estimate of 55.2 and the range (51.9–56.2), based on ten studies. Normally, including new studies requires a procedure for checking all country results, which takes a couple of weeks, with various mail exchanges with the authors. An essential element is the information of all regional GHG emission projections, to understand better how the global estimate has been calculated. Holz et al. does not provide these details in their publication. Given time restrictions for the publication of this IPCC report, we can only include new studies, if the underlying publication include all the regional detail to understand the calculations of the global estimate. Unfortunately, this information is lacking to include this new study, and therefore we cannot include this new study. In addition, this new study is also an outlier compared to the ten studies, which makes this check of regional information even more important.
52274	97	26	97	26	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Accepted
5524	98	1	98	2	In box 2.1 fig 1, I suggest including also the full range of scenarios in each category (not just the 25 to 75% range; could do this with 2 different bar widths). I do not see the reason for omitting the full range and without the full range one cannot conclude if the NDC is inconsistent with the full range of scenarios, and it reduces the transparency of this comparison. [Haroon KHESHGI, United States of America]	Rejected, Table 2.5 also presents the 25% and 75% next to the percentile ranges. I would prefer to be consistent with Chapter 2 here
61272	98	1	98	9	In Cross-Chapter Box 4.1, Figure 1, why are the 2010 numbers depicted as a range? Is this uncertainty in the observed amount? A more complete legend would be helpful here. [United States of America]	Accepted, all NDC studies have different assumptions on the 2010 emissions. The range in 2010 emissions is in line with the uncertainty range presented in IPCC AR, but no space to expand the legend
5522	98	3	98	9	The figure caption does not appear to accurately describe the scenarios considered. As I understand this figure, it is showing the ranges of emissions for 5 categories (or groups) of scenarios and not for 5 scenarios. For each category, the median and 25-75% range of scenarios in that category are shown. Suggest changing the caption to accurately describe the range. [Haroon KHESHGI, United States of America]	Accepted, caption will be changed to reference Table 2.5 with scenarios classes
47998	98	8	98	9	Kindly check: simplifying the lines [Sarah Connors, France]	Accepted
39294	98	15	98	20	These are important policy findings. Please highlight in SPM. [Lindsey Cook, Germany]	Noted. (with thanks)
28732	98	17	103	21	Cross-Chapter Box 4.1: This box contains very valuable material to inform policymakers about the gap in global ambition following current pledges under the UFNCCC with regard to reaching 1.5C/2C or at least keeping 1.5/2C in reach. We would appreciate to see more of this material lifted to the SPM. However, Box 4.1 needs substantial revision, e.g. !1) the numbers should be updated to include chapter 2 results, 2) the rather fragmentary treatment of the Paris Agreement text needs to be revised diligently in order to make sure there are no unintended re-interpretations of the agreement's language or mechanisms; 3) in the absence of suitable scientific evidence (lack of 1.5C adaptation scenarios to compare NDC contribution against, difficulties in aggregation, gaps in reporting), it may make more sense to separate the two issues and restrict CC Box 4.1 to consistency between NDCs and mitigation scenarios, instead of having a very unequal representation of the two topics. Else one could also argue that Box 4.1 would have to assess consistency of finance with 1.5C (Art.2.1c). Please also edit Fig1 in order to clarify the source of the emission numbers in 2020 and 2030 respectively, as the current representation is confusing. [Germany]	Accepted: 1) we have checked for consistency with chapter 2 on the numbers; 2) PA section deleted. 3) Adaptation is not included in all NDC and is not quantified, hence the different length and details of the two sections.
57398	98	18	98	18	Use uncertainty language [Hans Poertner, Germany]	Accepted,

Comment No	From Page	From Line	To Page	To Line	Comment	Response
53504	98	19	98	21	two additional reference should be added that also confirm this findig: CSO Review 2015 and Holz et al 2018, both cited in chapter 5. Holz, Christian; Sivan Kartha and Tom Athanasiou (2018) "Fairly Sharing 1.5 – National Fair Shares of a 1.5°C-compliant Global Mitigation Effort" in International Environmental Agreements: Politics, Law and Economics, , 18(Special Issue: Achieving 1.5°C and Climate Justice), 117–134. [doi: 10.1007/s10784-017-9371-z] CSO Review (2015) Fair Shares: A Civil Society Equity Review of INDCs. Manila, London, Cape Town, Washington, et al.: CSO Equity Review Coalition. [civilsocietyreview.org/report] [doi:10.6084/m9.figshare.5917399] [Christian Holz, Canada]	Rejected, It should be noted that the estimates in Holz et al. are very low compared to the estimate from the median estimate of 55.2 and the range (51.9–56.2), based on ten studies. Normally, including new studies requires a procedure for checking all country results, which takes a couple of weeks, with various mail exchanges with the authors. An essential element is the information of all regional GHG emission projections, to understand better how the global estimate has been calculated. Holz et al. does not provide these details in their publication. Given time restrictions for the publication of this IPCC report, we can only include new studies, if the underlying publication include all the regional detail to understand the calculations of the global estimate. Unfortunately, this information is lacking to include this new study, and therefore we cannot include this new study. In addition, this new study is also an outlier compared to the ten studies, which makes this check of regional information even more important.
38628	98	23	97	30	I suggest moving this part (3.) up, i.e., before 2. [Jan Fuglestvedt, Norway]	Accepted
61274	98	31	98	31	It is unclear what is meant by the use of "envisioned" in this sentence. Who is doing the envisioning? [United States of America]	Noted but text changed so no more relevant
996	99	6	99	6	deeperand faster SPACING [Robert Shapiro, United States of America]	Accepted
53506	99	12	99	13	add "if near term ambition is not strengthened beyond the level implied by the current NDCs" to the sentence. (the sentence is very far from the earlier utterance "implementation of the NDCs by 2030 (but nothing more)" in line 6 so I am afraid the reader will have forgotten that frame by the time they read line 12/13) [Christian Holz, Canada]	Accepted
5526	99	17	99	17	This sentence refers to the "risk of failure" but does not quantify the risk (or is it really probability). If we do not know the probability, then it might not be accurate to assert that the risk would be reduced; I suggest that this should rather conclude the range (or window) of emission pathways would be widened. [Haroon KHESHGI, United States of America]	Accepted section deleted.
5528	99	20	100	18	I do not see the connection between this part of the discussion of NDCs and the topic of the box (consistency with 1.5) and the report more generally. Suggest deleting. [Haroon KHESHGI, United States of America]	Reject the discussion on uncertainty in NDCs is important, as we are assessing the NDC consistency with 1.5C
1900	99	21	99	23	This line could be sharpened: Some studies assume full succesful implementation of all of the NDCs' proposed measures, even though the implementation of a majority of the NDCs is conditional upon mitigation finance, adaptation finance, technology transfer and capacity building (see Pauw et al., 2016) Pauw et al., 2016: NDC Explorer. www.NDCexplorer.info [Willem Pieter Pauw, Germany]	Section deleted
1902	99	28	99	30	I think the line of argument should be turned around: 1) improved guidelines; 2) more focused energy accounting. I would add 3) increased transparency and comparability. Pauw et al. 2017 https://link.springer.com/article/10.1007/s10584-017-2122-x could be added as a reference next to Rogelj et al. [Willem Pieter Pauw, Germany]	Accepted
24396	99	34	99	35	I recently saw another paper on this topic in ERL by Benveniste et al: http://iopscience.iop.org/article/10.1088/1748-9326/aaa0b9. This could be included here. [Joeri ROGELJ, Austria]	noted but no space to add a new reference
29486	99	41	99	42	Ch 4 Current text: In addition, there are land-use mitigation uncertainties, with some literature (Forsell et al., 2016; Grassi et al., 2017), and also the literature on the impact of GWPs (UNFCCC, 2016). Addition proposed (in bold red) after the sentence above: Land-use options, and especially forestry, play a key role in the emission reductions proposed by many countries to fulfill their NDCs (i.e., up to a quarter of planned global emission reduction in 2030, Grassi et al. 2017). However, most of the scientific analyses on NDCs do not directly use land-use related emissions from country GHG inventories for their global land-use emission estimates, mainly because of the large discrepancies between scientific studies and country estimates (Rogelj et al 2011). Some study (Grassi et al. 2017) indicate that this discrepancy (about 3 GtCO2/y globally) is mainly due to different approaches in estimating the "anthropogenic" forest sink between countries and scientific studies, and highlights the need to reconcile it for the purpose of the global stocktake. I think this is important to highight the relative importance of land use (as perceived by countries) and an area of needed improvement in the light of the global stocktake REF: Rogelj J, Hare W, Chen C, Meinshausen M. Discrepancies in historical emissions point to a wider 2020 gap between 2C benchmarks and aggregated national mitigation pledges. Environ Res Lett. 2011;6(2). Grassi G., House J., Dentener F., Federici S., den Elzen M., Penman J. (2017) The key role of forests in meeting climate targets requires science for credible mitigation, Nature Climate Change, doi:10.1038/nclimate3227. [Giacomo GRASSI, Italy]	Accepted
1904	99	44	99	46	86 countries have BAU pledges. In addition, 9 have intensity targets, 2 have peaking targets and 34 do policies and actions as their main type of target in their NDC. I am not the expert, but should these be added to the argument made? See https://klimalog.die-gdi.de/ndc/#NDCExplorer/worldMap?INDC??climatechangemitigation???cat1 [Willem Pieter Pauw, Germany]	Noted but section deleted.
38630	99	48	99	48	(like Kigali) is too imprecise. Please improve. [Jan Fuglestvedt, Norway]	Noted but section deleted.
61276	99	48	99	48	Please remove the parenthetical "(like Kigali etc.)". Rationale: The cited paper seems to, incorrectly, put the Kigali Amendment to the Montreal Protocol in the same category as other initiatives such as GMI and CCAC. The Kigali Amendment to the Montreal Protocol is a part of a multilateral treaty process whereas CCAC and GMI are international initiatives with voluntary involvement of national governments, non-governmental organizations, and the private sector. [United States of America]	Noted but section deleted.
34670	99	51			Please separate every word [Mexico]	Accepted
7222	100	2	100	18	This is an important addition to the SR. I have added material to section 5.6.2 that discusses equity principles and differences in the NDCs. Let's talk. [Petra Tschakert, Australia]	Noted, thanks
53508	100	5	100	6	two additional reference are relevant here: CSO Review 2015 and Holz et al 2018, both cited in chapter 5. Holz, Christian; Sivan Kartha and Tom Athanasiou (2018) "Fairly Sharing 1.5 – National Fair Shares of a 1.5°C-compliant Global Mitigation Effort" in International Environmental Agreements: Politics, Law and Economics, , 18(Special Issue: Achieving 1.5°C and Climate Justice), 117–134. [doi: 10.1007/s10784-017-9371-z] CSO Review (2015) Fair Shares: A Civil Society Equity Review of INDCs. Manila, London, Cape Town, Washington, et al.: CSO Equity Review Coalition. [civilsocietyreview.org/report] [doi:10.6084/m9.figshare.5917399] [Christian Holz, Canada]	Accepted OK to add Holz

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45670	100	7	100	11	The end of the sentence is misleading. As it is written, the sentence implies that "(Clarke et al., 2014; Höhne et al., 2014; Kartha et al.; Stanton et al., 2009)" used the same criteria, and that "(Höhne et al., 2017; Pan et al., 2017; Robiou du Pont et al., 2016)" combine with other criteria. First of all, Katha et al., which is a critique and not an article introducing research material, did not provide an assessment framework and does not compare with the other references. Stanton et al. 2009 discussed other criteria than those the IPCC AR5 WGIII Table 6.5 (which is from 2014). Many of the models and quantifications used in Höhne et al. 2014 and therefore in Clarke et al. 2014 are using equal marginal abatement costs. The distinction brought in this sentence is misleading and erroenous. Finally, I am not sure how informative this distinction would be, even if it were done correctly. [Yann Robiou du Pont, France]	Accepted, Kartha and Stanton ref. are eliminated, plus rephrasing
45664	100	9	100	9	The list of citations to support this claim is partly erroneous and incomplete. The reference to Kartha et al refers to a document that does not provide an assessment framework. This reference leads to a critique of a single existing assessment framework and therefore does not illustrate this sentence. [Yann Robiou du Pont, France]	Accepted Kartha eliminated
45666	100	9	100	9	The list of citations to support this claim is partly erroneous and incomplete. The reference to Stanton et al. refers to a document that does not provide an assessment framework. This reference may add interesting considerations on the equity limitations of IAM models, but does not seem to illustrate this sentence.. [Yann Robiou du Pont, France]	Accepted Stanton eliminated
45668	100	9	100	9	The list of citations is incomplete, the research from Pan et al. 2017 and Robiou du Pont 2016 (DOI: 10.1038/nclimate3186) and Holz et al. 2017 seem the most appropriate references, in particular with the optic of 1.5°C warming threshold. At the moment, references to equity assessments in line with a 1.5°C warming are completely lacking in this section, which stands out given the purpose of the report. Pan et al. 2017 ((DOI: 10.1016/j.envsci.2017.04.020) models and quantifies the effort sharing catergoy introduced in IPCC AR5 WGIII Table 6.5 both under a 2°C and a 1.5°C threshold. Robiou du Pont et al. 2016 models and quantifies the effort sharing catergoies quantified in IPCC AR5 WGIII Figure 6.28, both under a 2°C and a 1.5°C threshold. Robiou du Pont et al. 2016 provides an update of IPCC-AR5 Figure 6.28 with the 1.5°C objective and compares the efforts under the well below 2°C threshold to that under the 1.5°C at the global, regional and national levels. These are important results that are in line with the objective of the 1.5°C special report. Holz et al. 2017 provides an assessment framework under one of the categories of effort sharing from the IPCC AR5 Table 6.5 and FIgure 6.28, in line with the 1.5°C threshold. There may be additional literature provide assessment frameworks under a 1.5°C threshold, but such assessments should not be overlooked in this 1.5°C special report. Additional sentences would be useful, and I suggest using figuress from Robiou du Pont et al. 2016 and Pan et al. 2017 in order to include national mitigation allocations, or Robiou du Pont et al. 2016 (Figure 1.g to 1.k DOI: 10.1038/nclimate3186) to include information at the regional level and thereby update the Figure 6.28 from the IPCC AR5 WGIII with the new 1.5°C threshold. [Yann Robiou du Pont, France]	Accepted, reference to Holz added in the previous sentence
61278	100	13	100	14	The statement "The equity principle embedded in the Paris Agreement in Article 2 on CBDRs," is overly simplified. It should be revised to read, "According to Article 2.2 of the Paris Agreement, it will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances." [United States of America]	Accepted
998	100	14	100	14	principle in embedded' should be 'principle is embedded' [Robert Shapiro, United States of America]	Noted, but sentence has been changed
16548	100	14	100	14	The sentence refering to Article 2 and its treatment of the equity principle needs to be edited for clarity. [Australia]	Accepted see reply to comment 61278
45672	100	16	100	17	The sentence is useful but the reference is not. The reference to Kartha et al refers to a document that does not provide an assessment framework as it is a critique and not an article introducing research material. This reference leads to a critique of an existing assessment framework and therefore does not belong to this sentence. There is much additional interesting literature providing framework to quantify, for example based on consumption (Davis et al. 2010, PNAS, DOI 10.1073/pnas.0906974107). [Yann Robiou du Pont, France]	Accepted, sentence eliminated as well s reference to Kartha
61280	100	20	101	13	This entire discussion of adaptation and NDCs is confused and includes various misstatements about the Paris Agreement. As a threshold matter, NDCs as described in Article 4 are focused on mitigation actions, not other actions. Article 7 refers to communications of adaptation actions and needs as "adaptation communications." These communications are not required (Article 7 says that Parties "should" submit them). Although these may be submitted with or as a component of an NDC, they also may be submitted with other documents, as explicitly recognized in Article 7. Thus, the discussion in this box about adaptation in NDCs only confuses the situation and the role of NDCs. If discussion on this topic is retained, it should be moved to a separate box and explained in its proper context. [United States of America]	Accepted, text has been revised to properly explain the voluntary nature of adaptation goals within the Paris Agreement.
1906	100	22	100	32	This section is too much about the adaptation goal and too little about the NDCs, I reckon. I would delete most of it. [Willem Pieter Pauw, Germany]	Rejected - the role of adaptation within the PA and NDCs will be reworded
61282	100	23	100	25	The language that the goal is "currently" qualitative could suggest that it would change to non-qualitative. There is no process for changing the goal other than amending the Agreement. In addition, this report should not state as fact a rationale for provisions in the Agreement as different Parties may have had different understandings or rationales for different provisions. Therefore, this should simply state: "This global goal is qualitative rather than quantitative." [United States of America]	Accepted, suggested text has been incorporated
61284	100	25	100	28	For consistency with the Agreement, this sentence should be revised to state: "Countries can include domestic adaptation goals in an adaptation communication, which can be submitted with other communications or documents, including a national adaptation plan, an NDC, and/or a national communication. Parties have flexibility to design and adjust their adaptation trajectories as their needs evolve and as progress is evaluated over time." [United States of America]	Accepted, suggested text has been incorporated
16550	100	34	100	36	Adaptation communications are voluntary under the Paris Agreement. Suggested revision: "The Paris Agreement encourages Parties to submit Adaptation Communications…." [Australia]	Accepted, suggested text has been incorporated
61286	100	34	100	36	The cited language from the Paris Agreement follows a provision that makes clear that adaptation communications are recommended ("should"), not required. Including this statement out of context that says that adaptation communications "shall" be submitted is misleading. To capture the meaning taking into account all of the relevant provisions, this should state that "under the Paris Agreement, Parties are encouraged to submit adaptation communications, which are to be submitted ..." [United States of America]	Accepted, paragraph has been rewritten to better portray the voluntary nature of adaptation goals under the Paris Agreement
1000	100	35	100	35	as anNDC, SPACING [Robert Shapiro, United States of America]	Accepted
16552	100	41	100	46	The sentences refering to the treatment of adaptation in the Paris Agreement's Transparency Framework are incorrect. Under Article 13 on the transparency framework, Parties are encouraged to provide information on related to climate change impacts and adaptation. There is no submission and review every 5 years under Article 13. It is incorrect to state that each Party must submit information on adaptation under the transparency framework, as it is not a mandatory requirement. [Australia]	Accepted, suggested text has been incorporated
55884	100	41	100	41	Space between period and likewise [Debora Ley, Guatemala]	Editorial.
61288	100	41	100	46	The last three sentences in this paragraph are inaccurate and should be deleted. They include misstatements/characterizations of the Agreement that are not consistent with its text (e.g., there is no requirement in the transparency framework or elsewhere to submit and review adaptation communications every 5 years; reporting on adaptation is recommended but not required; and the shorthand description about the transparency framework is not consistent with the text). [United States of America]	Accepted, text has been removed

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34262	100	44	100	45	The Paris Agreement's transparency framework requires Parties to submit information not just on finance, but support (which comprises finance, technology transfer and capacity building). See text of Paris Agreement, Article 13. [Joe Thwaites, United States of America]	Accepted, text now reflects comment.
47120	100	44	100	44	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested alternative '...Party submits information…' [Sarah Connors, France]	Accepted, text has been modified
1908	100	48	100	55	Adaptation goals have mostly been provided qualitatively. Only 38 NDC, all from developing countries, include quantified adaptation targets (mostly in forestry and water, see Pauw et al., 2017) [Willem Pieter Pauw, Germany]	Accepted
1910	100	48	100	55	I would be careful with mentioning costs. We did a very careful and detailed analysis on adaptation costs based on data from the UNFCCC secretariat that we improved, and come to a total of USD 806,5 billion. However, we do not intend to publish this number, as 1) it was never intended that countries would list their adaptation costs in NDCs; 2) only 58 did so (what about the other 107?); 3) the number vary to a great extent (3 countries take up 57% of the total sum, and the 13 NDCs with the lowest costs only reach 1 billion together). Finally, fourth, countries are still turning their INDCs into NDC. In other words, this politically highly sensitive and incomplete number might be outdated by the time this report is published [Willem Pieter Pauw, Germany]	Accepted, section has been deleted
46466	100	48	100	55	It would be important to qualify adaptation cost numbers taken from the NDCs, as they have not been prepared using a common, comparable methodology, which raises questions about usefulness of aggregating them. [Sven Harmeling, Germany]	Accepted, section has been deleted
54142	100	48	101	5	The findings and percentages there must be compared/confronted with other research to the same effect as there are methodolical issues. See: Preliminary Research Findings: Adaptation in the NDCs and INDCs under the 2015 Paris Agreement of the UNFCCC, CLGI, 2017 [Ayman Bel Hassan Cherkaoui, Morocco]	Accepted - text revised. Stats omitted
56430	100	49	100	51	Smithers et al 2017 was a policy briefing that was superseded by a comprehensive report Smithers et al 2017 (see comment above for full reference). The text should read "….cost estimates aggregated to the global level are at USD 140.5 billion with USD 19.0 billion in international support requested (estimated costs are provided in 34% of all NDCs that included adaptation) (Smithers et al. 2017)". [Richard J. Smithers, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, section has been deleted
56432	100	51	100	55	Smithers et al 2017 was a policy briefing that was superseded by a comprehensive report Smithers et al 2017 (see comment above for full reference). As the lead author of Smithers et al 2017, I do not recognise any of the facts and figures presented in the last three sentences of the paragraph and strongly recommend that they are deleted unless a suitable reference can be cited. [Richard J. Smithers, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, section has been deleted.
1912	101	3	101	5	The actual number are (I looked them up based on the references included): water (76%), agriculture (76%), health (58%), forests (56%) and biodiversity/ecosystems (53%) [Willem Pieter Pauw, Germany]	Accepted, section has been deleted.
54144	101	7	101	13	There are many differences between NAPs and NDCs. Without going into details, I think it is important to at least specify that unlike NDCs, only developing Countries as per para 28, 29 decision 5/CP17 [Ayman Bel Hassan Cherkaoui, Morocco]	Accepted - text added to emphasize it is just developing countries
54146	101	7	101	13	NAPs seek to enhance coherence between adaptation and development planning, and are designed so countries can monitor and review them on regular bases. That is not the only purpose of NAPs. That is only one of the two objectives stated in Deicsion 5 CP 17. The other, direct, objective must also be mentioned as per article 1 a of Decision 5/CP17: "To reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience " [Ayman Bel Hassan Cherkaoui, Morocco]	Accepted - noting the text has changed since the SOD text such that the text in question is no longer included
61290	101	7	101	13	This paragraph should be deleted. It is policy prescriptive and misunderstands the nature of NDCs and the relationship of different elements of the Paris Agreement (i.e., NDCs vs. adaptation communications) and the ongoing processes to develop further guidance. [United States of America]	Rejected - text will be revised to better explain the relationship between NDC's and other adaptation communications
5534	102	1			This box puts SRM in the context of 1.5 by focusing on the peak-shaving concept which is useful, and provides some quantitative information. Additionally, for 1.5 pathways the peak-shaving as shown in the figure would occur mid-century which implies the time available for this concept to become feasible as response option. I did not see any summary statement on SRM in either the SPM or the ES of Ch 4 that is corresponds to the discussion of SRM in this box. Suggest that this timeframe be considered as part of the summary regarding the potential role of SRM in the context of 1.5. [Haroon KHESHGI, United States of America]	taken into account, SPM and ES were revised a bit
7276	102	1	108	70	There needs to be a discussion of sources of evidence and confidence in the results. Most of what is reported is from model results or imperfect analogues. This is hinted at but needs to be called out explicitly. This paper also needs to be discussed: http://onlinelibrary.wiley.com/doi/10.1002/2015GL065391/full because it gets directly at the issue of confidence. [Ben Kravitz, United States of America]	Taken into account. First - we provide a visual representation of uncertainties at the figure 1 (Cross-Chapter box 10), then we revised text significantly. Moreover we added to conclusions "most of the knowledge about SRM is based on imperfect model simulations and some natural analogues. "
19146	102	1	108	22	Although the box has improved as compared to the FOD, it is still of insufficient quality for an IPCC report. There is a risk that it appears as biased. The "moral hazard" is mentioned many times, but the counter-argument that "if SRM appears to be dangerous and not acceptable, it may drive more mitigation" is not made. Likewise the fact that SRM does not address ocean acidification is repeated many times, but how many units of pH are we talking about in the context of a peak-shaving such as those of figure 1, and for how long. Is this really a problem? [Olivier Boucher, France]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, and this part has been deleted.
9538	102	1	108	21	Overall, this entire box suffers from some implicit biases and is problematically vague on what comparisons are being made. As noted a few times in my comments, I'd suggest being clear right up front that there are always two comparisons that are relevant to make; one between the same CO2 concentration but without RMM (higher temperature) and the other with the same temperature and lower CO2 concentration. Both are interesting. If you believe RMM's can realistically be deployed as a supplement to mitigation, then the first is arguably more important, if you consider RMMs as an alternative, then the second comparison is the relevant one. Best if you just say all this right up front, and then be really clear whenever you make some statement about what RMM's might do, as to which comparison you're making. This would solve most of your problems. (You can also then get out of the business of making implicit normative jugments that you aren't supposed to be making and let the reader decide for themselves.) [Douglas MacMartin, United States of America]	Taken into account, combined with other comments. The entire box is reorganized.
19148	102	1	108	22	I don't think the SPM make much justice to this cross-chapter box. [Olivier Boucher, France]	Noted, SPM was revised a bit. It mentions now that "some of SRM methods may be theoretically effective in reducing an overshoot"
38632	102	1	107	34	I find the roles of section 4.3.9 and the box a bit confusing. These should be further developed in a way where these two can complement each others with clear roles. I am not sure if a box is the place for assessment; I think that would be mainly in the text - building on and referring to the info in the box. [Jan Fuglestvedt, Norway]	Taken into account. The BOX and section 4.3.8 were significantly rewritten and shortened to focus on SRM in the context of 1.5C. Section 4.3.8. assess mostly feasibility of SRM from economical, governmental and ethical view points.
61292	102	1	103	21	This box may be somewhat redundant with Section 4.3.9. Also, note that the reference to ocean acidification and associated risks is very soft; these are major risks to sustainable development and should be clearly presented as a major weakness of relying on SRM/RMM that would need to be addressed in any comprehensive strategy. [United States of America]	Noted, we rewrote this section about SD significantly, and we added statement that SRM "would not address or even worsen (Tjiputra et al., 2016) negative effects from continued ocean acidification".

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62032	102	2	107	35	Please use AR5 as a starting point. Include IPCC calibrated language in conclusions. Provide a visual representation of uncertainties in climate modelling in Figure 1 (e.g. spread of CMIP model responses to aerosol forcing). [Valérie Masson-Delmotte, France]	Taken into account. Figure 1 (Cross-Chapter box 10) has been improved accordingly. Middle panels now show the uncertainties range (5-95%) as derived from CMIP5 model.
1074	102	3	102	3	It is confusing to call its Solar radiation management in the heading and Radiation Modification Measures in the body [Jesse Reynolds, Netherlands]	noted, we are focussing at peer-reviewed literature, so we do not citing proposed reference
37502	102	3	102	3	It is confusing to name Solar radiation management in the heading and Radiation Modification Measures in the body. The term RMM does not add anything to the assessment and is not rooted in the literature. It is counter to my understanding of the IPCC's mandate to come up with novel terminologies for concepts that are well established in the literature. You can find a quick clarification of terms here: Boettcher, M., Parker, A., Scha?fer, S., Honegger, M., Low, S. & Lawrence, M. G. (2017). Solar Radiation Management. IASS Fact Sheet 2/2017, Institute for Advanced Sustainability Studies (IASS) Potsdam, Germany. [Matthias Honegger, Germany]	noted, we rewrote this section significantly, thus corresponding sentence was removed
55126	102	3	108	22	This Box is way too long. Create some imbalance compared to other less deployed technology (e.g. wave, tidal energy, CDR…). Also need to check how much is alsready referred on RMM into Chapter 2. [Yamide Dagnet, United States of America]	Accepted, Box was shortened significantly
61294	102	3	102	3	The authors should at least consider the planned Harvard aerosol injection experiment. It helps people recognize better how seriously some are considering RMM. [United States of America]	noted, we rewrote this section significantly, thus corresponding sentence was removed
54078	102	7	102	18	The "peak shaving" scenario is a proposal by david Keith only and it´s far from proven it´s even feasible in MODELLING. Imaging in reality! Other authors point out that there are many reason why SRM could be interrupted, including political and economic factors. Ref: Trisos et al, 2017 https://www.nature.com/articles/s41559-017-0431-0, "Regional" SRM seem to be another wordgame, as any SRM will affect the climate, which is a global ecosystem. All these new labels are designed to confuse the public that partial SRM deployment is possible which is far from reality and absolutely unproven. See Trisos et al (2017); Pierrehumbert (2017, https://thebulletin.org/trouble-geoengineers-%E2%80%9Chacking-planet%E2%80%9D10858 [Elenita Daño, Philippines]	rejected, we have this in the 4.3.8 and can't repeat this text
54082	102	7	108	22	In the whole box, there are scarce mention of some of the most important risks of SRM such as: a) the unequal distribution of impacts and impacts on biodiversity. Trisos et al, (2017) (link above) and Robock, 2008 and 2016.http://onlinelibrary.wiley.com/store/10.1002/2016EF000407/asset/eft2168.pdf;jsessionid=A2BFDD961594B96D7C15B09DAD2FCCC5.f02t04?v=1&t=je1ya36r&s=fbf2a51baedf51cc4ed26ecfc3e2722afb7780c5; b) there is NO mention at all at the risk of weaponization and the exacerbation of geopolitical power imbalance even BEFORE deployment, as some powerful countries that have control over the technology can threaten others as it happens with nuclear weapons. See HBF adn ETC Group, http://www.geoengineeringmonitor.org/2017/05/new-briefing-climate-change-smoke-and-mirrors/ [Elenita Daño, Philippines]	Accepted. We added Trisos et al, (2017) to the list of references. But we do not mention the risk of weaponization itself because most of the literature use term "unilateral action", also this Box do not discuss governmental issues, because this is in section 4.3.8 (previous 4.3.9)
41686	102	8	102	8	The most important characteristics of SRM/RMMs should be front and centre in the introductory paragraphs. They are: 1) if a combination of mitigation and carbon removal actions prove unable to keep warming below 1.5C, and if SRM could ever be made to work, then it would be the only option for keeping warming below 1.5C. This is a basic physical fact because no other method for quickly stopping the rise in global temperatures has been proposed, and it must be in a report on 1,5C 2) A decade of modelling studies has indicated that moderate use of SRM would reduce many of the projected impacts of climate change for most regions on the planet. 3) But the world doesn't behave exactly as models say it will and there are large uncertainties about the full physical impacts of SRM, and its use could end up compounding the physical risks of climate change, plus there are also some projected physical side effects. 4) In addition, the socio-political implication could be even more problematic than the physical ones. Point 1 and 2 are critical as they are not well represented in the report. I know that many people do not feel comfortable with these facts but they should not be left out for this reason. The authors of this Box should ask themselves firstly, are my statements 1 and 2 here true? Then are statements 1 and 2 important? If the answers to these questions are yes (and I can't see how they can be anything but yes) then these statements should be included with some prominence both in this box and in the SPM [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Point 1 is too obvious to include. It goes without saying. Point 2 is included in the x-chapter box.
54336	102	8	102	12	I strongly disagree with the statement that renaming SRM into RMMs increases clarity. All section headings on this topic, including in the SPM, remain 'Solar Radiation Management' because this is obviously a term that people know. If someone reads the 1.5 report and subsequently searches for 'radiation modification measures' in the scientific literature, they will miss almost all the publications and reports relevant to this topic. Furthermore, the RMM terminology does nothing to clarify or improve the already problematic concept of SRM and its inclusion of vastly different approaches, ranging from rooftop whitening to stratospheric sulfur injection, and essentially meaning the latter approach most of the time anyways. Instead, it continues the game of redefining geoengineering to make it sound as benign and scientific as possible. This should not be encouraged by an authoritative scientific organisation such as the IPCC, especially not in a report commissioned by policy makers to facilitate decision making and progress towards reaching the 1.5 degree target. [Ina Möller, Sweden]	accepted, now we use SRM acronym, but M we use for Modification
5708	102	10	102	12	There is no need to invent yet another acronym (RMM). If you don't want to use SRM, use albedo modification (AM) as used in the US National Academy reports (2015) or the new AGU statement on climate intervention. [Alan Robock, United States of America]	Accept, we now use SRM but solar radiation modification.
5710	102	10	102	12	What is RMM? If you are going to use a term, you have to explain what it is. What measures? What kind of radiation? You also have to make clear right at the beginning that no such measures exist. These are only theoretical schemes, and there are serious questions about whether they would work at all. [Alan Robock, United States of America]	Accept. See response to comment 5708
7500	102	10	102	12	Is it necessary to coin a new term RMM, given that the term SRM is used by all relevant literature in the field? [Axel Michaelowa, Switzerland]	Accept. See response to comment 5708
45548	102	10	102	10	this is not for clariry it's for confusion as it appropriates a term from one branch of science and applies it in another! [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	accepted, now we use SRM acronym, but M we use for Modification
63286	102	10	102	12	RMM has no intentional impact on GHGs? Please see https://www.nature.com/articles/nclimate3376?WT.feed_name=subjects_physical-sciences [Greg Rau, United States of America]	Noted. We have decided to not cite commentaries. The conclusions by this paper are (as expressed by the authors) highly uncertain. And the intention of SRM is to reduce radiative balance, the other impacts are side-effects.
54074	102	11		12	Delete RMM and replace with SRM in the whole chapter and report. The change of name from SRM to RMM aims to distract the attention of the readers from the many potential impacts associated with Solar Radiation Management and geoengineering. [Elenita Daño, Philippines]	Accepted, we use SRM but "M" is refer to Modification now
54080	102	13		21	Delete "responsibly" as there is nothing close to that. As argued above, there is no proof of any peak-shaving scenario even in modelling to merit inclusion in this report. Also, please DELETE "responsibly implement SRM" in hte last part of the paragraph, line 21, as there is no proof at all that ANY deployment of SRM can ever be responsible. [Elenita Daño, Philippines]	Accepted, this word "responsibly" deleted

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5146	102	14	102	16	That the negotiations at Paris led to the goal of keeping the increase in global average temperature to less than 1.5 C (or 2 C) does not mean that 1.5 C is somehow a level that can be considered without substantial consequences, perhaps higher than society really wants to accept. There was virtually no scientific basis, as I understand it, in choosing these values--they were simply as low as it was hoped mitigation might be able to keep the temperature rise. As this assessment shows, however, it is very unlikely that this can really be achieved given the very slow pace of mitigation actions to date. This really raises the question of the relative consequences of choosing both various peak values and, as they certainly need not be the same, the long-term value that is accepted. As Hasnen et al for a bit ago have argued, exceeding 0.5 C is actualy where significant change started, particularly relating to the loss of mass from the Antarctic and Greenland ice sheets, and so, given that paleoclimatic evidence suggests that the equilibrium sea level sensitivity is something like 15-20 meters of sea level rise per degree C of global warming (!!!), it would seem pretty clear that initiating the loss of mass from the ice sheets needs to be avoided. I think it really important that the scientific community not simply accept that the first estimate arrived at by negotators should somehow be accepted as the right value to be aiming for and also very unfortunate that this scientific assessment does not layout the implications for the environment and society of various amounts of peak warming and various levels of long-term warming. What RMM could potentially be designed to do then is to shave off the going over of the ideal conditions--and I think that should be the focus of this sentence, not just accepting the 1.5 C value. So, in the sentence here, I'd suggest phrasing this to indicate the notion would be to do the additional pulling down of the global average temperature to the value that is below the level that would be expected to lead, soon or over the longer-term, to very severe consequences for society and the environment. [Michael MacCracken, United States of America]	Noted. It is a fair point, but beyond the mandate of this report, which is, after all, on 1.5C. Chapter 1 has some reflections on that particular temperature limit, but it is not up to the IPCC to recommend a "right" temperature limit. See also responses to earlier comments along these lines.
7340	102	14	102	19	More papers have been written on overshooting scenarios, including MacMartin and Keith (2015) (http://doi.org/10.1038/NCLIMATE2493) and Sugiyama et al. (2017) (http://doi.org/10.1080/14693062.2017.1323721) [Masahiro Sugiyama, Japan]	Noted. Because of page restrictions, we had to reduce the number of references were are citing. The Sugiyama paper has been cited here though.
28734	102	14	102	19	It should be addressed the uncertainty of RMMs methods; compare with p.42 , 9-12: “Recent papers have asserted that RMMs could reduce some of the global risks of climate change related to temperature rise (Izrael et al., 2014; MacMartin et al., 2014a), but others indicate that the risks of changing precipitation, ozone, cloudiness and implications thereof outdo the benefits (Pitari et al., 2014; Visioni et al., 2017a).” [Germany]	Taken into account. This is what we mean with the 'new risks'. We are citing the same references but did not want to repeat what is already in 4.3.9 (4.3.8 in FGD).
2120	102	15			1.5C limit arbitrary - lower limits (eg 1C) are possible, and have been previously discussed [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted, Yes, but this report is about 1.5C and we are assessing SRM in this context
9500	102	16	102	16	Can add MacMartin, Ricke and Keith, in Phil. Trans. Royal Soc A to this list (insofar as it was expressly written for the purpose). doi:10.1098/rsta.2016.0454 [Douglas MacMartin, United States of America]	Noted. We have to limit the number of references, but this paper is cited twice in the FGD.
41688	102	17	102	17	This sentence is unbalanced in its framing. It says that potential peak-shaving benefits have only been proposed, where it states categorically that there would be new risks and challenges. But the risks and the benefits are subject to the same uncertainties and so should be framed in the same way [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, would changed to "could" However, the text was then significantly revisited.
2122	102	18			cite long and shepherd Long, J. C. S. and Shepherd, J. G. (2014). "The Strategic Value of Geoengineering Research" in "Global Environmental Change, Handbook of Global Environmental Pollution". Freedman, B. (ed) Dordrecht, Springer Netherlands. 1: 757-770. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, we cited it in 4.3.8.1
5148	102	18	102	19	While there would ceertainly be new issues to be addressed, it is not at all clear that there would be new risks. First, it should be said that the model experiments that have been done have ususally been assuming very large offsets, so offsetting all of a CO2 doubling or more, etc. And yet these simulations generally get conditions back very close to their preindustrial situation (and analyses have not really looked to see if came back to within range of natural variability, which is really what matters). For the peak-shaving case, the amount of RMM would tend to be a good bit less difference, and in every case to conditions far less perturbed that were RMM not being done. So, I think this last phrase of the sentence needs greater context and qualification (and similar comment has been made on this phrase that is repeated in the main text). With respect to RMMs being a "highly debated" topic, I'd suggest that this has been more in the context of RMMs as a potential substitute for mitigation rather than a complement to mitigation--and, as indicated earlier, the analyses used have been in reference to getting back to preindustrial (or similar) which I would argue is not the right comparison--the question that faces us is whether we would be better off with mitigation, CDR, and adaptation and then with or without RMM peak shaving. As this assessment and earlier IPCC and natural ones, going to 1.5 or 2 C, much less to what seems like an inevitable overshoot to 3 C or more, such conditions would lead to very severe consequences for society, both in the near-term due to extremes and biodiversity loss, etc. and in the longer-term as sea level keeps rising and rising. I just don't think the framing for the discussions with the public have been as forth right as really would be appropriate. [Michael MacCracken, United States of America]	Accepted, "would" changed to "could". "Highly debated" was removed from the text. Even if SRM is applied only for peak-shaving there will be governmental, ethical and others issues, they are discussed in 4.3.8 and below in the Box. In general, this paragraph was revised to reflect a bit what was mentioned by reviewer
28736	102	21	102	21	Please add after "discusses" the words "RMM in the context with" [Germany]	accepted, added. However, afterwards the text was modified significantly and this particular phrase was deleted.
5150	102	28	102	30	RMMs would be done with the intent to reduce impacts substantially--and were they not doing this they would be terminated and not done--or redesigned to not be increasing impacts. Initiated slowly and phased in, iterating as this was occurring to offset what could not be accomplished by mitigation and CDR, it is just not plausible for this statement to be giving equal weight to "reduce" and "increase"--the whole design purpose is to reduce impacts. It might be that the reductions in impacts are not the same everywhere, but it is just not clear at all what the justification is for including the word "increase" here. Basically, no one benefits from climate change as the warming continues up and up, so how is it that pulling back on the warming could be seen as increasing impacts? [Michael MacCracken, United States of America]	Noted. However, things do get done that harm sustainable development as the interests are not always running in parallel. The idea here is to indicate that the impacts of SRM might have undesired impacts besides the (desired) cooling.
37296	102	28	102	35	This paragraph could also quote Horton and Keith (2016) which addressed our currently limited ability of mitigation to address near-term risks without increasing intra-generational inequality and the high costs of and limits to adaptation, especially for those most vulnerable. It also calls for research on geoengineering. [Joshua Horton and David Keith. 2016. "Solar Geoengineering and Obligations to the Global Poor." In Climate Justice and Geoengineering: Ethics and Policy in the Atmospheric Anthropocene, edited by Christopher J. Preston. London: Rowman & Littlefield).] [Joshua Horton, United States of America]	noted, we are focussing at peer-reviewed literature, so we do not citing proposed reference

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5152	102	30	102	35	But the main way that RMM effects are being considered is to pull back the climate change being caused by the GHGs by more than can be done by mitigation and CDR. It would seem appropriate here to be at least presenting the primary view and perspective of using RMMs to further reduce the impacts. While RMM is relatively low cost, it is also capable of moderating climate change impacts that simply cannot be done by mitigation of CDR in nearly as timely a way. On the notion of reponding to humanitarian emergencies, what RMM would be aimed to do in the type of global implementation discussed in this report is to moderate overall climate change, so the multi-decade average conditions, basically shifting the typical bell-shaped distribution curves back toward baseline conditions. Global RMM, which is all that has been discussed in this report, is not an approach that could be implemented to respond to some particular crisis in terms of time and space--what it is intended to do is reduce the likelihood of occurrence of adverse extremes, offsetting the increase that has occurred. Yes, there may be ways to try to use RMM to offset some broad regional impacts like Arctic amplification or ocean warming in tropical cyclone intensification areas, but these approaches are not discussed in this assessment and there is much less, though not zero, literature on such approaches that could be cited, but I'm not aware of discussion to alleviate particular human emergencies--and I think the wording here needs reworking. [Michael MacCracken, United States of America]	Noted. This sentence was not only reworked, but completely removed.
5714	102	31	102	31	some see RMMs This is supposed to be an assessment, and not just a list of papers that say something. Please assess these papers and say whether RMMs would do this or not. [Alan Robock, United States of America]	Noted. On SRM, literature results differ. The IPCC procedures prescribe that in such cases, we should give both views. Hence this formulation.
28738	102	31	102	31	Please add: "not taking into account indirect and social costs, research and development costs and monitoring expenses (compare with p. 43 1-13) [Germany]	rejected, we have this in the 4.3.8 and can't repeat this text
41690	102	31	102	42	Again here is the same imbalance in framing, where the potential benefits of SRM are introduced as 'some see that' before the risks are presented as certain. Lines 28 - 35 need to spell out that if SRM were able to stabilise global warming that would assist in wider efforts to meet manyu of the SDGs. [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	noted, we rewrote this section significantly, and hopefully took care of this point.
5712	102	33	102	33	What is "SD?" Define all acronyms. [Alan Robock, United States of America]	accepted, done
48128	102	33	102	33	Suggest using sustainable development instead of SD [Sarah Connors, France]	accepted, done
2126	102	37			sentence too long and bereft of helpful punctuation [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	accepted, revised
5154	102	37	102	39	Yes, quite simple proposed RMM implementations do not evenly restore precipitation in all regions, but there is significant movement toward moderation of the impact, and this is before any efforts have been made to fine tune the distribution of the RMM influence--basically, there has not yet been any engineering of geoengineering to try to minimize side effects. Examples of what it would make sense to consider if there were an organized research effort would be seasonal and latitudinal variations in the intensification of the RMM that was deployed--there just has not yet been effort to try to optimize, so such complaining about regional precipitation influences that are not fully restored ids really premature. While global cooling actually does hep a small bit on ocean acidification, faulting RMMs for not being about to do everything seems a rather jaundiced view--mitigation and CDR can have an early effect on the increase in global average temperature, so why not similarly throw them out. To do all that needs to be done, we need multiple types of efforts, all pursued pretty aggressively, and the set of approaches could well be expanded in the analysis to include suggestions that have been offered to deal with ocean acidification even though they do not help on the climate. I just think there needs to be context offered--there are a number of approaches to dealing with climate change and each has its strengths and weaknesses and a comprehensive program would emply the rage of possibilities to do as much as possible of what is needed as fast as possible. And if the goal is indeed to get back to below 0.5 C as it needs to be for there to be any chance to limit sea level rise so less than a few meters, then all approaches are needed and we had best get working on them ASAP. [Michael MacCracken, United States of America]	noted, we rewrote this section significantly, thus corresponding text was removed. See also response to similar comments (on the need of going lower than 1.5C)
28740	102	37	102	37	It should be expressed, that RMM is still an idea but not an available technology. That means, there is an uncertainty not only for regionally-specific climate effects but also for global effects, e.g. ozone loss. [Germany]	Taken into account. We are not calling it 'technology' but 'measure" for this reason.
37298	102	37	102	44	This paragraph misrepresents a number of regional-specific impacts of RMM. Specifically, while referring to RMM's negative impacts, the paragraph did not clarify the baseline to which these effects were compared. This can result in misleading conclusions. For example, while geoengineering has been shown to impact Asian monsoon and lead to less precipitation compared to an RCP 8.5 baseline, such impacts can be beneficial in reducing extreme precipitation events caused by GHG warming [Irvine et al. 2016 "overview" in WIRES]. In addition, the intrinsic trade-off between the temperature and precipitation targets can be addressed systematically by adjusting SRM implementation strategies. For example, with moderate geoengineering, precipitation and temperature can both be brought closer to a pre-industrial baseline [MacMartin et al., 2012, Kravitz et al., 2014]. Features of precipitation can also be adjusted independent of global mean temeprature [Kravitz et al., 2016; Kravitz et al., 2017] . Possible implementation of other geoengineering methods beyond stratospheric aerosol injection provide even more degrees of freedom to achieve multiple climate objectives [Cao et al., 2017]. [Ben Kravitz et al., 2014 A multi-model assessment of regional climate disparities caused by solar geoengineering, Environ. Res. Lett. 9 074013; Cao, L., L. Duan, G. Bala, and K. Caldeira (2017), Simultaneous stabilization of global temperature and precipitation through cocktail geoengineering, Geophys. Res. Lett., 44(14), 7429–7437, doi:10.1002/2017GL074281.; Kravitz, B., D. G. MacMartin, H. Wang, and P. J. Rasch (2015), Geoengineering as a design problem, Earth Syst. Dynam. Discuss., 6(2), 1635–1710, doi:10.5194/esdd-6-1635-2015.; Kravitz, B., D. G. MacMartin, M. J. Mills, J. H. Richter, S. Tilmes, J.-F. Lamarque, J. J. Tribbia, and F. Vitt (2017), First simulations of designing stratospheric sulfate aerosol geoengineering to meet multiple simultaneous climate objectives, J. Geophys. Res. Atmos., Submitted, doi:10.1002/2017JD026874.; MacMartin, D. G., D. W. Keith, B. Kravitz, and K. Caldeira (2012), Management of trade-offs in geoengineering through optimal choice of non-uniform radiative forcing, Nat. Clim. Chang., 3(4), 365–368, doi:10.1038/nclimate1722] [Joshua Horton, United States of America]	noted, we rewrote this section significantly, thus corresponding paragraph was removed. We also focus on 1.5C-worlds, not on RCP8.5 as a baseline. Thank you for all the references, many of which are cited elsewhere in the box or section 4.3.8 (in the FGD).
41692	102	37	102	39	This sentence is inaccurate and unbalanced It is not because SRM has uncertain regional impacts it is a risk to SDGs. If SRM *were to* have damaging differential regional impacts then it *would* present a risk to the SGDs, but once again, the evidence indicates that moderate SRM would reduce climate impacts for the majority of regions. This should be clearly stated instead. [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	noted, we rewrote this section significantly, thus corresponding sentence was removed. On substance, the sentence should be read in conjunction with the previous paragraph which gives a more balanced view. Also, no references given for the statements that regional impacts would be mild and on balance positive. We have the impression that the evidence for that is mixed.
2124	102	38			current knowledge indicates a "no losers" result for regional variation - provided SRM to over-drying is not used http://www.tandfonline.com/doi/abs/10.1080/21550085.2014.926078?src=recsys&journalCode=cepe21 - over drying can be avoided using cocktail geoengineering [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, we rewrote this section significantly, thus corresponding sentence was removed

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9502	102	38	102	39	Um… the fact that RMM doesn't solve ocean acidification wouldn't mean that RMM results in risk as a result, unless you're implicitly assuming that the choice affects mitigation pathways (which earlier the report points out that there isn't much empirical evidence to look at for that, and not even agreement on the sign, so you can hardly assume now that you know the sign when there's no literature to support that). Suggest you (i) break this into two sentences with the two separate thoughts, and (ii) even with regards to the hydrological cycle changes, I think a weaker "may entail risks to SD" is about all we can support right now from literature, and would be less normative to say "might also entail some different risks to SDGs". As with many other comments, the report needs to be clear about whether the comparisons are being made to same CO2 levels but lower temperature (in which case it seems likely from available evidence that there would be net benefit to SDGs). [Douglas MacMartin, United States of America]	Taken into account. We rewrote this section significantly, thus the point was indeed removed.
54076	102	38			It is not accurate to say that SRM will not solve or affect ocean acidification. SRM will worsen ocean acidificaiton. Partly because the emissions will continue with SRM, and if the sea is colder it will absorb more CO2 and increase acidification. See also Tjiputra el al, 2016. [Elenita Daño, Philippines]	Accepted, reference added
56994	102	38	102	38	Its not clear that by not solving ocean acidification albedo modification entails risks to SD. It doesn't make the SD any easier by not solving something it doesn't solve, sure. But land tenure reform doesn't solve ocean acidification, either -- by not doing so does it, too, entail risks? [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	noted, we rewrote this section significantly, thus corresponding sentence was removed
2128	102	39			RMMs do NOT have the -ve effects claimed to SD - see eg no-losers argument in http://www.tandfonline.com/doi/abs/10.1080/21550085.2014.926078?src=recsys&journalCode=cepe21. It is the underlying CO2 which causes the SD problem. Blame can only fall to RMMs in the event that they worsen CO2 pollution - a moral hazard link which is highly tenuous - as is described elsewhere in this paper In fact, uncontrolled climate change poses a far greater SD risk than does RMM-controlled climate change. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, we rewrote this section significantly, thus corresponding sentence was removed
5156	102	39	102	42	The sentence needs to make clear what the comparison is being made with respect to and what iterative learning has been done to see how these problem might be moderated. So, if the comparison here is with respect to returning to the unperturbed GHG world before anything happened, well that is just not the situation that we face. The world's climate is being significantly altered and without RMM there will be tremendous changes for everyone, so the comparison that needs to be evaluated is whether the climate situtation with increased GHG and reduced emissions by mitigation and CDR is better or worse if peak-shaving RMM is applied (with the RMM being carefully tuned and iterated to limit any adverse problems, etc.). It just does not appear that that is the analysis being done--instead the comparison being made to the state before andy CO2 was added, and that is just not a possible situation until after centuries of mitigation and CDR, and if those efforts are large enough, RMM will no longer be needed. So, I just don't think adequate context has been provided. [Michael MacCracken, United States of America]	Noted, we rewrote this section significantly, thus corresponding paragraph was greatly revised. See also response to comment 5154.
2130	102	42			models the show precip disruption are typically theoretical, and occur in over-dried models. In practice, cooling to pre-industrial leading to over-dryingn would not be used, it is not appropriate to project theoretical experiments as policy prescriptions. They make no attempt to be! Peak-shaving deployments are more likely than hard-reverse to pre-industrial [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, we rewrote this section significantly, thus corresponding sentence was removed
5158	102	42	102	44	Indeed, few studies have been done, but all modeling studies show that RMMs tend to greatly reduce the magnitude of the impacts even if not getting back to a perfect unperturbed state, but again, that is not a possible state to be getting to given the atmospheric GHG perturbation--so the appropriate comparison is to the perturbed state with as much mitigation and CDR as can be accomplished. It is just very important to be describing the comparative situations, not some impossible state with no GHG effect as that is just not a possible outcome given all the emissions that have occurred. [Michael MacCracken, United States of America]	Noted. In our view, the studies indicate that SRM can indeed lower temperature, but whether the impacts is reduced is highly uncertain. GMT is only one part of the impacts. For the "baseline" question, see response to comment number 5154.
5766	102	46	102	49	A brief discussion on regional RMM schemes such as Arctic Geoengineering which were proposed to reduce warming in the Arctic region could be also discussed here. A recent modeling study (Nalam, Bala, and Modak, 2017 Climate Dynamics) showed the rainfall in the Northern Hemisphere monsoon regions could be reduced by the implementation of Arctic Geoengineering because of a southward shift in ITCZ. This is one of the drawbacks of these types of regional schemes. [Govindasamy Bala, India]	Noted, we tried to focus on the methods which would have global effect, that's why we have shortened CCT and MCB parts and don't discuss the smaller-scale ones.
5718	102	47	102	47	Stratospheric Aerosol Injection (SAI) is not correct. The technique most studied is not injectiof of aerosols into the stratosphere, but injection of a gas, sulfur dioxide, which then converts to aerosols over a period of weeks. [Alan Robock, United States of America]	Taken into account, acronym SAI is widely used, so we use it also, But we added clarification about injection type to the Table 4.7. where all SRM methods summarized
2132	102	48			GBAM not GABM [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, we rewrote this section significantly, thus corresponding sentence was removed
5716	102	48	102	48	ground-based albedo modifications should be GBAM, not GABM. [Alan Robock, United States of America]	accepted, rewritten
9504	102	48	102	48	Wouldn't the acronym for "Ground based albedo modification" be GBAM, not GABM? [Douglas MacMartin, United States of America]	accepted, rewritten
19144	102	48	102	48	GABM or GBAM? Are these ugly acronyms really needed? [Olivier Boucher, France]	accepted, rewritten. Unfortunately, yes.
5160	102	51	102	53	Sentence needs some smoothing of the English [Michael MacCracken, United States of America]	accepted, text revised
56996	102	51	102	51	mimicking much too strong. The mechanism of SAI cooling is the mechanism of volcanic cooling, but volcanoes are quick emplacement, not ongoing, sometimes restricted in their impact to a single hemisohere, etc. "is in some ways analogous to" would be better than "aims at mimicking" [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	accepted, text revised
9506	102	54	102	54	The range might be higher… (and I didn't go back to those references). Kravitz et al (2017), . doi:10.1002/2017JD026874, found 1C required 5 Tg S/yr (10 Tg SO2), which is at least -1W/m2. (Which is more what one might expect, since a reasonable guess for CO2 would be 1.2 W/m2 for 1C of warming). Niemier and Timmreck 2015 found similar values to Kravitz et al. [Douglas MacMartin, United States of America]	Taken into account, combined with other comments. The text is revised, quantitative characteristics of SRM are summarized in the Table 4.7
2134	103	1			non-linearity depends massively on injection technology. Direct h2so4 Plume condensation is more effective than gas release. https://link.springer.com/chapter/10.1007/978-1-4614-5770-1_3 - http://eprints.uni-kiel.de/41466/ [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.
5162	103	1	103	2	It is not that some little increase causes a big change in effectiveness, given that the injection spreads out over the world, so this is really not a significant issue unless one is really trying to offset quite large amounts of forcing--and if RMM is used in the peak shaving approach where strong mitigation and CDR have been used first, this is just not a big issue. With respect to uncertainties in amount of SO2 needed, well they do exist, but this can be addressed iteratively, learning as it is done and this is mainly an engineering issue and not a scientific one. Indeed, the rate of injection might well need to change over the seasons and adjusted to not waste having SO2/sulfate in the winter zone where there is no sunlight. So, this complain about uncertainties in injection rate is just not scientifically all that significant. [Michael MacCracken, United States of America]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.
9508	103	1	103	2	Niemeier and Timmreck's results show that the nonlinearities aren't so large at injection rates that provide up to a degree or two of cooling (and Kravitz et al 2017 found no substantial nonlinearity out to more like 5 degrees of cooling). I'm not sure what constitutes "large" uncertainty, suggest just removing the adjective. [Douglas MacMartin, United States of America]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.

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2136	103	2	103	4	sentence unclear. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.
5164	103	2	103	4	Indeed, there is the opportunity to learn as one works along through the system, and that the sulfate aerosol has a lifetime of only a year is an advantage so that one can do with injections what is not being done by volcanic injection of change in solar intensity. So, this supposed disadvantage is really an advantage that is not being explained. Yes, having a short lifetime of the injected material does require injection of more material and likely in more than one or two locations, but it has an advantage of being able to be adjusted given other changes going on. [Michael MacCracken, United States of America]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.
9510	103	2	103	4	No idea what this sentence says… why would one want to inject a constant amount if the goal is peak-shaving, and why does it take decades to reach steady-state; that's not what other references have used or found. And for peak-shaving, the injection rate would have to go up, until the peak, and then back down again, after the peak, so the first part of this sentence is simply wrong. [Douglas MacMartin, United States of America]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.
56998	103	2	103	4	I don't understand this sentence, which suggests it should be redrafted. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.
62224	103	2	103	4	uncertainty is not only in the quantity of sulfur, but on the effectiveness itself of the process at a global scale. Line 3, the "could approximately compensate" should be qualified with "if it delivers the radiation limitation". [Antoine Bonduelle, France]	Taken into account, combined with other comments. The text is revised.
2138	103	6			worth at least mentioning alternative particles (titania, etc) - some with better radiative and ozone properties (although challenging to distribute) https://doi.org/10.1073/pnas.1615572113 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted, yes, but SAI is used in the Box only as an example of the most researched SRM.
5166	103	6	103	11	Yes, there are uncertainties that need investigation, but independent to the actual number, which would emerge as one went along, is that adjustments are possible in response to what is happening--so learning as one goes along. Nothing being locked in is a real advantage. So, this is an uncertainty that can readily be dealt with whn one is pursuing a peak shaving implementation--with learning going on as the actual implementation goes along--there is no real need to have this all perfectly known before deploying as there is plenty of sulfur (or other substances) around and adjustment is quite possible. There are quite significant uncertainties for CDR that are much more difficult to be dealing with, so why the focus on the uncertainty here? [Michael MacCracken, United States of America]	Noted, significant uncertainties for CDR also discussed in the chapter. Concerning uncertainties of SRM we think that it worth to mention this here, because there uncertainties very often mentioned in the literature
19152	103	6	103	11	Not clear to me what 1 Wm-2 does not translate approximately into 1°C here. Efficiency is also known to be highly non-linear. See eg Kleinschmitt et al, ACP, in press, 2018. [Olivier Boucher, France]	Taken into account, combined with other comments. The text is revised.
9512	103	8	103	9	Add Kravitz et al (2017), doi:10.1002/2017JD026874 to this list. (Which conveniently falls in the middle around 5 Tg S.) [Douglas MacMartin, United States of America]	Noted, but because of the space limit not all references could be included
5720	103	10	103	10	What does "maximal" mean? [Alan Robock, United States of America]	Taken into account, combined with other comments. This sentence is deleted and all quantitative estimates are summarized in table 4.7.
9514	103	10	103	10	If you include Kravitz et al, the upper limit should be 5 instead of 4. Niemier and Timmreck 2015 would give 4. [Douglas MacMartin, United States of America]	Taken into account, combined with other comments and text and numbers revised.
5168	103	13	103	21	Very nice to be considering these cases, but the likelihood of the world's actual emissions being anything like the pathways being considered is near zero--the world has shown no indication at all that it could get on one of these pathways. In addition, being at 1.5 C on a sustained basis will have very serious consequences (e.g., for sea level rise)--the world needs to get back to no more than 0.5 C . Using such really unrealistic pathways for the discussion here given political realities is just really misleading with respect to the need there will be for RMM as an option. [Michael MacCracken, United States of America]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted. See also responses to earlier comments, e.g. number 5154.
5722	103	16	103	16	global mean temperature exceeds 1.5°C is not correct. It is the amount above a pre-industrial level. [Alan Robock, United States of America]	Accept. Text revised.
38634	104	1	104	21	Useful figure. Could perhaps separate the two different columns and cases better; e g by different background color. That would help the reader to quicker see how to read the figure. [Jan Fuglestvedt, Norway]	Taken into account, combined with other comments. The figure was revised to take this into account.
61296	104	1	104	13	Figure 1 in Cross-Chapter Box 4.2 would benefit from a clearer explanation of what is depicted. For example, how is the cross-hatching to be understood? [United States of America]	Taken into account, figure is improved and the caption now clarifies.
5170	104	4	104	13	The caption does not explain what the hatching implies--is this a range of uncertainty? Indicating that the figures show, for example, "RFF-RM" does not really make clear if the "-" is a dash or a minus sign, at least on first glance. Again, with respect to the figure, the cases shown may be for technologically viable emission pathways, but there is as yet no indication that these pathways will be near to the much slower mitigation and CDR phase up that the world's nations seem to be headed towards, where the overshoot will be to 3 C plus. [Michael MacCracken, United States of America]	Accepted. A better description of figure 1 (Cross-Chapter box 10) in now included in the revised text. Besides, the caption of Figure 1 has been revised.
5726	104	4	104	4	negative exponent in y-axis labels appears as a box [Alan Robock, United States of America]	Accepted. Figure 1 (Cross-Chapter box 10) has been improved as recommended.
57000	104	5	104	5	Tjiputra et al 2016 is a highly improbable scenario--complete cancellation of the warming in RCP 8.5. I don't think the ocean acidification effect has been seen in less powerful implementations, and I wonder if this should be made clearer. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. The set-up is standard for SRM experiments. Strictly speaking, global warming in such a scenario would be less than 1.5°C, hence results are relevant to report.
5724	104	11	104	11	(Seneviratne et al.) missing year [and in two more locations] [Alan Robock, United States of America]	accepted, we added year. This was because the paper was not yet published at the time of the SOD.
48000	104	11	104	11	Kindly check: Plazzotta et al.; please specify the year [Sarah Connors, France]	taken in to account
5172	104	15	104	15	Given that the incoming solar radiation varies with latitude and season, it is not at all clear that a relatively uniform distribution of stratospheric aerosol in time of year or in latitude is what would be aimed for--for example, there is no need for aerosols in the polar night as there is no sunlight, so the statement here is both strange and sort of irrelevant; indeed, it may be desireable and possible to have latitudinally and seasonally varying amounts. [Michael MacCracken, United States of America]	Not sure what this pertains to but the comments overall let to a significant rewrite of the box.
5174	104	16	104	17	While the forcing may not be mostly uniform, MCB causes slow changes in the ocean temperatures and these can transferred around by currents so it is not at all clear that its regional patterns will really make a large difference. As an example, the centroid of SO2 emissions and sulfates has shifted from the North Atlantic basin countries in the 1950s-80s or so to Southeast Asia since roughly 2000, say, and I've not seen any studies talking about some large shifts in the atmospheric circulation because of this. There are analog situations to be investigated and that could potentially provide useful information, but given the rather modest and slowly moving around influences of MCB that are likely, it is not at all clear how much more heterogeneous that situation will be--and do remember that comparison needs to be on whether RMM makes the mitigation plus CDR situation better or worse. [Michael MacCracken, United States of America]	Noted, thanks for those valuable thoughts on MCB. As we had to shorten text, we focussed on SAI as the SRM measure with most literature associated, and don't provide as detailed of a discussion on MCB as provided here.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
4326	104	18			The choice of spray patterns between 30 N and 30 S was for convenience of model comparisons. It would not be a bad choice for static spray sources operating all the year round with no rate control but it would be more intelligent to move sources to track between tropics at equinoxes. This is similar to the idea of having steering wheels on road vehicles and drivers with good eyesight. The advantage of such movement is shown in figure 4b of Oreopoulos and Platnick at doi:10.1029/2007JD009655. Their highly relevant paper is not included in the IPCC references. At the poles in midsummer there is more incoming energy to be reflected than at the equator. There is a higher cloud fraction and a lower boundary layer. Sometimes the concentration of condensation nuclei is very low. In a month either side of midsummer fewer than a hundred spray vessels could reflect energy equivalent to the latent heat of fusion of a year's melting ice. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.
5728	104	18	104	18	use degree signs: 30°N and 30°S [Alan Robock, United States of America]	Accepted. The text on MCB however has been deleted as we had to shorten text significantly.
57002	104	18	104	18	Since the technical requirements for SAI or MCB are relatively easily replicated, termination by political means requires either all moderately empowered nations to agree on termination or a subset of those nations to impose termination by force. Bth of these things become less likely as the magntiude of the potential termination shock increases. Thus in practical terms it may well be that the termination shock is a much less likely outcome than its prevalence in discussions of SRM to date would have one think. I think this point sould be worked in. The relevant reference is Irvive and Parker (Earth's Future 2018) [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Parker and Irvine 2018 cited in the box in the context of termination shock.
4328	104	20			This says that the ability of marine cloud brightening to bring global temperature down towards 1.5 C has not been studied. This is simply not true. The earliest paper by Jones Haywood and Boucher doi:10.1029/2008JD011450 says that an area of only 3.3% of the surface area of the globe could get a reduction of 0.97 watts per square metre. Even though the authors used what they thought was the best area for all year spray there are many more areas which are nearly as good, as shown in the Oreopoulos and Platnick paper. A heavy dose on one area is less effective than a lower one in a wider area so we should not over-dose a small area. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted. All quantitative estimates are now summarized in the table 4.7.
47196	104	21	104	21	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Reject. In general this is of course true but in the context of this very physically phenomenon, the use of "needs" is OK.
4334	105				The bottom cell of the table says that marine cloud brightening will increase coral bleaching. In fact cooling water over coral will reduce bleaching. This is reported by Latham at doi:10.1002/asl.402 . I can give IPCC approximate calculations of the number of spray vessels needed to reduce water temperatures over the Australian Barrier Reef. I found that if we accept Schwartz and Slingo interpretation of Twomey's work the spray vessel number surprisingly small. I would like somebody in IPCC to check my figures. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	taken into account, we removed corresponding statement because it is disputable and replaced it with what Keith and Irvine (2016) indicate about this matter.
4332	105				The bottom cell of the table says that there will be regional rainfall responses. This is true but implies that all changed responses must be bad. Stjern et al at doi.org/10.5194/acp-2017-629 show that the mean of nine models predicts a small but useful increase of precipitation in drought-stricken regions even though the spray was held steady all year and released only between 30 N and 30 S. Most of the reductions in precipitation were over the sea. This work was aimed at model comparisons rather than drought prevention. In many places round the world conditions are not the same through the year so we may be able to choose seasons and places which improve on the drought reduction result. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Reference not added because too detailed. These regional responses have not been sufficiently considered. Regional targeting would be difficult to achieve.
37300	105		106		For SAI, key references should cite Eastham et al. 2018 (Eastham, S. D., Keith, D., & Barrett, S. R. (2018). Mortality tradeoff between air quality and skin cancer from changes in stratospheric ozone. Environmental Research Letters). This publication examines the possibility that SAI could improve air quality associated by reducing ozone levels in the planetary boundary layer, where ozone is deleterious to human health. [Joshua Horton, United States of America]	accepted, reference added
4330	105	1			This gives very large numbers, 200 to 590 Tg a year, for the amount of sea salt needed for marine cloud brightening. This comment shows a profound misunderstanding of the work of both Kohler and Twomey on which the entire idea for marine cloud brightening depends. I could find no mention of Kohler or Twomey in chapter 4. It is the number of successful nucleations which matters not the mass of sprayed material. We want to use a mono-disperse spray of liquid drops 0.8 microns diameter. If they dried completely the mass of sea salt would be the same as a cube with a side of 130 nanometres. This is at the very smallest end of what atmospheric physicists call the accumulation mode. It is big enough to be sure of nucleation according to Kohler but above the Aitken mode which Alterskjaer at doi:10.1029/2012GL054286 says will cause warming. Most climate models so far have used the full width of the accumulation mode. Our salt residues would have a mass well below 1% of the mass of aerosol particles at the top skirt of the accumulation mode. This difference would explain the very much larger quantities of salt mass in results from some climate models. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Accepted partly, MCB efficiency in Table 4.7. has been changed to "100–295 Tg dry sea salt W-1 m2 yr−1". We provided a range of dry sea salt amount needed to be annually injected which is based on model simulations studies (GeoMIP) and reflect the maximum dispersion. You did not find references to Kohler and Twomey because their publications are older than AR5.
2152	105	6	105	10	doesn't address engineering difficulties. Even if CCT works, it may not be possible [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted. Technical and feasibility aspects are discussed in 4.3.8.
5764	105	6	105	10	It may be useful to state that CCT could lead to enhanced global hydrological cycle while reducing the global mean warming. A recent study (Cao et al. 2017 GRL) showed that changes in both global mean surface warming and precipitation can be simultaneously offset by combining CCT and SAI (the so called “cocktail” schemes). It would useful to discuss this type of combined RMM schemes here. [Govindasamy Bala, India]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted. All quantitative estimates are summarized in the FGD in table 4.7.
36160	105	6	105	10	Add - CCT could lead to enhanced global hydrological cycle which reduces the global mean warming. A recent study (Cao et al. 2017 GRL) showed that changes in both global mean surface warming and precipitation can be simultaneously offset by combining CCT and SAI (the so called “cocktail” schemes). It would useful to add this type of combined RMM schemes here. [India]	Taken into account, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted. All quantitative estimates are summarized in the table 4.7. Technical and feasibility aspects are discussed in 4.3.8
1002	105	7	105	7	degree of cloud optical depth modification the location and' should be 'degree of cloud optical depth modification, the location and [Robert Shapiro, United States of America]	Accepted, combined with other comments. The text is significantly shorted and reorganized, so this part is deleted.
5730	105	7	105	7	add comma: modification, the [Alan Robock, United States of America]	Accepted. The text is significantly shorted and reorganized, so this part is deleted.
46966	105	12	105	12	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accept.
48002	105	13	105	13	Kindly check: Seneviratne et al.; please specify the year [Sarah Connors, France]	taken in to account, year added
7274	105	14	105	14	0.1 what? [Ben Kravitz, United States of America]	Not applicable, this sentence is no longer included.
48004	105	15	105	15	Kindly check: Seneviratne et al.; please specify the year [Sarah Connors, France]	taken in to account, year added
34680	105	20			Please complete the reference [Mexico]	taken in to account, year added now that it's published.
48006	105	20	105	20	Kindly check: Seneviratne et al.; please specify the year [Sarah Connors, France]	taken in to account, year added
50754	105	20	105	20	Before "the use of massive" there are two dots ".." [Francisco Javier Hurtado Albir, Germany]	noted, this sentence deleted

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2154	105	26	105	30	doesn't address engineering difficulties. Even if microbubbles works, it may not be possible https://bravenewclimate.com/2011/10/08/low-intensity-geoengineering-microbubbles-and-microspheres/ [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Not applicable, this table is no longer included.
61298	105	26	106	99	Cross-Chapter Box 4.2, Table 1: It would be useful to present in this table any information about the cost and potential scalability of these options. [United States of America]	Noted. Scalability discussed in the text. Costs discussed in the section 4.3.8. We do not include costs in the Table because there estimates are not robust as we concluded from 4.3.8.2. Also these costs assessment do not related to 1.5C.
2156	105	30			SAI: disruption to precip is minimal compared to that caused by global warming esp if using cocktails http://onlinelibrary.wiley.com/doi/10.1002/2017GL074281/full; not all solar power is affected (mainly CSP), amorphous cells AFAIK are relatively unaffected https://journals.ametsoc.org/doi/abs/10.1175/JAMC-D-16-0298.1; chemistry impacts limited to S-injection, other particulates are available http://www.pnas.org/content/113/52/14910; cloud microphysics affected by fall speed, in turn affected by whether condensing plume is used (although macro effects are dominant https://doi.org/10.5194/acp-2018-107 in review). MCB: claims of worsening coral bleaching are highly dubious http://onlinelibrary.wiley.com/doi/10.1002/asl2.442/full. CCT: solar power and atmospheric chemistry impacts appear to be conditonal/tenuous/dubious - requires clearer treatment - CCT would intuitively aid solar power. GBAM regional climate disruption is well-established for some techniques, eg brightening deserts http://onlinelibrary.wiley.com/doi/10.1029/2011JD016281/abstract [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	accepted partly. 1) the point here is that SRM could redistribute precipitation l a new way. Yes, global warming itself would lead to changes in precipitation, but we are assessing SRM options itself, as it appear in scientific literature. 2) We revise text: "in case of sulphur injection - disruption to stratospheric chemistry and stratospheric ozone loss". We rewrite this Box significantly, so some other points of this comment also reflected
5176	105	30	106	1	How is it that MCB leads to increases in coral bleaching conditions, given MCM seeks to cool ocean temperatures and can be located in various regions. Asserting this without giving a qualifying likelihood seems unjustified, especially in that the text on page 106, lines 8-9 indicates the opposite outcome. And the other listed impacts there are really likely beneficial or within natural variability. [Michael MacCracken, United States of America]	accepted, this sentence was deleted
48008	105	30	105	30	Kindly check: Robock et al., 2008 is not available in the reference list. [Sarah Connors, France]	accepted, checked
50528	105	30	105	30	Table 1 on SAI indicates much higher levels of certainty and consensus than are actually available, and leaves out the most problematic aspects in 'RMM specific impacts' category, which are termination shock, potential fo political conflict, and moral hazard. The latter should be explicitly addressed in the info box (ref. for example McLaren 2016 in Earths Future for a thorough and nuanced assessment), as it is a core counter-argument for the research on and potential deployment of SRM [Ina Möller, Sweden]	noted, we moved this Table to the 4.3.8 because we had to shorten the Box significantly. Political conflict and moral hazard are discussed in section 4.3.8. Termination shock is discussed in this Box, but in "general impacts"
61300	105	30	105	30	Clarify in the table that the impact of SAI is "stratospheric ozone loss"; currently it just says "ozone loss". [United States of America]	accepted, corrected
9516	105	31	105	31	SAI causes ozone depletion and increased surface UV if sulfate is used. Other aerosols such as calcite would have the opposite sign effect. (See papers by David Keith's group at Harvard.) Adverse impact on solar power is primarily (exclusively?) for concentrating, not for photovoltaic (where the increased diffuse radiation might actually increase power rather than decrease it). Suggest just deleting this point. [Douglas MacMartin, United States of America]	accepted, clarifications added and point on solar deleted.
9518	106		106		Note CCT box was copied from SAI box. CCT would not affect straotspheric chemistry, water vapor, etc the same way. [Douglas MacMartin, United States of America]	accepted, rewritten
1076	106	2	107	13	The fact that modeling evidence consistently indicates that RMMs could reduce climate change anomalies (both temperature and precipitation) at the regional scale should arguably be the first message within this section. After all, this is RMMs' purpose, and the most relevant question appears to be, Would they be effective toward achieving their purpose? As it stands, this key message is buried in E. Overall feasibility of RMMs, on the next page. [Jesse Reynolds, Netherlands]	accepted, we start this section with "Deploying SRM in a supplement to mitigation scenarios could reduce global temperature-related extremes such as rainfall intensity. increases, and lessen the resulting impacts such as further loss of coral from increasing sea-surface temperatures ". Overall feasibility revised
37504	106	2	107	13	The fact that modeling evidence consistently indicates that SRM/RMM could reduce climate change anomalies (both temperature and precipitation) at the regional scale should be the first message within this section. After all, this is the purpose of SRM/RMM and only reason to discuss SRM/RMM in a report on achieving the 1.°C target! The most relevant question thus is: "Could SRM/RMM be effective toward achieving its core purpose?" Statements on uncertainties on side-effects (potentially outweighing benefits from achieving this core purpose) and feasibility are independent and unaffected by statements on its apparent effectivenes. Key References: MacMartin, D. G., Ricke, K. L. & D. W. Keith (2018). Solar Geoengineering as part of an overall strategy for meeting the 1.5°C Paris target. Forthcoming in Phil. Trans. Royal Soc. A. doi:10.1098/rsta.2016.0454 Jones, A., Hawcroft, M., Haywood, J., Jones, A., Guo, X., & Moore, J. (2018). Regional climate impacts of stabilizing global warming at 1.5 K using solar geoengineering. Earth's Future. [Matthias Honegger, Germany]	accepted, we start this section with "Deploying SRM as a supplement to mitigation scenarios could reduce global temperature-related extremes such as rainfall intensity. increases, and lessen the resulting impacts such as further loss of coral from increasing sea-surface temperatures ".
40484	106	2	106	2	"General impacts of radiation modification measures" Potential social and cultural impacts, or negative impacts on ecosystem and agro-ecosystem dynamics, are not considered in this section. The intensity and the wide spatial and temporal scale of the potential impacts of RMM, as well as their irreversibility, must be fully discussed here in the context of sustainable development and the precautionary principle. This comment applies to all geoengineering strategies, but is particularly relevant to the ones with a large geographical impact like RMM. (See, for example, Bravo. 2013. "The Political Ecology of Geoengineering". Letras Verdes. Revista Latinoamericana de Estudios Socioambientales, 14:358-63. https://doi.org/https://doi.org/10.17141/letrasverdes.14.2013.1009. and references therein) [Pedro Alfredo Borges Landaez, Venezuela]	Accepted. We added "Potential ethical and impacts and issues related to the governance and economics are discussed in the section 4.3.8.". Due to words count we can't repeat this
50530	106	2	107	13	The risks of relying on SRM are severly understated in these paragraphs. For example, there is no reference at all to the effects that SRM deployment and termination would have on biodiversity (see Trisos et al. 2018 in Nature Ecology & Evolution), implications for human rights (e.g. Adelman 2017 in Journal of Human Right and the Environment, or Burns 2016), or potentials for global political conflict (Hulme 2012 in Progress in Physical Geography). [Ina Möller, Sweden]	Accepted. We added reference to Trisos. Human rights discussed in 4.3.8. "relying" was a wrong word, we deleted this
1078	106	3	106	5	RMM's potential to increase ocean acidification is due to its impacts on the carbon cycle. This finding would be better reported in section D. Impacts of RMMs on the carbon budget, on the next page, which provides a fuller context. [Jesse Reynolds, Netherlands]	accepted, we moved text here
1080	106	3	106	5	Although this statement is true, it remains unclear how a termination of RMM could occur. See Parker, A and Irvine, P. J., "The risk of a termination shock from solar geoengineering," Earth's Future, accepted and forthcoming. [Jesse Reynolds, Netherlands]	accepted, we revised text here and included the reference.
5178	106	3	106	5	It would really be helpful to reader to give an indication of the mechanism leading to this regional effect and how it compares to the situtation that is already present at that point. [Michael MacCracken, United States of America]	Not applicable, the box was shortened and this sentence is no longer included.
37302	106	3	106	3	A broader statement explaining the fact that RMMs act to directly modify the climate without changing the underlying drivers (e.g. cumulative carbon emissions) would be better to open with here. It seems odd to focus on ocean acidification here when there is a carbon cycle section that follows this one. [Joshua Horton, United States of America]	accepted partly, we revised text here

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37304	106	3	106	5	This result arises because: a) Solar geoengineering reverses the reduction in the intensity of the AMOC; b) the slower AMOC is less efficient at transferring carbon from the surface ocean (where most ocean life exists and which exchanges with the atmosphere) to the deeper ocean. This enhanced transport to the deep ocean as part of an partially restored AMOC seems likely to be a net benefit. [Joshua Horton, United States of America]	Not applicable, the box was shortened and this sentence is no longer included.
9520	106	3	106	3	Overarching implications would also include continued car accidents, stock market fluctuations and miscarriages. Fair to remind the reader that it doesn't affect ocean acidification very much, but "overarching implication" is deliberate normative bias and inappropriate in an IPCC report. This is only an appropriate sentence if you are explicitly talking about using RMM as an *alternative* to mitigation, yet in the peak-shaving discussed in the rest of this section it is generally being considered as a possible supplement to insufficient mitigation. More to the point would be to explicitly add a sentence to this section acknowledging the distinction between looking at impacts relative to the same CO2 concentration without RMM, or relative to the same temperature (i.e. lower CO2 concentration) without RMM. [Douglas MacMartin, United States of America]	Noted. There is evidence that SRM "may worsen ocean acidification, for example, in the case of global-scale SAI implementation (Tjiputra et al. 2016)".It is not just because humans will not reduce CO2 emissions
41694	106	3	106	5	Ocean acidification is not a consequence of SRM, it's a consequence of increased concentrations of CO2 in the atmosphere. What is meant here (I think) is that if SRM development or use resulted in an increase CO2 emissions then that increase would cause ocean acidification. But for balance if you wanted to say this then you should also say that if the development of SRM caused increased commitment to mitigation (a possiblity this chapter notes when addressing 'moral hazard') then that would slow the rate of ocean acidification. I would advise removing both of these speculations and simply stating that SRM cannot be used as an alternative to emissions reductions because does nothing about ocean acidification [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Noted. There is evidence that SRM "may worsen ocean acidification, for example, in the case of global-scale SAI implementation (Tjiputra et al. 2016)".It is not just because we will not reduce CO2 emissions
2158	106	4			SRM inherently tends to worsen OA - however, this works as a CDR method. This trade-off should be made explicit https://www.nature.com/articles/nclimate3376?WT.feed_name=subjects_biological-sciences [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	rejected, proposed reference is a Commentary which we decided not to use in our assessment
37306	106	7	106	9	This point deserves an entire paragraph and should cite the relevant primary literature (not a commentary piece). It should address the global response and cover the broad geographical distribution of outcomes for: Temperature – mean and extreme; Precipitation extremes; Precipitation – evaporation; Sea-level rise; Storm intensity (including hurricanes). There should also be a full paragraph devoted to the climate impacts implications of solar geoengineering that cites the primary literature. [Irvine et al. (2016) "overview of earth system science" in WIRES, and Irvine et al (2017) "towards a climate impacts perspective" in Earth's future] [Joshua Horton, United States of America]	Not applicable, the box was shortened and this sentence is no longer included.
5180	106	9	106	10	While one may not have regional patterns for SAI, it is quite possible and my be beneficial to have mainly latitudinal and seasonal variations, and use these to optimize the desired response in some way. This needs to be recognized. [Michael MacCracken, United States of America]	Rejected. The degree of regional targeting is limited. In addition, the box was shortened, and much of the text had to be condensed. However, this statement is no longer included.
7278	106	9	106	10	This is not correct. See Tilmes et al., 2017, MacMartin et al., 2017, and Kravitz et al., 2017, all published in JGR-Atmospheres. [Ben Kravitz, United States of America]	Noted. The box was shortened and this statement is no longer included.
9522	106	9	106	10	Depends on what one means by "regionally optimizing". See Kravitz et al 2016 (doi:10.5194/esd-7-469-2016) and more importantly MacMartin et al 2017 (doi: 10.1002/2017JD026868) and Kravitz et al 2017 (doi:10.1002/2017JD026874); there is no doubt from well-known patterns of stratospheric circulation that some limited optimization is possible, so need to reword this sentence to be more accurate. See also Dai et al (GRL, 2018) and ban Weiss and Caldeira (ERL, 2010). [Douglas MacMartin, United States of America]	Noted. The box was shortened and this statement is no longer included.
37308	106	9	106	11	Not true--see Irvine et al. (2016) "overview of earth system science" including supplementary material, Chapter 7 of WG1 IPCC AR5. More generally, there is far too much text devoted to surface albedo geoengineering. There have been only a very few papers on this idea and it is not in the same class as the other ideas like stratospheric aerosol geoengineering and marine cloud brightening each of which have tens of papers. [Joshua Horton, United States of America]	Noted. However, the referred text did not mention a lack of literature on surface albedo geoengineering.
2160	106	10			SAI can be meridonally tuned, it cannot practically be zonally tuned. https://search.proquest.com/openview/1907c5a43c2d1e51279c334d57e5a607/1?pq-origsite=gscholar&cbl=105744 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, this sentence was deleted
2162	106	11			Mention tropospheric AI, which is regionally-tunable, and particularly suited to heatwave mitigation http://web.b.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=16807316&AN=89361359&h=%2f5KnqltO2LvdRS2kr%2f6pYN4qkzAyTXgbiZ2dnyAxA3gPVBYRKdXbZLbIju2GTUYYr5c1NW%2bVD6k3V0MaFkhtqw%3d%3d&crl=c&resultNs=AdminWebAuth&resultLocal=ErrCrlNotAuth&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26authtype%3dcrawler%26jrnl%3d16807316%26AN%3d89361359 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, but due to space limit all this sentence was deleted
5182	106	11	106	14	could is not really within IPCC likelihood, and to what extent is this based on a presumption that SAI distribution is uniform in season and latitude with no allowance for adjustments to vary the SAI in latitude and season. This overall statement seems quite speculative and dependent on many presumptions about the global system, and there is no comparison to what the situation is without RRM, where the situation can be quite dire. Context is needed. [Michael MacCracken, United States of America]	Noted. The box was shortened and this statement is no longer included.
34682	106	11			Please complete the reference [Mexico]	accepted, done
37310	106	11	106	14	This is a commentary piece which speculates on these issues rather than simulating them. Furthermore, it seems reasonable that as solar geoengineering would reduce the overall magnitude of climate change it would result in benefits on all these measures compared to a case without geoengineering. [Joshua Horton, United States of America]	accepted, we revised text here
37506	106	11	107	14	This sentence is non-sensical: Any regional climate impact (from non-SRM/RMM climate change or from SRM/RMM climate change) has the stated potential of causing global impacts. Suggest to rephrase: "Given the potential for global implications caused even by local climatic changes due to complex..... (Sillmann et al., 2015) future research may want to pay particular attention to the possibilities of regionally disparate outcomes from SRM/RMM". [Matthias Honegger, Germany]	Accepted. The box was shortened and this statement is no longer included.
41696	106	11	106	14	Again the chapter asserts that SRM would cause regional changes to rainfall patterns and extreme weather, when the evidence we have indicates that SRM use would reduce the changes to extreme weather and rainfall patterns caused by climate change. Seeing as this is what the models have found, this should be reflected instead (Curry et al, Moore et al) [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The box was shortened and this statement is no longer included.
50756	106	11	106	11	At the end of the line "et al.)" should be "et al.)." (dot after the bracket is missing) [Francisco Javier Hurtado Albir, Germany]	accepted, done

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2164	106	14			Effects of climate change are worse. This contradicts the recent no-losers research http://www.tandfonline.com/doi/abs/10.1080/21550085.2014.926078?src=recsys&journalCode=cepe21 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Rejected, because it is based on a link to a commentary only that uses references that were not published at the time. One of the final published article (e.g., Kravitz et al. 2014 in ERL) does state "However, for some regions under some metrics (e.g., most of the weight assigned to precipitation), any amount of solar geoengineering can exacerbate climate changes that are due to CO2 alone. As such, our simple example of using mean temperature and precipitation illustrates that solar geoengineering would involve trade-offs." The paragraph was rephrased a bit to reflect this.
4336	106	16			This mentions termination shock. The model predictions are that, if marine cloud brightening was stopped, temperatures would rise to where the pre-treatment trajectory would predict in a period of ten years. A fast change is worse than a slow change but an irreversible change might be worse still. Ten years is much too short a time for most species (except drosophila) to evolve or populations to migrate but it is a long time to repair or replace spray vessels. The loss of electricity generation causes serious problems in 20 milliseconds, a computer network in 2 seconds, a telephone network in about two minutes, food distribution and sewage treatment in 2 days. These possible termination problems have not been given as reasons to prevent the use of such valuable technologies. We might want to stop marine cloud brightening suddenly if there was a repeat of Pinatubo but this would be a deliberate decision reached with plenty of time. The fact that spraying could stop at the click of an email and the resultant cooling could be stopped in a few days is an attractive feature of marine cloud brightening especially when we are learning how to do it. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	accepted, paragraph about termination shock was revised
5184	106	16	106	18	When used in a peak shaving mode, this potential termination shock is nowhere near as large as some of the references suggest. in addition, given the ease of supposedly doing this, it would be quite possible for other nations to substitute in--indeed, if done as an international project, it would likely be that the effort is being shared. The real shock to be worried about is that climate situation that would exist without RMM, which would likley cause far greater losses and seems to be much more probable. I just think too much is being made of this possibility given the other threats of not enough mitigation, of CDR not panning out as needed and assumed, etc.--and the text has not really seemed to mention these in nearly as prominent a way. [Michael MacCracken, United States of America]	accepted, we revised text here
9524	106	16	106	19	Two independent thoughts here, thus this should be separated into two sentences. The one (see my earlier comment) is to acknowledge distinction in defining risks regarding whether RMM is a supplement or replacement. (And that part of the sentence yet again reveals inappropriate normative bias, suggesting that the author was compelled to acknowledge the possibility that RMM could be used as a supplement but didn't actually believe it.) The second thought is the termination issue, which is more or less unrelated; regardless of how it is used, there is potential for termination, with the impacts dependent on how much RMM is being used to cool and how rapidly it is terminated. (Of course this also raises the question of whether said termination is likely or not, as a real risk assessment should include both severity and probability, and not just one of those.) [Douglas MacMartin, United States of America]	Accepted, SRM is supplementary to mitigation. We start the Box with this. Text about termination shock was revised as well.
37312	106	16	106	18	It is critical to contextualize the potential for a termination shock with an explanation of just how unlikely it is to occur given the relative ease with which a robust deployment system could be developed and the fact that all nations would be united in their desire to avoid this outcome. Parker and Irvine (2018, Earth's Future, "The risk of termination shock from solar geoengineering") provides a thorough discussion of the likelihood of a termination shock. [Joshua Horton, United States of America]	accepted, we revised text here and added this reference
37508	106	16	107	18	add: though the likelihood of such termination is debated (Parker and Irvine, 2018) Parker, A., & Irvine, P. (2018). The risk of a termination shock from solar geoengineering. Forthcoming in Earth's Future. [Matthias Honegger, Germany]	accepted, text revised
41698	106	16	106	18	Need to add in: "Although recent research has concluded that termination shock should be much easier to avoid than previously thought, as it should be relatively easy to design an SRM system that would be robust and resilient against almost all drivers of termination (Parker and Irvine (2018) Earth's Future) [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	accepted, we revised text here and added this reference
50526	106	16	106	18	Considering the enormous effect that the 'termination shock' would have on the planet, it is discussed extremely briefly in Box 4.2. I strongly encourage the inclusion of at least one paragraph explaining what the termination shock is, how it is induced, the kinds of emissions savings and negative emissions deployment needed to avoid it, plus a graph showing the effects in rising temperatures (as modeled by Jones et al. 2013, whose data is already being used to show the increase in carbon budget that SAI would enable). [Ina Möller, Sweden]	accepted, we revised text here
2166	106	18			Termination shock is theoretical. It is difficult/impossible to imagine circumstances where it would be allowed to occur, absent a global societal collapse. https://www.spp-climate-engineering.de/files/ce-projekt/media/download_PDFs/CERSYM%20PresentationTeil57.pdf [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	accepted, paragraph about termination shock was revised
62034	107	1	107	34	Inconsistency between the upper part of this apge (low confidence for effects of RMM on ecosystem health and crop yields) and the lower part (carbon sinks by ecosystems and carbon budgets). Discussing the sources of uncertainties is important (e.g. effect of CO2 on plant productivity, processes and their representation in state of the art coupled climate models...). [Valérie Masson-Delmotte, France]	Taken into account, we rewrite text here. Although relevant, we think that the impact of termination of SRM on carbon budget is an important point because it relates to the permanence of CO2 storage.
2168	107	2			claims of uncertainty are dubious and uncited [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The box was shortened and this statement is no longer included.
5186	107	2	107	7	This seems a very overstated and one-sided criticism, and applies in its way to the other approaches of mitigation and CDR on short term evaluations (as are presumably being referred to here). If done persistently, the changes would be detected and could be attributed. The uncertainties being mentioned apply equally to the projections of major cahnges that are leading to the decision to end release of CO2 by changing over the global energy system or can be readily dealt with as an engineering and implementation issue through iterative learning--deployment is not a once and for all decision with specified amounts, etc., it would best be done iteratively and learning as one goes along. And regarding the assessment on food production and ecosystem health, there is really no question that RMM would make the situation better than for situations without RMM even if the conditions are not brought back exactly to preindustrial. I just don't think this is a balanced criticism, and it is mainly because the overall situation being faced has not been provided and used as context. [Michael MacCracken, United States of America]	Noted. The box was shortened and most of this text is no longer included.
9526	107	2	107	5	Would this paragraph be identical if you substituted "mitigation" for "RMM"? I think it is clear that (i) there are larger uncertainties for RMM than mitigation, but (ii) because RMM acts immediately, it would likely be eaiser to detect and attribute harms... Not suggesting that as written this is technically wrong per se, but the issue is far more subtle than this paragraph would convey. [Douglas MacMartin, United States of America]	Taken into account. The text has been clarified to make this more clear
37314	107	2	107	3	It is not clear what this means. Don't the same uncertainties apply to climate change, making potential risk management tools such as RMM worthy of critical, balanced assessment? If not, why not? [Joshua Horton, United States of America]	taken in to account; the previous paragraph refers to risks associated to SRM deployment. The impacts of SRM on vegetation concerns more the food production system because of regional impacts of SRM on cropland areas. The revised text has been clarified accordingly.

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9528	107	5	107	7	Again, are you comparing to the same CO2 concentrations without RMM or the same temperature. If it is the former, then presumably everything else in SR1.5 that talks about how 1.5C is less risk than higher temperatures would also apply here, no? (This is, again, a fundamental framing problem with this entire section.) [Douglas MacMartin, United States of America]	Taken into account. The text has been clarified accordingly.
37316	107	5	107	7	There are relatively few studies of SRM effects on either food production or ecosystem health, but limited results have shown relatively positive effects. Thus while there is low confidence in any assessment, positive or negative, more research is warranted. See Irvine et al. (2017) for an overview. [Joshua Horton, United States of America]	Taken into account. The text has been clarified accordingly.
2170	107	7			incorrect - there is high confidence that a high--CO2 world with SRM would benefit from higher NPP due to higher diffuse radiation and lower evapotranspiration. This sets off any over-drying (which people would be unlikely to cause deliberately, anyhow). Over drying can be avoided using cocktail geoengineering http://onlinelibrary.wiley.com/doi/10.1002/2017GL074281/abstract [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Reject. It is unclear what the effects would be. In case of termination shock, negative impacts would far outweigh any potential benefits. The literature is not large enough to provide a robust assessment on this point. However, note that the box was shortened, and this specific statement is no longer included.
5188	107	9	107	13	These statements are made when there has been essentially no funding provided for research of this RMM options and ways to optimize their influence. I would also note that a number of CDR and even some mitigation options (e.g., biofuels) are subject to similar critiicsms, though not really pointed out in the report. Also, the various RMMs approaches really imitate natrual phenomena or at least for MCB existing ship tracks, and so a good deal is understood about them--and what is really problematic is unconstrained global warming, even as limited by the level of mitigation and CDR that is likely to actually be accomplished. I just do not see this as a balanced criticism of RMMs compared to what has been said about what levels of mitigation and CDR can be accomplished. [Michael MacCracken, United States of America]	Taken in to account, this part of the text was revised significantly to make it more balanced. Also we added some positive SRM effects such as reduction of extreme temperatures and rate of sea level rise to the last section of this Box.
9530	107	9	107	9	Again, could be clearer before using words like "relying"; agree completely that everything we know about RMM's says we shouldn't relax our mitigation efforts, but we also know that overshoot of 1.5 is nearly certain. Just exactly what do you mean, then, by "rely"? If RMMs are the only way to maintain 1.5C, are we relying on them, or are you trying to imply that we are facing a choice between RMMs and mitigation and we should pick the latter? This seems like you're sweeping a big issue under the rug and hoping no-one notices. [Douglas MacMartin, United States of America]	Accepted. Text has been revised
37318	107	9	107	9	There are two distinctly different interpretations of “relying on RMMs” here: 1) as a substitute for emissions cuts, 2) as a complement to emissions cuts. [Joshua Horton, United States of America]	Accepted. This paragraph has been revised.
37320	107	9	107	10	Not clear how this is a risk. [Joshua Horton, United States of America]	Taken into account. this paragraph has been revised
37322	107	10	107	10	This would be an appropriate place to cite Keith et al. 2014 (Keith, David W., Riley Duren, and Douglas G. MacMartin. "Field experiments on solar geoengineering: report of a workshop exploring a representative research portfolio." Phil. Trans. R. Soc. A 372.2031 (2014): 20140175). This publication lays out a systematic approach to empirically assessing the scientific uncertainty in understanding the physical science of RMM, and increasing the physical scale of experimentation to provide a gradual and governable pathway to "field testing." [Joshua Horton, United States of America]	Noted. This box was substantially shortened and this aspect is not addressed in detail anymore.
37324	107	10	107	11	The effects of SAI on the troposphere are mixed. This statement is generally negative, unspecific and does not cite the primary literature. What are these negative effects and are they substantial or trivial? Deposition is not a substantial problem - http://onlinelibrary.wiley.com/doi/10.1029/2009JD011918/full. Diffuse light does not greatly affect sky appearance - http://onlinelibrary.wiley.com/doi/10.1029/2012GL051652/full. And Eastham (2018) and https://www.atmos-chem-phys.net/17/11913/2017/acp-17-11913-2017.pdf shows reduced strat ozone could result in less tropospheric ozone health impacts. [Joshua Horton, United States of America]	Accepted, this part o the text has been revised
37326	107	11	107	12	This is very unclear. I'd also suggest that the balance of evidence points towards the fact that solar geo would reduce risks for these factors compared to a case without solar geo. Glienke et al. (2015) showed increased net primary productivity in a geoengineered case relative to the control and higher productivity in most models outside of high-latitude regions which benefit from global warming. Irvine et al. (2017, WIRES) review the agriculture modeling studies at the time of publication and conclude that solar geo would likely reduce impacts on agriculture though would also reverse gains in regions that benefit from climate change. [Joshua Horton, United States of America]	Noted. This box was shortened and this statement is no longer included.
2172	107	12			see lockley and coffman on the importance of distinguishing moral hazard (malfeasance) from morale hazard (recklessness) http://journals.sagepub.com/doi/abs/10.1177/1461452916659830 [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	noted, thank you for the reference. We discuss moral hazard in section 4.3.8.
37328	107	12	107	13	If “relying on” refered to displacing emissions reductions then this statement is redundant. Further, this would be an appropriate place to cite a publication where the moral hazard of regional scale experimental assessment of SAI has been investigated: Lenferna, Georges Alexandre, et al. "Relevant climate response tests for stratospheric aerosol injection: A combined ethical and scientific analysis." Earth's Future 5.6 (2017): 577-591. [Joshua Horton, United States of America]	Accepted. We revised this text
38636	107	15	107	35	I think a better explanaition of how SRM affects the C budget is needed. Need a clear explanation that distinguish between the case where temp is kept lower for the same amount of cumulative CO2 and the case where SRM affects the C cycle. [Jan Fuglestvedt, Norway]	Accepted. The text has been clarified accordingly.
37330	107	16	107	17	All show a substantial net increase in land carbon storage. [Joshua Horton, United States of America]	Noted. This is addressed in other sections, not in the box on SRM.
37332	107	16	107	20	There are well understood positive temperature-carbon feedbacks on land (more rapid decomposition of soil carbon and the melting of permafrost which drives carbon emissions) that first principles suggest solar geoengineering would reduce should be made absolutely clear here. Every single carbon cycle simulation to date has shown that solar geoengineering results in greater carbon storage on land (and less in the atmosphere and ocean). There are large uncertainties in the magnitude of this effect but there is consistent theoretical and modeling evidence that solar geoengineering would reduce the positive climate-carbon feedbacks that cut into the carbon budgets. Note, that the first carbon cycle studies of Matthews and Caldeira are missing from this citation list. [Keller et al. (2014) https://www.nature.com/articles/ncomms4304 , Cao et al. (2017) http://onlinelibrary.wiley.com/doi/10.1002/2017GL076546/full , matthews and caldeira (2007) http://www.pnas.org/content/104/24/9949.short; Keith et al. (2018) present this high-level perspective: https://www.nature.com/articles/nclimate3376] [Joshua Horton, United States of America]	Accepted. The references have been included; and the text has been amended accordingly. We now clearly state that most of the carbon uptake is driven by land.
5190	107	18	107	20	Indeed, quite idealized simulations and not really related to what would happen with gradual, peak shaving implementation, and this needs to be mentioned. [Michael MacCracken, United States of America]	Taken into account. This point is already mentioned in the text. We cannot provides further caveats in regards of the space dedicated to this box.
5192	107	22	107	26	The idea is not to increase the allowable carbon budget, so more mitigation--the objective is to get the increase in the global average temperature back to less than 0.5 C as soon as possible rather than sustain a 1.5 C warming, for which there is not scientific justification and many reasons to be concerned about the impacts at that level of warming. So, this is very strangely worded--every bit of help is needed to get the temperature back down, and using RMM to shave the peak warming down to 0.5 C or less would be even more beneficial through the carbon cycle. [Michael MacCracken, United States of America]	rejected. Indirectly with increased C budget, SRM would impact global mean temperature. However, we stress that the level of carbon uptake driven by the deployment of SRM remains small compared to CDR (though this statement was removed because of page length issues).
5532	107	22	107	26	this paragraph is not understandable. E.g., what is "(see 0)". I do not understand the final sentence; seems to say that since not much CMM is assumed then it is small -- seems like a circular agruement? Suggest clarifying this sentence. [Haroon KHESHGI, United States of America]	taken into account, this paragraph has been revised.

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37334	107	22	107	26	It is unclear where these spuriously precise results come from and such precision is not justified given the state of understanding on this issue. [Joshua Horton, United States of America]	taken into account, this paragraph has been revised accordingly
3272	107	23	107	24	In-text reference is incorrect "…(see 0)…" [Vassilis Daioglou, Netherlands]	Accept. Text revised.
2174	107	24			see 0 - ???? [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, revised
37336	107	25	107	26	It is not clear why the relative size of this effect compared to the CDR carbon draw downs is relevant. [Joshua Horton, United States of America]	Taken into account, this paragraph has been revised accordingly and the reference to CDR was taken out.
41648	107	25			Why "SO2" in "Tg(SO2)" in brackets? See "GtCO2" in page10 line 40 for example. [Czech Republic]	Accepted, revised
28742	107	26	107	26	To prevent misunderstanding, please add "on carbon budget", so that is written: …,the impacts of SAI on carbon budget are weak. [Germany]	Taken into account, this paragraph has been revised accordingly. Rather than passing judgment on whether it's a weak or a strong effect, we mention the numbers.
5194	107	28	107	34	Given the primary purpose of proposed RMMs is to limit the warming, any ability to allow the oceans and biosphere to pull CO2 from the atmosphere is a nice co-benefit, but making this a key critierion for RMM implementation really is focusing on the wrong aspect of what RMM is proposed to do. Again, context is needed, including the dire situation likely to be faced if RRM is not deployed and playing a role. And including a graphic on page 108 about all of this seems to use for too much space for addressing a minor issue instead of considering the importance of RMM in limiting the impacts of a much warmer climate. [Michael MacCracken, United States of America]	Taken into account. Correct, SRM does not aim of lowering atmospheric CO2 concentration at the first place, but its impacts on surface temperature does. The role of SRM has been clarified in this section.
2176	107	34			Termination shock is theoretical. It is difficult/impossible to imagine circumstances where it would be allowed to occur, absent a global societal collapse. https://www.spp-climate-engineering.de/files/ce-projekt/media/download_PDFs/CERSYM%20PresentationTeil57.pdf [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Taken in to account. See also response to comment 2170.
5530	108	3	108	10	To understand the implications of this chart, one needs to know the context of how much RMM is being carried out. Suggest that this be described in the figure caption (e.g. is this for the case mentioned on page 4-107 of 4TgS/yr injection?) [Haroon KHESHGI, United States of America]	noted, this figure was removed from this Box due to space limits
2178	108	12	108	21	generally unsubstantiated. No economic models of SRM suggest it's undeliverable eg http://iopscience.iop.org/article/10.1088/1748-9326/7/3/034019. 'Most harmful' effects are an invention - research shows a net gain in welfare http://www.tandfonline.com/doi/abs/10.1080/21550085.2014.926078?src=recsys&journalCode=cepe21. Ethical implications of SRM are not necessarily inherently worse than for CDR - and may be better (eg food production conflicts). Sustainable development impact in fact has the opposite sign to claims herein. SRM not as unpredictable as the impacts from continuing global warming, esp wrt c-cycle feedbacks - which are large, poorly constrained and highly impactful in unconstrained situations (esp permafrost). http://iopscience.iop.org/article/10.1088/1748-9326/9/8/085003/meta [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	taken into account, we revised this para and removed reference to economic factors.
5196	108	13	108	14	Specifying 1.5 C here is too limiting--RMMS are capable of offsetting warming to pull back to a range of possible levels, including 0.5 C, which would be much more reasonable a level to focus on than 1.5 C. [Michael MacCracken, United States of America]	Noted, this report should be focused on 1.5C only, because it has strong space limits, all other details will be in AR6. See responses to earlier comments, e.g. 5154.
37338	108	13	108	21	In general, this section tends to emphasize on the uncertainties of RMM and downplay many agreed-upon benefits of RMM. Broadly, risks of RMM are often stated out of the context of climate change, and not as associated with potentially large benefits. It also misses studies that show engineering capacities in RMM strategies to address potential drawbacks. The many possible drawbacks and limitations (including political legitimacy) of RMM techniques for reaching the 1.5°C target are a necessary element to conclude this section of the report. It is also certainly true that these factors may constrain the responsible implementation of RMM. There are, however, other viewpoints to making sense of these challenges. For example, Asayama et al. 2017 (Asayama, Shinichiro, Masahiro Sugiyama, and Atsushi Ishii. "Ambivalent climate of opinions: tensions and dilemmas in understanding geoengineering experimentation." Geoforum 80 (2017): 82-92) find an abiding ambivalence in the Japanese public regarding SAI. They conclude that researchers should embrace ambivalence in presenting the risks and benefits of geoengineering and reflect on their own preferences, values, and judgments to promote a debate that is democratic and inclusive. [Joshua Horton, United States of America]	taken into account, text revised to be more balanced. Some of the controversial statements were deleted. Asayama cited in 4.3.8
41700	108	13	108	14	This para should unpack the potential impacts of SRM as the potential drawbacks have been unpacked elsewhere, rather than just stating with some austerity that SRM could reduce temperature-related impacts of passing 1.5c. Firstly that will imply erroneously to some readers that SRM is good for temp and bad for precip, a myth that this report should be careful not to perpetuate. Secondly it can easily go into more detail with appropiate referencing at each step, stating that modelling has found that SRM should be able to reduce climate impacts on: global average temperatures (Irvine et al 2016), extreme temperatures (Curry et al 2013), extremes of precipitaton (Curry et al 2013), disruptions to average precipitation (Irvine et al 2016), rate of sea level rise (Moore et al 2010) and intensity of tropical cyclones (Moore et al 2015; Jones et al 2017). [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, we revised this para and have added some details about SRM benefits
5198	108	14	108	16	This is simply not a fair and balanced presentation of the issue: (1) any harmful effects of RMM would be, by design, far less than the impacts of not undertaking RMM--unless RMM is beneficial, it is not going to be done, or will be adjusted and redesigned, so this is just misstating the situation; (2) on governance issue, they are far less than would seem likely to result if RMM is not moderating overall climate change--when overshoots of what is likely to happen based on progress to date will be causing all sorts of governance issues in the world due to environmental refugees, etc.; (3) regarding ethical issues, the much larger, yet unmentioned ethical issues relate to what would happen if an approach is held back that could significantly moderate the impacts of the rise in GHGs--and yet that issue is not even covered in the wirte-up on the RMM issue: (4) public resistance now is based on the very low likelihood that the Paris agreement is going to be met and that it can be met--and it is just not at all likely that this is the case and when this is really realized and accepted, the public reaction to those who held back consideration and investigation of RMM is going to be a very serious issue; and (5) it will be much harder to reach the SDGs wihtout RMM than with it. So, in my view, the statement here is very seriously misleading and needs much more balanced presentation. [Michael MacCracken, United States of America]	Taken into account, text revised to be more balanced. Some of the controversial statements were deleted.
37510	108	14	108	15	This sentence fails to capture the essence of the dilemma. Replace: "Yet, even in the uncertain case that scientific evidence in the future suggests with high confidence that expected harmful effects of specific RMM deployment approaches would be exceeded by the expected benefits, could governance issues, ethical implications, and public resistance render RMMs socially or politically infeasible". [Matthias Honegger, Germany]	Noted, this was actually deleted

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9532	108	14	108	16	The preceding discussion didn't really identify what constitutes "harmful side effects", since that depends on the comparison one is making. Suggest deleting all of the text between the first two commas, and change the "could" on line 16 to something softer like "may". I have a hard time predicting what people 20 years from now will choose, in part because I don't know what the consequences of not pursuing RMMs will look like; if they are clear and sufficiently bad, then it is quite plausible that all of the societal challenges noted here won't preclude feasibility. Agree that this report should acknowledge these concerns, but I don't think this report should take a position based on guessing what future people will decide. [Douglas MacMartin, United States of America]	Noted, however, this particular phrase was deleted.
7280	108	15	108	16	Or not. It's also plausible that societies view RMMs as a way of quickly relieving suffering and will want to ensure it is done. You don't know the future. [Ben Kravitz, United States of America]	Accepted partly, text revised
1082	108	16	108	16	There is no evidence to suggest that RMM would be economically infeasible. See section 4.3.9.2 [Jesse Reynolds, Netherlands]	Accepted, text revised
5200	108	16	108	21	Given that there has been essentially no research on RMMs based on the now fading hope that mitigation would be able to sufficiently limit warming, there is an insufficiency of understanding on the issue just when it is really needed in that mitigation along and even mitigation with CDR simply cannot, in any realistic implementation, be expected to prevent significant overshoot (as some parts of this report make clear). With respect to uncertainties, what matters are not absolute uncertainties, but projected changes and relative uncertainties. Analog situations (volcanic eruptions and ship tracks) make clear that the leading RMM approaches have the potential to offset at least some warming and return condtions toward those consistent with a much lower level of impacts than were RMMs not deployed. Yes, tuning and iterative learning will be needed to work through the effects of some of the uncertainties, but this would be mainly an engineering effort during implementation than posing a scientific basis for not proceeding. The consequences of not having RMM shaving off the peak warming and associated impacts will be disastrous, as will viewing the 1.5 C level as a long-term equilibrium level of warming, and getting to a lower level is just not possible in any timely way without RMM given what is known about CDR and DAC and how these can be phased up--and if these approaches can be phased up more rapidly, then it would be early to have RMM play less of a role. But given where the situation is, not having RMM as a means of shaving off peak conditions, the impacts of climate change will be catastrophic for society. [Michael MacCracken, United States of America]	taken into account, text revised. We start this section with statement "SRM can potentially reduce the climate impacts of a temporary temperature overshoot alongside intense mitigation and adaptation efforts. "
9534	108	18	108	18	Not sure what is meant by "unpredictability", a reader might infer something about year to year unpredictability. A better set of words to use here would be something like "currently insufficient knowledge" [Douglas MacMartin, United States of America]	Noted, this was deleted
1084	108	20	108	20	I believe that "effectiveness" is better than "efficiency," which requires a denominator [Jesse Reynolds, Netherlands]	Noted, this was deleted
1086	108	20	108	20	These conditions (technological maturity, physical understanding, efficiency to limit global warming, and ability to scale, govern and legitimise) are largely due to the current state of knowledge. Further research could decrease these conditions. Therefore, these conditions constrain our *present* ability to implement them, and our *understanding* of our ability to implement them. [Jesse Reynolds, Netherlands]	Accepted, we revised text here to include the point about the "near future".
9536	108	20	108	20	Should include the word "currently" constrain our ability… [Douglas MacMartin, United States of America]	Accepted, we added also "in near future"
37512	108	20	108	20	Replace "efficiency" by "effectiveness". [Matthias Honegger, Germany]	Noted, this was deleted
7226	109		116		Cross-chapter box 4.3: the poverty, livelihood and sustainability consequences remain underexplored - more input needed from Ch5 LAs (Sharina, Avelina, and Patricia). [Petra Tschakert, Australia]	Accepted, all case studies have a clear explanation of the sustainable development, poverty and livelihood implications of the corresponding adaptation options.
5664	109		109		The account of adaptation in the Arctic in box 4.3 is insufficient and does not consider the emotional and psychological effects of colonialism, genocidal policies against indigenous peoples, and the pressure to adapt to more urban and less land-based economies. The Arctic has a high population of indigenous peoples, and is in addition subject to massive amounts of forest fires (Canada and Alaska), while Siberia has massive damage from petroleum infrastructure, and the European Arctis is under siege from designs to drill for oil and expand shipping routes. The indigenous populations in the Arctic have long been under pressure through colonial practices and other forms of cultural genocide that affects indigenous peoples including substance abuse, domestic violence and gender-based violence. Likewise, Arctic settler populations are under economic and regional pressure, generally marginalized by their urban-based governments. This report seems to insufficiently indicate these issues as well as the increased pressure national governments are exerting on regions in the north to increase extractive industries and displace the populations that are struggling to continue living a subsistence lifestyle. If there is not space to expand these short accounts in the box, it might be better to drop them, as they appear all too harmonizing without considering the human cost as well the cost to the integrity of ecosystems. In future reports, it seems key also to highlight the previous stressors that heighten the difficulty of some populations to adapt rather than others... Possibly the report should also address the myth among some that a warming Arctic will mean better agricultural possibilities and other economic benefits in those regions, adaptations that may be unrealistic given unsuitable soils, eropison and ocean acidification, problematic ocean aquacultures such as fish farms, and other challenges. Some of this is mentioend in 5-13 line 44 if briefly, but it needs also to be mentioned here. [Marion Grau, Norway]	Accepted - text revised (sentence added on challenge posed by colonization, marginalization etc. for adaptation)
9584	109				Box 4.3 is a useful addition to highlight broadly risks and adaptation in various regions. It would be even more useful to have some specific examples. For example, line 46-48 indicates that adaptation initiatives and actions are being increasingly observed at local levels that respond to multiple stressors - is it possible to include links to examples? It would be most useful for the audience of this report to have information that directs us to where we can access details about what adaptation actually looks like. Furthermore, in this table under the Arctic example, line 53 notes the importance of incorporating Indigenous knowledge. As stated in a comment above, the Inuit Circumpolar Council advocates for the utilization of Indigenous knowledge rather than the integration or incorporation of this knowledge into the western system as these latter terms imply that IK is attempted to be fitted and molded into the scientific knowledge form (i.e. something that IK is not), instead of it being recognized and applied on equal footing. [Joanna Petrasek MacDonald, Canada]	Accepted - some examples were included in this box. Additionally, and although not explicitly detailed in this box, other examples of adaptation and uses of IK are in other section of Ch. 4. For example, Box 4.3 focuses on indigenous knowledge.
62036	109	1	116	10	explain the reason for chosing these examples. The link with the information from chapter 3 is not clear enough (today's and 1.5°C impacts and risks). The example for the Amazon appears quite different (oriented at mitigation and forest preservation rather than adaptation as currently written). The statement about "climate impacts already felt in regions" is ambiguous (climate variability? climate change? link to attribution). A cautious wording is needed here. [Valérie Masson-Delmotte, France]	Accepted. Each case study was selected based on socio-ecological systems identified in Chapter 3. Text has been revised and the Amazon example is now more focused on climate impacts, the adaptation options to respond to these impacts, and the sustainable development implications of these options, as do other case studies in the box.
18676	109	3	114	45	It is surprising that there are no examples from Europe, which is very active in mitigation and adaptation measures at the different levels (from European Union's to local) and also bottom-up. Overall, the report present very few European examples. Is there a particular reaason for that? (lack of examples in the literature)? [Andrea TILCHE, Belgium]	Taken into account - case studies were selected based on socio-ecological systems identified in Chapter 3.
62816	109	4	116	9	In Cross chapter box 4.3, it seems important to include a case study for Africa. [Smail Khennas, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - case studies were selected based on socio-ecological systems identified in Chapter 3.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
33996	109	18	109	55	Cross-Chapter Box 4.3: Please consider to address scientific findings related to the emotional and psychological effects and the challenges related to maintaining their livelihoods. Possibly the report should also address the myth among some that a warming Arctic will mean better agricultural possibilities and other economic benefits in those regions, adaptations that may be unrealistic given unsuitable soils, erosion and ocean acidification, problematic ocean aquacultures such as fish farms, and other challenges. Some of this is mentioned in 5-13 line 44 if briefly, but consider also to be mention it here. [Norway]	Accepted - text revision (text added on emotional and psychological impacts)
5202	109	24	109	25	This seems a statement that is far too strong, expecially with only one reference to support the position. With model simulations consistently underestimating the pace of sea ice retreat over recent decades, how is it possible to come to a finding with such high confidence? Already with 1 C global warming, the thickness of ice is way down and its overall quality in late summer is quite poor. A key question is what "ice free" means, as a great deal of the ice cen be melted back without losing 100% of the ice, and so ice free has not generally meant 100%, but less than something like a million square kilometers. Given this situation, it just seems to me that suggesting there will not be much greater loss, including the potential for virtually complete loss of sea ice in summer. As a related point it is not at all clear that ice cover in September is a key metric for the state of the Arctic. Peak ice in winter is dropping decade by decade and the summer ice is also dropping--I just don't think that asserting this with "very unlikely" is wise or justified. [Michael MacCracken, United States of America]	Accepted - text changed to capture the most recent research on sea ice change in-light of 1.5C and beyond
46968	109	25	109	25	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted - text revised (alternative wording used)
9414	109	26	109	26	Incorrect termimology - it should be "permafrost thaw" not "melt" [Sharon Smith, Canada]	Accepted - text altered as recommended
45996	109	43	109	43	Some more insight or example of "stakeholder view" for this case, as it may be very variable by case. [Hiroyuki ENOMOTO, Japan]	Accepted - text revised ("views" changed to "engagement")
9416	109	46	109	55	Reference to other regional AACA/AMAP reports would be useful here as not all regions are the same in terms of impacts or approaches to adaptation. Also there are concrete examples (some of which are mentioned for eg. in Permafrost chapter of AMAP SWIPA 2017 report) that could be mentioned to illustrate approach. Canadian examples include Northern Infrastructure Standards Initiative (under leadership of Standards Council of Canada - see https://www.scc.ca/en/nisi) such as CAN/CSA-S500-14 (Thermosyphon design); CAN/CSA-S501-14 (moderating effects of permafrost degradation); CAN/CSA-S502-14 (managing snow load risk); CAN/CSA-S503-15 (community drainage). Northern advisory committees were a key component of this initiative. There have been other things regarding best practices etc. as mentioned in SWIPA 2017 report (see for e.g pg 87-88) [Sharon Smith, Canada]	Accepted - text revised (reference to AMAPs AACA assessments made, but the SWIPPA report at time of writing is only available as a summary)
5204	110	3	110	13	The World Bank did a major report on impacts in this area several years ago that merits mention. Their findings indicate that sea level rise would be very likely to be the most significant and widespread impact. While it is mentioned in this paragraph, the impression here seems to me to be quite hidden, even though it would seem pretty likely that this will over time have very devastating consequences, etc. I would urge giving the expectation for long-term sea level rise much more attention--and drawing on the findings and reporting that is included in that World Bank report. [Michael MacCracken, United States of America]	Noted - Not sure which World Bank report is being referred to but the authors have conducted a fresh search. The WB and GEF Mekong 'Delta Integrated Climate Resilience and Sustainable Livelihoods Project' has only started recently so results from the project are not available. The current text acknowledges the key role of sea level rise in the Mekong region (based on cited reference Smajgl, A., T. Q. Toan, D. K. Nhan, J. Ward, N. H. Trung, L. Q. Tri, V. P. D. Tri, and P. T. Vu, 2015: Responding to rising sea levels in the Mekong Delta. Nat. Clim. Chang., 5, 167.) Mekong case has now shifted to x-chapter box on Food Security in Chapter 3.
52276	110	3	110	4	Where are these places being described? [Jason Donev, Canada]	Taken into account. The places are described at the beginning of Box 4.3. Mekong case has now shifted to x-chapter box on Food Security in Chapter 3.
7132	110	17	110	17	Add and new experimental technologies, such as magnetic water irrigation treatment, which has in some cases proved to improve crop yelds, accelerate nutrient delivery and raise effiency, lower water consumption. Example, Basant L. Maheshwari, Harsharn Singh Grewal, Magnetic treatment of irrigation water: Its effects on vegetable crop yield and water productivity, Agricultural Water Management, Volume 96, Issue 8, 2009, Pages 1229-1236, ISSN 0378-3774, https://doi.org/10.1016/j.agwat.2009.03.016. [Jose Di Bella, Canada]	Noted - Experimental technologies such as magnetic treatment have not been discussed due to low evidence base of its effectiveness in the Mekong region. Also, this report focusses on using post AR5 literature from 2014 onwards. Mekong case has now shifted to x-chapter box on Food Security in Chapter 3.
45074	110	46	114	24	Middle east is quite sensetive to changes in the climate, especially to drought and dust. In recent years, the dust storm has been spread to central Asia and southern Europe in addition to the Middle East countries. In thi sregard, a special topic on Middeel east dust and drought is needed to add to this chapter, as seen for Caribbean and Amazon. [Iman Babaeian, Iran]	Taken into account - there aren't case studies for each hotspot or socio-ecological system identified in Ch. 3. This box is not meant to be exhaustive.
48254	110	46	114	24	Middle east is quite sensetive to changes in the climate, especially to drought and dust. In recent years, the dust storm has been spread to central Asia and southern Europe in addition to the Middle East countries. In this regard, a special topic on Middeel east dust and drought is needed to add to this chapter, as seen for Caribbean and Amazon. [Iran]	Taken into account - there aren't case studies for each hotspot or socio-ecological system identified in Ch. 3. This box is not meant to be exhaustive.
5666	110	46	113		The section on hurricanes is important and good to have updated. It would also be important to use Puerto Rico as a comparative with Cuba, Jamaica etc as governance and access are major issues in PR. The graph with estimated hurrican damages highlights the difference between the Arctic and the Caribbean in terms of the damage being less dramatic, but thus also less quantifiable? It is possible to render a graph of the cost of sea ice and loss of property and land due to loss of permafrost? [Marion Grau, Norway]	Rejected - there is not sufficient academic literature and lessons learned on the case of Puerto Rico, but it can be considered for AR6. We are not able to create a graph of the cost of sea ice and loss of property and land due to loss of permafrost as this data is not available.
33998	110	46	114	1	The section on hurricanes is important and useful to have updated. It would also be important to use Puerto Rico as a comparative with Cuba, Jamaica etc. since governance and access are major issues in PR. The graph with estimated hurricane damages highlights the difference between the Arctic and the Caribbean in terms of the damage being less dramatic. However, is it therefore also less quantifiable? It is possible to render a graph of the cost of loss of sea ice and loss of property and land due to reduction in permafrost? [Norway]	Rejected - there is not sufficient academic literature and lessons learned on the case of Puerto Rico, but it can be considered for AR6. We do have a case study of an overseas territory. We are not able to create a graph of the cost of sea ice and loss of property and land due to loss of permafrost as this data is not available
36506	110	48	110	52	This is a useful point that should be retained [Snaliah Mahal, Saint Lucia]	Accepted
57400	110	50	110	50	Should include here impacts on infrastructure and settlements [Hans Poertner, Germany]	Accepted - some information on these impacts were added, although emphasis of the case study is on multi-level governance.
36508	110	52	110	55	This is a useful point that should be retained [Snaliah Mahal, Saint Lucia]	Accepted
36510	111	4	111	6	This statement is written in a manner that makes it appear that Jamaica (and other such sovereign states), is receiving an unfair advantage in its access to climate finance over other overseas territories (OTs). It should be rephrased or deleted. The reality is that the controlling States referenced here have an obligation and responsibility to OTs that they tend not to honour. [Snaliah Mahal, Saint Lucia]	Accepted - text has been rewritten.
36512	111	6	111	8	Styles of governance are rooted in history, politics, etc. The sentence implies that the rest of the Caribbean should simply adopt Cuba's style of governance and once they do so, they will become less vulnerable. Rephrase [Snaliah Mahal, Saint Lucia]	Accepted - text has been rewritten to remove bias.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
61302	111	6	111	8	Cuba's approach should be explained where it is initally referenced. [United States of America]	Accepted - text has been rewritten.
36514	111	8	111	8	Reference to Table 2 here implies that the table should show how Cuba's manner of governance is positively influencing its vulnerability, compared to other islands in the Caribbean. This is not what is shown in Table 2 and Table 1 above it does not make a convincing case of reduced vulnerability for Cuba either. Further, for such a comparison to be made, the islands compared would all have had to be experiencing the same hurricane and strength in order to assess how each fared under similar circumstances. [Snaliah Mahal, Saint Lucia]	Taken into account. Table 2 has been removed
47212	111	10	111	10	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. Suggested alternative "incorporating holistic and integrated management systems by archiving climate governance would improve flexibility in existing collaborative decision-making processes." [Sarah Connors, France]	Accepted - text has been rewritten
61304	111	10	111	18	Suggest mentioning regional institutions like the CCCCC and the CCRIF that also played an important role in this particular region. [United States of America]	Taken into account - there are multiple regional actors even beyond these two, all of whom could not be mentioned. We acknowledge regional cooperation in the UKOT paragraph. CCRIF is referenced in Supplemental Material 4A.
46970	111	17	111	17	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted and revised
61306	111	20	113	1	Cross-Chapter Box 4.3, Table 1: Hurricane damages since 2014. This table is not very useful and could be deleted. In particular, there is no objective basis for comparison among the hurricanes based on the information presented. Without additional research, the reader cannot ascertain whether a particular hurricane struck each island, or how the windspeed, storm surge, rainfall, central pressure, duration of the storm, etc., compared at each island. Thus, there is little basis for understanding how one is to interpret the differences in impacts among the three sets of islands. What might be more useful would be to apply the information in Table 2 about the disaster resilience strategies to one or more specific disasters in which all three sets of islands experienced objectively similar weather impacts. [United States of America]	Taken into account. Table has been removed
52278	111	21	111	21	Compare apples to apples in this table. This table isn't as instructive as it could be. [Jason Donev, Canada]	Taken into account. Table has been removed
52280	111	21	111	21	Why is Jamaica empty in the first box below the word Jamaica? [Jason Donev, Canada]	Taken into account. Table has been removed
48130	111	29	112		The source of the data in the tables is not mentioned. It isn't clear if these come from the references cited in sub-section 'Adaptation in the Caribbean' on page 110 [Sarah Connors, France]	Taken into account. Table has been removed
52282	113	1	113	1	This table is too hard to read, don't present these results in a table, present them as paragraphs. [Jason Donev, Canada]	Taken into account. Table has been removed
1004	114	6	114	7	or 40% or total deforested area' What was meant here?? [Robert Shapiro, United States of America]	Taken into account - text has been modified
35390	114	6			4? warming - may be 4??? [Andrey Kalugin, Russian Federation]	Accepted - editorial, it is 4 degrees Centigrade.
61308	114	6	114	8	The discussion of "tipping points that should not be transgressed" veers into normative or policy judgments and should be deleted or reframed to avoid such a judgment. [United States of America]	Taken into account - text has been modified
16554	114	12	114	13	Please reconsider language used: "loss of indigenous people" [Australia]	Taken into account - text has been modified
3274	114	22	114	22	USUSD should be "USD" [Vassilis Daioglou, Netherlands]	Taken into account - text has been modified
4388	114	22	114	22	There is no agrement in the litearture if reforestation activities should be considered part of REDD+. Some national REDD+ programs certainly consider reforestation as part of their proposed activities. The fund transfer from Germany to Brazil are handled by the Brazilian "Amazon Fund," which supports conservation initiatives in genereal, not exclusively REDD+. Hence, it seems misleading to keep the term REDD+ in the sentence. [Thales A. P. West, Brazil]	Accepted - text has been removed
4390	114	22	114	22	There is a typo in the sentence: "USUSD" should be replaced by "USD" [Thales A. P. West, Brazil]	Accepted - this mistake has been corrected
48132	114	34	114	44	The para appears to draw heavily fron one reference only Georgeson et al., 2016. Suggestion could be adding more references or shortening the text here [Sarah Connors, France]	Noted. Text has been amended to add relevant references such as Revi et al. 2014; Araos et al. 2016; Amundsen et al. 2018.
46998	115		115		Colourblind check for this figure. Please avoid using greens and reds together in figures as they are hard to distinguish between. [Sarah Connors, France]	Noted. In the revised box, the map has been removed.
61310	115	1	115	1	Cross-Chapter Box 4.3, Figure 1: Adaptation profiles of cities around the world. This is a visually interesting and potentially useful illustration, but suffers from some issues with presentation and lack of explanation. The degrees of advancement in adaptation do not appear to be shown sequentially: presumably "extensive" should follow "moderate low" and "moderate high". The colors should also reflect a logical sequence; the purple would typically reflect a more advanced stage than red, rather than the opposite. It would also be helpful to have some sense of the criteria used to categorize the cities. Finally, it's questionable whether the grey cities are truly "non-adaptors." Perhaps the adaptation in some of those cities is happening in an informal or not centrally-planned way. [United States of America]	Noted. In the revised box, the map has been removed.
1006	115	7	115	7	sponsored development begun to' should be 'sponsored development have begun to' [Robert Shapiro, United States of America]	Accepted - text has been revised
1008	115	7	115	7	of 2017, proposed a series' WHO proposed?? [Robert Shapiro, United States of America]	Accepted - text has been revised
2406	116		119		Looking across the report the Loss & Damage box seems better suited to Ch 3. [Debra Roberts, South Africa]	Taken into account. We now actually moved it to ch.5 after discussions with co-chairs and chapter authors!
1010	116	1	116	1	launched in 2006to SPACING [Robert Shapiro, United States of America]	Accepted - editorial corrections have been done
52284	116	1	116	1	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Accepted - editorial corrections have been done
44700	116	2	116	8	It would be important to bring in the implications of the above case studies for 1.5 / in the context of 1.5 back into the conclusion. [Penny Urquhart, South Africa]	Accepted - the implications of the risks, impacts, adaptation options and of sustainable development, poverty alleviation, and equity are in all the case studies.
62038	116	15	119	11	Some concepts need to be explained (slow onset; soft and hard adaptation limits). As for other boxes, please avoid repetition of similar examples, and ensure coherency across chapters. Be focused on what is relevant for this report. Use IPCC calibrated language to report confidence in findings. The last paragraph may be more explicit about progress in attribution since the AR5, as attribution is barely considered in this special report, for instance by quoting the NAS report on the attribution of individual weather and climate extreme events. [Valérie Masson-Delmotte, France]	Accepted. Thank you- we have taken all these comments on, including the one on attribution.
32118	116	17	119	10	This box is a helpful inclusion in the report and reflects a growing source of highly relevant literature in an adequate manner. [Jamaica]	Noted. Thank you.
32196	116	17	119	11	The inclusion of this box is much appreciated to provide an assessment of loss and damage [Jamaica]	Noted. Thank you.
36484	116	17	119	10	This box is a helpful inclusion in the report and reflects a growing source of highly relevant literature in an adequate manner. [Snaliah Mahal, Saint Lucia]	Noted. Thank you.
36562	116	17	119	11	The inclusion of this box is much appreciated to provide an assessment of loss and damage [Snaliah Mahal, Saint Lucia]	Noted. Thank you.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
28744	116	17	119	10	On the attempt to define Loss and Damage: Defining L&D contradicts the assessment in the body of the chapter which states that L&D remains a political concept during the UNFCCC negotiations (p. 117, l. 28). In the same vein, it also points to the difference in stakeholders' perception of what L&D actually refers to (p. 117, l. 19-25) and states that loss and limits are context-dependent and often require place-based research into risk perception and experience (p. 117, l. 46-49). None of these and other key issues are currently reflected in the attempt to find a definition. In addition, the current attempt lacks recognition of the multiple drivers (see p. 117, p, l. 31/2) of climate-related risks due to extreme weather and slow-onset events, including socio-economic factors related to exposure and vulnerability. Despite the prominence in the literature (e.g. Schinko and Mechler, 2017, Ecologic Economics) and Suppl. Material 4A, there is no link to the comprehensive risk management framing, including the link between mitigation, risk reduction and adaptation. Finally, not all direct damages will be apt for quantification as many issues lack suitable indicators. Please revise. [Germany]	Accepted and taken into account. We responded to all the comments. 1. As we state in the glossary: Loss and Damage (capital letter) refers to the political debate, small letters refers to impacts and risks. 2.we better discuss stakeholders' perceptions and mention context-dependence.3. the risk management framing is now prominent in figure 5.2 and 4. we mention avoidance through mitigation and adaptation.
32200	116	17	119	11	The box should place more emphasis on specific impacts and their relationship to loss and damage, drawing from other portions of the report. The box should have less of a focus on definitions and theoretical discussions and more emphasis on scientific evidence of risk of loss and damage and actual loss and damage attributable to climate impacts. See for example: (1) Albert, S., Leon, J. X., Grinham, A. R., Church, J. A., Gibbes, B. R., & Woodroffe, C. D. (2016). Interactions between sea-level rise and wave exposure on reef island dynamics in the Solomon Islands. Environmental Research Letters, 11(5), 054011. and (2) Storlazzi, C. D., Elias, E. P., & Berkowitz, P. (2015). Many atolls may be uninhabitable within decades due to climate change. Scientific reports, 5, 14546. [Jamaica]	Accepted. We build more strongly on the impact and risk assessment in the report, see table 5.2. Also, we mention the hard limit of atolls becoming uninhabitable at 1.5 C
36566	116	17	119	11	The box should place more emphasis on specific impacts and their relationship to loss and damage, drawing from other portions of the report. The box should have less of a focus on definitions and theoretical discussions and more emphasis on scientific evidence of risk of loss and damage and actual loss and damage attributable to climate impacts. See for example: (1) Albert, S., Leon, J. X., Grinham, A. R., Church, J. A., Gibbes, B. R., & Woodroffe, C. D. (2016). Interactions between sea-level rise and wave exposure on reef island dynamics in the Solomon Islands. Environmental Research Letters, 11(5), 054011. and (2) Storlazzi, C. D., Elias, E. P., & Berkowitz, P. (2015). Many atolls may be uninhabitable within decades due to climate change. Scientific reports, 5, 14546. [Snaliah Mahal, Saint Lucia]	Accepted. We build more strongly on the impact and risk assessment in the report, see table 5.2. Also, we mention the hard limit of atolls becoming uninhabitable at 1.5 C
55890	116	17			Is the differential between 1 and 1.5C also going to be discussed? [Debora Ley, Guatemala]	Taken into account. . Not in very much detail given the medium evidence overall, but we say in the ES for chapter 5 and the SPM under B6: "Limits to adaptation and associated losses exist at every level of temperature rise (medium confidence), with place-specific implications."
32176	116	22	116	22	Remove the word 'any' as it implies that limits may not exist; this sentence can be moved to the second paragraph; pg 117 line 1. [Jamaica]	Accepted. Any has been removed.
36516	116	22	116	22	Remove the word 'any' as it implies that limits may not exist; this sentence can be moved to the second paragraph; pg 117 line 1. [Snaliah Mahal, Saint Lucia]	Accepted. Any has been removed.
38638	116	22	116	23	This statement needs more explanation, in my view. Why "increasing relevance" ? [Jan Fuglestvedt, Norway]	Accepted. We rephrased to say that residual risks and Loss and Damage have seen more attention in climate research and policy
32178	116	23	16	28	Remove the summary of the content of each of the chapters. This Is not directly relevant to the content of the box and takes up valuable space in the box. [Jamaica]	Accepted. We have done so.
36544	116	23	116	28	Remove the summary of the content of each of the chapters. This is not directly relevant to the content of the box and takes up valuable space in the box. [Snaliah Mahal, Saint Lucia]	Accepted. We have done so.
38640	116	23	116	28	I don't think you need to remind the reader about what the different chapters have done. [Jan Fuglestvedt, Norway]	Accepted. We have removed.
47200	116	26	116	26	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accepted. We have done so.
12536	116	30	116	34	Increasing climate related risk does not in itself suggest that the risks cannot be avoided/adapted to. AR5 WGII Ch16 states that whilst given knowledge of the vulnerabilities of regions and sectors, adaptation limits will be reached, 'economic development, technology, and cultural norms and values can change over time to enhance or reduce the capacity of systems to avoid limits'. Therefore, a brief discussion of adaptation limits may be more useful here along with an indication that loss and limits are context / risk perception dependent (as also stated later on in the box). An explanation of soft and hard limits and a consideration of incremental and transformational adaptation in reducing risks could also be discussed. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We indeed now discuss right at the outset the limits framing: "It recognised that adaptation is constrained by biophysical, institutional, financial, social, and cultural factors, and the interaction of these factors with climate change can lead to soft (adaptive actions currently not available) and hard (adaptive actions appear infeasible leading to unavoidable impacts) adaptation limits (Klein et al. 2014)."
12538	116	36	116	36	The UNFCCC set up the Warsaw International Mechanism, to look at how to avert, minimize and address loss and damage. It is hard to think of many cases where loss and damage cannot be reduced by adaptation, so risks of loss and damage and extent of loss and damage is rarely absolute and certainly is affected by factors other than just climate change. The statement “including that which cannot be reduced by adaptation" is therefore a bit misleading as it implies that there is agreement on the possibility to define what loss and damage that is not reduced by adaptation actually is. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We distinguish hard and soft adaptation limits and discuss those in the table. Coral reefs are an example, where limited adaptation is possible generally, and specifically not at 2°C.
12956	117	4	117	25	Include insight from Mace, M. J., & Verheyen, R. (2016). Loss, damage and responsibility after COP21: all options open for the Paris agreement. Review of European, Comparative & International Environmental Law, 25(2), 197-214. that addresses history of loss and damage in the UNFCCC process and loss and damage implications [Saint Kitts and Nevis]	Accepted. We discuss the genesis of the debate in more detail, and also refer more succinctly to the legal implications.
29518	117	4	119	10	The definition of "Loss and Damage" in the glossary is very vague and in contradicitons with statements made in chapter 4 (pag 117 line 28) which defines it as a political concept developed during the UNFCCC negotionations. [Italy]	Taken into account. We now say in the text; "There is no one definition of L&D in climate policy, and analysis of policy documents and stakeholder views has demonstrated ambiguity (Vanhala and Hestbaek 2016; Boyd et al. 2017). ", and state as follows in the glossary: "Research has taken Loss and Damage (capitalized letters) to refer to political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013, which is to "address loss and damage associated with impacts of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change." Lowercase letters (losses and damages) have been taken to refer broadly to harm from (observed) impacts and (projected) risks (see Mechler et al. 2018)."
32184	117	4	117	25	Include insight from Mace, M. J., & Verheyen, R. (2016). Loss, damage and responsibility after COP21: all options open for the Paris agreement. Review of European, Comparative & International Environmental Law, 25(2), 197-214. that addresses history of loss and damage in the UNFCCC process and loss and damage implications [Jamaica]	Accepted. We discuss the genesis of the debate in more detail, and also refer more succinctly to the legal implications.
36550	117	4	117	25	Include insight from Mace, M. J., & Verheyen, R. (2016). Loss, damage and responsibility after COP21: all options open for the Paris agreement. Review of European, Comparative & International Environmental Law, 25(2), 197-214. that addresses history of loss and damage in the UNFCCC process and loss and damage implications [Snaliah Mahal, Saint Lucia]	Accepted. We discuss the genesis of the debate in more detail, and also refer more succinctly to the legal implications.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12954	117	5	117	11	This background discussion on L&D within UNFCCC should be moved to the previous section on Introduction and Framing. [Saint Kitts and Nevis]	Taken into account. We now first start with the science, then go to the UNFCCC debate.
13384	117	5	117	25	This section should focus on providing a better understanding of the different definitions/understanding of loss and damage and implications as stated by the heading. There are a number of papers that discuss different understandings/definitions of loss and damage that can be referenced here. UNFCCC is not the only source for a definition of loss and damage. [Grenada]	Taken into account. We now provide more detail on stakeholder perceptions and understanding of Loss and Damage
32186	117	5	117	11	This background discussion on L&D within UNFCCC should be moved to the previous section on Introduction and Framing. [Jamaica]	Taken into account. We now first start with the science, then go to the UNFCCC debate.
32188	117	5	117	25	This section should focus on providing a better understanding of the different definitions/understanding of loss and damage and implications as stated by the heading. There are a number of papers that discuss different understandings/definitions of loss and damage that can be referenced here. UNFCCC is not the only source for a definition of loss and damage. [Jamaica]	Taken into account. We now provide more detail on stakeholder perceptions and understanding of Loss and Damage
36518	117	5	117	11	Include reference to fact that Article 3.3 of the UNFCCC speaks to "irreversible damage" [Snaliah Mahal, Saint Lucia]	Accepted. We discuss irreversible damage.
36552	117	5	117	11	This background discussion on L&D within UNFCCC should be moved to the previous section on Introduction and Framing. [Snaliah Mahal, Saint Lucia]	Taken into account. We now first start with the science, then go to the UNFCCC debate.
36554	117	5	117	25	This section should focus on providing a better understanding of the different definitions/understanding of loss and damage and implications as stated by the heading. There are a number of papers that discuss different understandings/definitions of loss and damage that can be referenced here. UNFCCC is not the only source for a definition of loss and damage. [Snaliah Mahal, Saint Lucia]	Taken into account. We now provide more detail on stakeholder perceptions and understanding of Loss and Damage
32122	117	8	117	17	This section should also include loss of coastal land due to sea level rise- particularly important loss for SIDS and other nations with extensive coastal regions. Sea level rise poses an existential threat for low-elevation SIDS- an example of complete loss. [Jamaica]	Taken into account. This is seeing more attention now and we have a SIDS example in table 5.2. We now provide more detail on stakeholder perceptions and understanding of Loss and Damage
36488	117	8	117	17	This section should also include loss of coastal land due to sea level rise- particularly important loss for SIDS and other nations with extensive coastal regions. Sea level rise poses an existential threat for low-elevation SIDS- an example of complete loss. [Snaliah Mahal, Saint Lucia]	Taken into account. This is seeing more attention now and we have a SIDS example in table 5.2. We now provide more detail on stakeholder perceptions and understanding of Loss and Damage
36520	117	14	117	14	The terms have been used in tandem, but there is nothing to imply that they are meant to be synonymous. [Snaliah Mahal, Saint Lucia]	Accepted. Deleted and we define losses and damages better
32190	117	15	117	16	Please elaborate on what is meant by econonomic and non-economic losses [Jamaica]	Accepted. Examples mentioned are: biodiversity, culture, health
36556	117	15	117	16	Please elaborate on what is meant by econonomic and non-economic losses [Snaliah Mahal, Saint Lucia]	Accepted. Examples mentioned are: biodiversity, culture, health
36522	117	19	117	21	Useful reference that should be maintained. [Snaliah Mahal, Saint Lucia]	Accepted. We maintained it.
12540	117	22	117	25	This section would benefit from clarification and the consideration of the wide variety of views expressed by different stakeholders. For instance, whilst a viewpoint exists that considers losses from natural climate variability, there are other views that don't – this should be made clear. See Boyd et al. as quoted in this section on some of the different approaches. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We now provide more detail on stakeholder perceptions and understanding of Loss and Damage
13382	117	24	117	25	Loss and damage is widely understood as climate change impacts that cannot be avoided by mitigation and adaptation. Thus 'loss and damage associated with natural climate variability' is not a widely utilized conceptualization and should not be highlighted in this box [Grenada]	Taken into account. We now discuss that there is indeed disagreement.
32192	117	24	117	25	Loss and damage is widely understood as climate change impacts that cannot be avoided by mitigation and adaptation. Thus 'loss and damage associated with natural climate variability' is not a widely utilized conceptualization and should not be highlighted in this box [Jamaica]	Taken into account. We now discuss that there is indeed disagreement.
36524	117	24	117	25	Dilution. One of the issues with loss and damage is the issue of attribution and the human-induced climate change, that additionality that is causing the unavoidable and irreversible permanent losses. Recommendation for deletion of this comment. [Snaliah Mahal, Saint Lucia]	Taken into account. IPCC's risk framing clearly gives a role to exposure and vulnerability in addition to hazards, yet we now state that there is indeed disagreement re climate variability
36558	117	24	117	25	Loss and damage is widely understood as climate change impacts that cannot be avoided by mitigation and adaptation. Thus 'loss and damage associated with natural climate variability' is not a widely utilized conceptualization and should not be highlighted in this box [Snaliah Mahal, Saint Lucia]	Taken into account. We now discuss that there is indeed disagreement.
13012	117	27	117	48	The box aims to report on emerging research and policy discourse on Loss and Damage and this section does not currently achieve those aims. This section should focus on assessing emerging loss and damage research. There are a number of substantial scientific studies that specifically address loss and damage and discuss how it is linked to other lines of research in a more coherent and comprehensive manner that should be utilized to strengthen this section. E.g.(1) Boyd, E., James, R. A., Jones, R. G., Young, H. R., & Otto, F. E. (2017). A typology of loss and damage perspectives. Nature Climate Change, 7(10), 723. (2) Huggel, C., Stone, D., Auffhammer, M., & Hansen, G. (2013). Loss and damage attribution. Nature Climate Change, 3(8), 694. (3) James, R., Otto, F., Parker, H., Boyd, E., Cornforth, R., Mitchell, D., & Allen, M. (2014). Characterizing loss and damage from climate change. Nature Climate Change, 4(11), 938. Chicago [Grenada]	Accepted. The studies have been picked up now.
32182	117	27	117	48	The box aims to report on emerging research and policy discourse on Loss and Damage and this section does not currently achieve those aims. This section should focus on assessing emerging loss and damage research. There are a number of substantial scientific studies that specifically address loss and damage and discuss how it is linked to other lines of research in a more coherent and comprehensive manner that should be utilized to strengthen this section. E.g.(1) Boyd, E., James, R. A., Jones, R. G., Young, H. R., & Otto, F. E. (2017). A typology of loss and damage perspectives. Nature Climate Change, 7(10), 723. (2) Huggel, C., Stone, D., Auffhammer, M., & Hansen, G. (2013). Loss and damage attribution. Nature Climate Change, 3(8), 694. (3) James, R., Otto, F., Parker, H., Boyd, E., Cornforth, R., Mitchell, D., & Allen, M. (2014). Characterizing loss and damage from climate change. Nature Climate Change, 4(11), 938. Chicago [Jamaica]	Accepted. The studies have been picked up now.
36548	117	27	117	48	The box aims to report on emerging research and policy discourse on Loss and Damage and this section does not currently achieve those aims. This section should focus on assessing emerging loss and damage research. There are a number of substantial scientific studies that specifically address loss and damage and discuss how it is linked to other lines of research in a more coherent and comprehensive manner that should be utilized to strengthen this section. E.g.(1) Boyd, E., James, R. A., Jones, R. G., Young, H. R., & Otto, F. E. (2017). A typology of loss and damage perspectives. Nature Climate Change, 7(10), 723. (2) Huggel, C., Stone, D., Auffhammer, M., & Hansen, G. (2013). Loss and damage attribution. Nature Climate Change, 3(8), 694. (3) James, R., Otto, F., Parker, H., Boyd, E., Cornforth, R., Mitchell, D., & Allen, M. (2014). Characterizing loss and damage from climate change. Nature Climate Change, 4(11), 938. Chicago [Snaliah Mahal, Saint Lucia]	Accepted. The studies have been picked up now.
12542	117	28	117	29	This would benefit from re-phrasing/clarifying what is meant by 'technical roots' – the technical literature did not define the term loss and damage. As stated in the first half of the sentence, 'loss and damage' is essentially a political construct. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. See above and we don't use the term 'technical roots' anymore
13378	117	28	117	29	Remove this first sentence. Context is incorrect; linkages that are being made to adaptation and disaster risk reduction are not correct; this statement keeps loss and damage as part of adaptation rather than as a separate issue that is beyond the limits of adaptation. [Grenada]	Taken into account. We explain the various perspectives and discuss the limits framing prominently, such as in the figure and table.

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32180	117	28	117	29	Remove this first sentence. Context is incorrect; linkages that are being made to adaptation and disaster risk reduction are not correct; this statement keeps loss and damage as part of adaptation rather than as a separate issue that is beyond the limits of adaptation. [Jamaica]	Taken into account. We explain the various perspectives and discuss the limits framing prominently, such as in the figure and table.
32120	117	28	117	28	The statement that loss and damage is a 'political concept' is inaccurate. The term 'loss and damage' may have originated in the UNFCCC arena but the term refers generally to impacts of climate change that exist despite mitigation and adaptation- these impacts currently exist and are increasing, despite what term is used to identify them. Stating that loss and damage is a political concept is negating the existing impacts that are currently being faced. Suggestion to remove the statement "remains a political concept". [Jamaica]	Accepted. Thank you the phrasing was indeed awkward, and we now say in the text; "There is no one definition of L&D in climate policy, and analysis of policy documents and stakeholder views has demonstrated ambiguity (Vanhala and Hestbaek 2016; Boyd et al. 2017). ", and state as follows in the glossary: "Research has taken Loss and Damage (capitalized letters) to refer to political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013, which is to "address loss and damage associated with impacts of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change." Lowercase letters (losses and damages) have been taken to refer broadly to harm from (observed) impacts and (projected) risks (see Mechler et al. 2018)."
36486	117	28	117	28	The statement that loss and damage is a 'political concept' is inaccurate. The term 'loss and damage' may have originated in the UNFCCC arena but the term refers generally to impacts of climate change that exist despite mitigation and adaptation- these impacts currently exist and are increasing, despite what term is used to identify them. Stating that loss and damage is a political concept is negating the existing impacts that are currently being faced. Suggestion to remove the statement "remains a political concept". [Snaliah Mahal, Saint Lucia]	Accepted. Thank you the phrasing was indeed awkward, and we now say in the text; "There is no one definition of L&D in climate policy, and analysis of policy documents and stakeholder views has demonstrated ambiguity (Vanhala and Hestbaek 2016; Boyd et al. 2017). ", and state as follows in the glossary: "Research has taken Loss and Damage (capitalized letters) to refer to political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013, which is to "address loss and damage associated with impacts of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change." Lowercase letters (losses and damages) have been taken to refer broadly to harm from (observed) impacts and (projected) risks (see Mechler et al. 2018)."
36526	117	28	117	29	This statement is written in a manner that is quite dismissive of loss and damage and should be deleted. It is unclear what it is trying to establish. [Snaliah Mahal, Saint Lucia]	Taken into account. We explain the various perspectives and discuss the limits framing prominently, such as in the figure and table.
36546	117	28	117	29	Remove this first sentence. Context is incorrect; linkages that are being made to adaptation and disaster risk reduction are not correct; this statement keeps loss and damage as part of adaptation rather than as a separate issue that is beyond the limits of adaptation. [Snaliah Mahal, Saint Lucia]	Taken into account. We explain the various perspectives and discuss the limits framing prominently, such as in the figure and table.
39058	117	28	117	28	The statement that loss and damage is a 'political concept' is inaccurate. The term 'loss and damage' may have originated in the UNFCCC arena but the term refers generally to impacts of climate change that exist despite mitigation and adaptation- these impacts currently exist and are increasing, despite what term is used to identify them. Stating that loss and damage is a political concept is negating the existing impacts that are currently being faced. Suggestion to remove the statement "remains a political concept". [Grenada]	Accepted. Thank you the phrasing was indeed awkward, and we now say in the text; "There is no one definition of L&D in climate policy, and analysis of policy documents and stakeholder views has demonstrated ambiguity (Vanhala and Hestbaek 2016; Boyd et al. 2017). ", and state as follows in the glossary: "Research has taken Loss and Damage (capitalized letters) to refer to political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013, which is to "address loss and damage associated with impacts of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change." Lowercase letters (losses and damages) have been taken to refer broadly to harm from (observed) impacts and (projected) risks (see Mechler et al. 2018)."
12544	117	31	117	32	This is an important point from AR5, however might be better addressed in 'Introduction and Framing' – see comments on lines 30-34 on p116. It may also be useful to explore the connection of multifactorial climate related risk to the concept of LnD. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We refer to AR5 in the introduction as follows: "The AR5 (IPCC 2013; Oppenheimer et al. 2014) documented impacts that have been detected and attributed to climate change, projected increasing climate-related risks with continued global warming, and recognised barriers and limits to adaptation. It recognised that adaptation is constrained by biophysical, institutional, financial, social, and cultural factors, and the interaction of these factors with climate change can lead to soft (adaptive actions currently not available) and hard (adaptive actions appear infeasible leading to unavoidable impacts) adaptation limits (Klein et al. 2014)."
38642	117	33	117	34	A recent commentary (peer reveiwed) by Otto et al in Nature Climate Change is potentially relevant for this section: Assigning historic responsibility for extreme weather events. Nature Climate Change 7, 757–759 (2017)DOIdoi:10.1038/nclimate3419. [Jan Fuglestvedt, Norway]	Rejected. We have been advised not to use commentaries, so we did not pick this up.
12546	117	35	117	37	Legal and political response to LnD is outside the scope of this report. In addition, the Paris Agreement explicitly rules out compensation. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We shortly refer to legal and policy research (not specifically responses) as this is relevant for the debate.
40486	117	35	117	36	The report says <There is now a policy mechanism under the United Nations Framework on Climate Change (UNFCCC) to address "Loss and Damage" (L&D) from climate change impacts, including that which cannot be reduced by adaptation (UNFCCC, 2013a).> but the original UNFCC reference (Decision 2-CP.19) says <Also acknowledging that loss and damage associated with the adverse effects of climate change includes, and in some cases involves more than, that which can be reduced by adaptation>. Changing "can" for "cannot" actually reverse the meaning. The decision for the Warsaw International Mechanism for Loss and Damage (WIM) states that the mechanism covers adverse impacts of climate change even if they could have been avoided through adaptation. [Pedro Alfredo Borges Landaez, Venezuela]	Taken into account. We provide more nuance now: "COP19 in 2013 established the Warsaw International Mechanism for Loss and Damage (WIM) as a formal part of the UNFCCC architecture (UNFCCC 2013). It acknowledges that L&D "includes, and in some cases involves more than, that which can be reduced by adaptation" (UNFCCC 2013: 6). The Paris Agreement recognised "the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change" through Article 8 (UNFCCC 2015: 27)."
12548	117	40	117	41	This sentence would benefit from clarification. What does 'touching on' mean? [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We explain soft and hard limits in more detail now incl. fig 5.2 and table 5.2
55886	117	41	117	42	Supplementary material is on overarching adaptation options- are these also considered for residual risks and adaptation limits? Not clear. [Debora Ley, Guatemala]	Taken into account. We refer to the sections in ch.4 on overarching adaptation options and refer to transformative adaptation.
52286	117	42	117	42	This line (or lines) is missing a space (or more than one). There seems to have been some sort of problem in converting this document to pdf. [Jason Donev, Canada]	Noted. Thank you.
55888	117	42	117	42	Space between period and adaptation [Debora Ley, Guatemala]	Noted. Thank you.
12550	117	44	117	48	This is a really excellent summary. Might be preferable to leave out 'tentative consensus' and just say 'Emerging research sees the LnD debate…'. Would benefit from an explanation of soft and hard limits. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted and taken into account. Thank you, we removed tentative, but discuss research as it has been taken forward. Soft and hard limits are better explained as we hope.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
36528	117	47	117	48	This implies that loss and damage can be anything to anyone. Another potentially dismissive statement. See earlier reference to: "Analysis of L&D policy discussions and stakeholder views (Boyd et al., 2017; Vanhala and Hestbaek, 2016) 20 suggest that many view L&D as climate change impacts which cannot be avoided by mitigation and/or 21 adaptation, also drawing on the notion of limits". Also: "As a point of departure, the AR5 (IPCC, 2014) projected increasing climate-related risks with continued 31 global warming, suggesting that not all risks will be avoided (unavoided) and some cannot be avoided at 32 higher levels of warming (unavoidable)." [Snaliah Mahal, Saint Lucia]	Taken into account. We hope we are clearer now. and now say in the text; "There is no one definition of L&D in climate policy, and analysis of policy documents and stakeholder views has demonstrated ambiguity (Vanhala and Hestbaek 2016; Boyd et al. 2017). ", and state as follows in the glossary: "Research has taken Loss and Damage (capitalized letters) to refer to political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013, which is to "address loss and damage associated with impacts of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change." Lowercase letters (losses and damages) have been taken to refer broadly to harm from (observed) impacts and (projected) risks (see Mechler et al. 2018)."
7224	117	48	117	48	Please add the following ref here: Barnett, Jon, Petra Tschakert, Lesley Head, and W. Neil Adger. "A science of loss." Nature Climate Change 6, no. 11 (2016): 976. [Petra Tschakert, Australia]	Accepted. Done.
12552	117	50	117	51	It would be more precise for this title to refer to limits to adaptation and residual risk only given Loss and Damage has not been defined. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We now adapted the title to read "Limits to adaptation, residual risks, and losses in a 1.5°C warmer world" so risks (potential impacts) and losses (actual impacts) are mentioned.
12554	117	52	118	1	Important point. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. Thank you.
36530	117	55	118	1	Add "though not impossible". [Snaliah Mahal, Saint Lucia]	Accepted. We provide such an assessment now.
48134	118	4	118	6	Not clear what is meant by 'examples at 1.5' [Sarah Connors, France]	Noted. The table has changed.
39296	118	11	118	55	All these are important points, also wish sentences in 15-17 could be made more important to the policy makers, who may not appreciate the critical role of biodiversity. [Lindsey Cook, Germany]	Accepted. Biodiversity is prominent in the table now.
46972	118	11	118	11	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted. Thank you and done so.
12556	118	12	118	12	Loss and Damage' has not been defined - this could be better phrased without the use of the term. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We now say in the text; "There is no one definition of L&D in climate policy, and analysis of policy documents and stakeholder views has demonstrated ambiguity (Vanhala and Hestbaek 2016; Boyd et al. 2017). ", and state as follows in the glossary: "Research has taken Loss and Damage (capitalized letters) to refer to political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013, which is to "address loss and damage associated with impacts of climate change, including extreme events and slow onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change." Lowercase letters (losses and damages) have been taken to refer broadly to harm from (observed) impacts and (projected) risks (see Mechler et al. 2018)."
36532	118	12	118	13	Useful input to be retained. [Snaliah Mahal, Saint Lucia]	Accepted. This is in the table now.
12558	118	15	118	16	What does the confidence level relate to here? [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. This refers to 1.5 and risk of extinction, and we adapted for the table.
36534	118	15	118	17	Useful input to be retained. [Snaliah Mahal, Saint Lucia]	Accepted. This is in the table now.
46986	118	16	118	16	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted. Thank you and done so.
12560	118	21	118	24	This would benefit from a reference. It would be good if the 'Exemplary evidence' section overall could be checked for references and cross references. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Thank you and done so-see table 5.2
18678	118	21	118	31	in line also with other comments, the impacts should not refer to SIDS, but rather should consider low-lying islands and coastal communities more broadly. [Andrea TILCHE, Belgium]	Taken into account/noted. SIDS are prominent in the report, and we refer to those, also we discuss coastal livelihoods.
36536	118	21	118	26	Useful input to be retained. [Snaliah Mahal, Saint Lucia]	Accepted. This is in the table now.
52288	118	21	118	21	Define SIDS [Jason Donev, Canada]	Noted. SIDS are defined earlier on in the report and chapter.
46974	118	23	118	23	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted. Thank you and done so.
12562	118	28	118	28	Should be clarified what impacts and risks are referred to here. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This is in the table now. We refer to sea level rise and increased wave run up combined with increased aridity and decreased freshwater availability.
36538	118	28	118	29	This gives the impression that there is a lot of space in which to migrate in SIDS. This needs to be augmented to speak to space limitations. [Snaliah Mahal, Saint Lucia]	Accepted. Thank you, and we discuss now in the SIDS entry in the table 5.2
12564	118	29	118	31	It would be helpful to mention that migration is not preferable to all (Jamero et al., 2017) and that there are other drivers, such as development (Speelman et al., 2017), as mentioned in section referenced here. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Thank you, and we discuss now in the SIDS entry in the table 5.2
12566	118	33	118	36	As stated earlier in box 4.4, climate related risk is multifactorial – this should be acknowledged. AR5 Ch16 also refers to the role and consideration of incremental and transformational adaptation that would be good to discuss in relation to various adaptation limits in the 'Exemplary evidence' section. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We discuss the IPCC risk framing, and refer to transformative adaptation.
36540	118	33	118	36	Useful input to be retained. [Snaliah Mahal, Saint Lucia]	Accepted. This is in the table now.
46976	118	44	118	45	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted. Thank you and done so.
12568	118	48	118	49	Can this be checked please, looks inconsistent with IDMC statistics, which state 26 million displaced by disaster and 30m by conflict. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. We don't mention the numbers anymore.
61312	118	48	118	49	This projection needs a citation. [United States of America]	Accepted. We don't mention the numbers anymore.
61314	118	48	118	49	This statement is highly questionable, as there are a number of non-climatic drivers that have affected displacement during this time frame. The authors should present their methodology for reaching such a conclusion, in particular how they relate instances of displacement where climate is one factor among many. It is also not related to 1.5°C. [United States of America]	Accepted. We don't mention the numbers anymore.
46988	118	49	118	50	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Accepted. Thank you and done so.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12570	118	53	119	10	Following the language of Article 8 of the Paris Agreement, referring to (in the title) and discussing options and actions to 'minimise, avert and address' residual risk and loss and damage could give a broader and more balanced and helpful view. A discussion of the importance of an integrated approach in the handling of Loss and Damage (i.e. including adaptation, mitigation, sustainable development, planning, capacity/resilience building, disaster response and various finance instruments) could also be referred to. Legal and policy responses are outside the scope of this report - IPCC should not be policy prescriptive. It is up to countries and individuals to respond to the findings of the IPCC. Also the Paris Agreement rules out compensation. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We refer now to "Approaches and policy options to address residual risk and loss and damage." see also prior comments on the integrated risk framing. Legal and policy research is important and to be mentioned to help understand the debate.
18682	118	53	119	10	The approved outline of this chapter covers potential and capacity limitations for development and deployment of adaptation responses. The subject of compensation and legal action for alleged failure to address climate change is another matter entirely, and not in keeping with the title of the section "options to address residual risk..." [Andrea TILCHE, Belgium]	Taken into account/noted. Chapter 4 discusses potential and capacity limitations for development and deployment of adaptation responses, in the box we pick this up and don't talk about compensation, but mention legal research (Not legal action) as important to understand the science informing the debate.
18680	118	53	119	10	Comment on Cross-Chapter Box 4.4: Residual risks, limits to adaptation and loss and damage (a comment to be replicated also in the glossary?) There is no agreed definition of what loss and damage is in the scientific literature. While this is recognised in the box, the authors then propose a working definition which does not find consensus in the literature. We see it inappropriate for the box to provide a definition based not on scientific consensus but political consideration. Moreover, the working definition proposed also includes impacts of natural climate variability (line 24-25 page 4). Similarly, the definition should not be included in the glossary (or, if included, it should clearly specify that it applies only to the special report). Similarly, limits to adaptation are treated as a static (albeit location-specific) context. The box recognises that there is very limited evidence on the limits to adaptation, also at 1.5 degrees. Yet the examples provided are treated as certain. Confidence statements should be included in the box for all of the examples. [Andrea TILCHE, Belgium]	Taken into account. See above glossary entry, and in the title we now refer to "Limits to adaptation, residual risks, and losses in a 1.5°C warmer world"
61316	118	53	119	10	This is not a comprehensive list of "options and actions" related to loss and damage, and the one included was specifically ruled out by the UNFCCC COP decision 1/CP.21. Recommend the deletion of this section of the box, as it is not specific to 1.5°C and presents an unbalanced and non-comprehensive review of the topic. [United States of America]	Taken into account. We adapted this final discussion, and indeed the options mentioned only provide a snapshot of the policy debate, while important to understand the discussions.
32124	118	54	119	2	Policy debate on loss and damage has also included comprehensive risk management approaches and "enhancement of support, including finance, technology and capacity-building, for averting, minimizing and addressing loss and damage". Please see UNFCCC WIM ExCom for further details and include in this discussion [Jamaica]	Accepted. We refer to the risk framing earlier and now mention "has highlighted the synergies and differences with adaptation and disaster risk reduction policies."
36490	118	54	119	2	Policy debate on loss and damage has also included comprehensive risk management approaches and "enhancement of support, including finance, technology and capacity-building, for averting, minimizing and addressing loss and damage". Please see UNFCCC WIM ExCom for further details and include in this discussion [Snaliah Mahal, Saint Lucia]	Accepted. We refer to the risk framing earlier and now mention "has highlighted the synergies and differences with adaptation and disaster risk reduction policies."
39060	118	54	119	2	Policy debate on loss and damage has also included comprehensive risk management approaches and "enhancement of support, including finance, technology and capacity-building, for averting, minimizing and addressing loss and damage". Please see UNFCCC WIM ExCom for further details and include in this discussion [Grenada]	Accepted. We refer to the risk framing earlier and now mention "has highlighted the synergies and differences with adaptation and disaster risk reduction policies."
46468	118	55	119	2	The sentence "The debate includes, policy proposals for compensation for the implementation of regional public insurance systems to address climate displacement" is a relatively confusing summary and mixes various policy proposals; e.g. regional insurance systems have been set up for various purposes. not only (if at all) to address displacement, and while support for regional insurance systems has been asked for, this has not necessarily been the case as "compensation"; thus it does not constitute an adequate reflection of the discussion; it would be more appropriate to e.g. reference other documents which given overview of certain issues, e.g. in the following way: "For example, various financial instruments are under discussion to address loss and damage, including Comprehensive risk management capacity with risk pooling and transfer, catastrophe risk insurance, contingency finance, Climate - themed bonds, catastrophe bonds" (UNFCCC 2016: http://unfccc.int/files/adaptation/groups_committees/loss_and_damage_executive_committee/application/pdf/aa7_d_information_paper.pdf) [Sven Harmeling, Germany]	Taken into account. Yes, we hope we now improved, the very snap-shot style (strict word limit) discussion.
12572	119	4	119	10	Legal and policy responses are out of the scope of this report, therefore this section should be deleted. [United Kingdom (of Great Britain and Northern Ireland)]	Noted and taken into account. We shortly refer to legal and policy research (not responses specifically) as this is relevant for the research debate.
36542	119	4	119	10	Useful input to be retained. [Snaliah Mahal, Saint Lucia]	Noted and taken into account. We shortly refer to legal and policy research (not responses specifically) as this is relevant for the research debate.
5670	120		123		Again, the question of the placement of FAQ at the end of the chapter. Perhaps the FAQs should be a separate document, like the SPM? How many people will make it to the end of this LONG chapter. Are not FAQs more for people who need quick, brief info?if so these people will likely not look for it at the end of chapters? [Marion Grau, Norway]	Noted. IPCC FAQs are placed within report chapters to be reviewed. Post approval of the SPM, FAQs are published as a booklet and online.
22774	120	1	121	22	This description of answer is quite weak. Only general text book type engineering and policy measures are indicated. Citizen based power is a good concrete example. More conrete poicies are to be illustrated. It is clear, for instance, material production process needs huge innovation which impact to industrial structure of every country. Ban of coal use is immediately done, while international assistance to poor contries who depend on coal is to be doubled. Risk of depending to much on unproven or limited measures such as CCS and BECCS need to be more stresssed (or in FQA2?). [Shuzo Nishioka, Japan]	Taken into account. Comment is policy prescriptive and no references or literature is cited to support comment. Final sentence is noted. FAQ4.2 has been edited to state many CDR techniques have not been tested at scale.
24092	120	1	121	22	This description of answer is quite weak. Only general text book type engineering and policy measures are indicated. Citizen based power is a good concrete example. More conrete poicies are to be illustrated. It s clear, for instance, material production process needs huge innovation which impact to industrial structure of every country. Stringent regulation on coal use is immediately done, while international assistance to poor contries who depend on coal is to be doubled. Risk of depending to much on unproved measures suchi as CCS and BECCS need to be more stresssed (or in FQA2?). [Shuzo Nishioka, Japan]	See response to 22774.
34000	120	1	123	16	FAQ: Perhaps the FAQs should be a separate document, like the SPM? Perhaps too few people will make it to the end of this long chapter. We think the FAQs are most used by people who need quick, brief info. These people might not look for it at the end of chapters. [Norway]	Noted. Post approval of the SPM, FAQs are published as a booklet.
40492	120	1	120	1	"Frequently Asked Questions" I would suggest an extra FAQ on the issue of significance, protection and incorporation of local and indigenous knowledge. This is an issue that is growing rapidly in the scientific literature and in the consideration of governmental institution and social groups; it can be very relevant for behavioural changes and deep transformation of production and consumption patterns and lifestyles. It is also a vital issue regarding sustainability, justice, equity and ethics. [Pedro Alfredo Borges Landaez, Venezuela]	Noted, however no additional FAQs will be added to the final draft

Comment No	From Page	From Line	To Page	To Line	Comment	Response
62040	120	1	121	24	Please explain the relevance of LED lights for 1.5°C transition pathways (what is their importance). Please explain "regeneration of cities". Explain what is "models" here. CDR is mentioned in several FAQs, so that an overview is needed. Explain what are "multiple advantages" of transformative changes. The last sentence is not the best ending (not sufficient on their own). [Valérie Masson-Delmotte, France]	Taken into account. Text has been edited to explain the role that disruptive innovation can play with transitioning to limiting to 1.5°C global warming. 'Regeneration of cities', 'multiple advantages' and 'models' no longer appear in the redrafted FAQ text. CDR is now covered only in FAQ4.2 within the chapter 4 FAQs.
3276	120	3	121	22	I think the "general" answer given to FAQ 4.1 would be more relevant as an answer to FAQ 2.2. Consequently, FAQ 4.1 could focus more or institutional, social and other aspects which would make these measures feasible. The chapter (4) offers a lot of important insights which can be employed here, but sadly are not. [Vassilis Daioglou, Netherlands]	Noted. Both FAQs have been substantially redrafted to avoid overlapping content. The enabling conditions are now part of FAQ4.1.
5210	120	3	120	3	This assessment unfortunately accepts the 1.5 C value as an acceptable upper limit and, apparently, long term objective without providing a comparative analysis to other choices. 1.5 C was a political choice based on what the negotiators felt, overly optimistically it is turning out to be, could be accomplished. In my view, the scientific community has an obligation to evaluate and explain the implications of this choice as a peak value and, to the extent that they did, the implications of this being a value that would be sustained, and then to also present the same set of information for other values and durations that the temperature is above that particular value. In my view, given how the pace of sea level rise picked up once the global average temperature rose above 0.5 C (as documented by Hansen et al.), the long-term stabilization level needs to be pulled back to below 0.5 C--coming back to 1.5 C is just not adequate and the scientific community should not be presenting a report that seems to acquiesce to this value without a comparative analysis of what differnt choices would mean. [Michael MacCracken, United States of America]	Noted. In this report, we are asked to assess 1.5C-consistent pathways, which involves remaining below 1.5C by 2100. Potential more stringent and longer-term temperature limits could be discussed in later reports, such as AR6. The 1.5C limit choice is explained in FAQ 1.1 (chapter 1).
37340	120	3	121	22	This section talks broadly about pathways that could limit warming below 1.5 degrees Celsius including growth of renewables, with net emissions from the energy sector reaching zero between 2030 and 2060 while all other emissions removed through carbon dioxide removal processes. It seems justified to make note of an alternate pathway involving responsible use of SRM in which time scales for energy transition and emissions cuts can be extended. [Joshua Horton, United States of America]	Reject. The report does not contain reference to modelling temperature scenarios with SRM.
5206	120	5	120	12	This seems far too mild a summary of the situation. The world is currently on track for warming of over 3 C, and keeping warming below 1.5 C (so no overshoot) will require going to net zero emissions within a couple of decades. It needs to be said very clearly that the world is not nearly on track to accomplish this, and large overshoots are virtually unavoidable. That it might be technologically possible is fine to say, but politcally and economically, this is unfortunately just not where the world is headed. [Michael MacCracken, United States of America]	Accepted. Text added: "Transitional changes are already underway in many systems but limiting warming to 1.5°C would require a rapid escalation in the scale and pace of transition, particularly in the next 10-20 years. "This FAQ is not a summary of the report or even this chapter, but an answer to the question "What transitions could enable limiting warming to 1.5C"? The information can be found elsewhere in the report or in other documentation.
10596	120	5	120	6	FAQ 4.1: What transitions could enable limiting global warming to 1.5°C? The answer to this question starts from ' Few cities, regions, countries, businesses or communities are currently in line with limiting global warming to 1.5°C.' This is not logical. [Hong Yang, Switzerland]	Taken into account, text has been revised
61318	120	5	120	14	land use change is not the only key area listed of growing greenhouse gas emissions, as stated. While electricity generation C-intensity may be decreasing, as a source of emissions, it continues to increase. [United States of America]	Accepted, text refers to land in general, rather than the change in land use in new draft.
12574	120	6	120	7	Reductions in non-CO2 emissions are not mentioned explicitly here. Would action in the four key areas necessarily lead to the required reductions in non-CO2 as well as CO2? If not then it would be worth including action needed on non-CO2 explicitly. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. The "transitions" don't include non-CO2 and SLCFs. However, this comment is not applicable anymore - the text has been substantially revised.
30700	120	7	120	7	« carbon intensity of fuels » How about the carbon intensity of electricity ? [France]	Not Applicable - text no longer included in the FAQ
61320	120	7	120	10	Verify that land use change is a growing source of emissions. This discussion reads as though energy emissions are well in-hand, whereas in fact those emissions have been growing. This conclusion seems at odds with the conclusions of AR5 (WGIII Chapter 11). The contrast between land-use change and energy emissions is misleadingly stated here. Reference AR5 characterization of LUC and document any updates. [United States of America]	Taken into account, text has been modified from land use change to land more broadly
33562	120	9			Do you mean "land use" not "land-use change"? [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text refers to land in general, rather than the change in land use in new draft.
5208	120	12	120	14	Saying "temporarily overshoot" is a serious understatement and misrepresentation of where we are headed. The world is currently on a path to overshoot 3 C and this will not be temporary in any useful sense as most impacts are going to be responsive to the peak temperature increase and quite a number of the impacts (rate of ice sheet loss, biodiversity loss, etc.) are not irreversible and going back to no overshoot of 1.5 C will not be particularly helpful. A much more forthright statement is needed. [Michael MacCracken, United States of America]	Not Applicable - text no longer included in the FAQ
47202	120	13	120	13	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Taken into account, text has been revised.
12576	120	14	120	14	Instead of "carbon" I suggest "greenhouse gases" would be better. [United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text no longer included in the FAQ. But yes, this is general policy.
49470	120	15			the Agreement was signed, individual countries pledged various actions ... replace "signed" by "adopted" - the signature opened on 22 April 2016 - months after the adoption of the Agreement in Paris (see http://unfccc.int/paris_agreement/items/9511.php). Furthermore write "individual countries had pledged various actions" as more than 150 Parties had send in their INDCs before COP 21 in Paris. [Manfred Treber, Germany]	Not Applicable - text no longer included in the FAQ
5212	120	20	120	21	Exactly--and I just do not see how this phrasing can be interpreted to mean that the 1.5 C value should be sustained indefinitely thereafter, and yet that is what this assessment does. WHY is it doing this? [Michael MacCracken, United States of America]	Noted. See response to comment number 5210.
61322	120	20	120	24	Carbon dioxide removal is also a critical element in the 1.5°C pathways. [United States of America]	Not Applicable - text no longer included in the FAQ
5214	120	21	120	24	While perhaps theoretically possible to do enough of the actions listed here to stay below 1.5 C, this is just not nearly the path that the world is on or is moving to be on and there is going to be a large overshoot. But such an overshoot will have very significant impacts and the only way to avoid them is going to be climate interventaion- Not making clear that readiation management is virtually certainly going to be needed to stay below 1.5 C given how little the nations are doing on mitigation, and so covering the need for radiation management and what it involves really merits much more coverage and a much more balanced perspective than has occurred [Michael MacCracken, United States of America]	Noted. We initially had a FAQ on SRM but it was removed.
30702	120	21	120	21	« improvements in energy efficiency » Please add "in all end-use sector (Transport, Buildings and industry)" [France]	Not Applicable - text no longer included in the FAQ
30704	120	27	120	27	Unclear sentence. Compared to changes that would have happened at the end of the century? [France]	Accepted. Sentence has been revised.
61324	120	28	120	29	Disruptive Innovation is used earlier in the chapter but not defined. There should be a citation for this term. [United States of America]	Taken into account. This term is defined in the special report glossary.
5216	120	30	120	32	are larger is a very unfortunate understatement. Nothing to date has come near to reducing the 80+ % dependence of the world on fossil fuel energy, and yet that is what must be done (as welll as develop tools to pull CO2 out of the atmosphere to a large degree). [Michael MacCracken, United States of America]	Accept. It is not a clear word, initially intended to avoid the word "scale" which was perceived as too difficult for the FAQ audience. Scale is back now though.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
30706	120	33	120	33	What is meant here with "regeneration" of cities? [France]	Not Applicable - text no longer included in the FAQ
46978	120	37	120	37	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Taken into account, text has been revised.
5218	120	42	120	43	The sentence needs multiple exclamation points at the end, or to be put in bold or otherwise really highlighted. [Michael MacCracken, United States of America]	Noted. IPCC formatting does not allow for this.
61326	120	42	120	48	Do not ignore the role of CCS. [United States of America]	Noted. The new text does not talk so much about options, and therefore did not allow for inclusion of CCS.
30708	120	43	120	43	By the middlle of the century or slightly after, cf Fuglestvedt doi: 10.1098/rsta.2016.0445, 2018. [France]	Not Applicable - text no longer included in the FAQ
12578	120	47	120	48	Essentially all options for reducing emissions have implications for sustainable development, positive and negative. I would suggest removing this sentence, unless there is clear evidence that CDR options have bigger implications than "traditional" mitigation options such as electric vehicles, bioenergy, fossil fule CCS, carbon pricing, etc. [United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, text has been revised.
47122	120	48	120	48	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Accept. Text has been revised.
3788	121	11	121	17	There is a focus here on advantages only. There are however individuals, groups, even countries, for whom a rise in temperature has overall or even exclusively positive effects. Unfortunately, the report never discusses the potential benefits of temperature rising (such as access to alternative trade routes and resources, higher costs for economic competitors, etc.) – neither here nor in the many other subsections where this would be appropriate, given the importance attached (p.11 l. 4) to political and social acceptability and other conditions for feasibility. [Marcel Wissenburg, Netherlands]	Taken into account. Chapter 3 is on the impacts of 1.5C, and would list advantages of temperature rise like the ones mentioned. However, literature generally indicates that on balance the impact is negative.
46980	121	11	121	11	Check use of IPCC uncertainty language. Text should be highlighted in italic font when used. Please use alternative wording if not meant to be official IPCC uncertainty language. [Sarah Connors, France]	Taken into account, text has been revised.
13230	121	15	121	17	Delete the text "and, in the absence of carbon pricing, economic incentives are insufficient to achieve the pace and scale of mitigation needed to keep global average warming below 1.5°C.". [Eleni Kaditi, Austria]	Accepted, text has been removed.
47204	121	15	121	17	Avoid policy prescriptive language like should / must / need. Replace with alternative terms such as 'would need to', 'could' etc. [Sarah Connors, France]	Taken into account, text has been revised.
39298	121	18	121	22	This is an important policy finding. Please highlight in SPM. [Lindsey Cook, Germany]	Not Applicable - text no longer included in the FAQ
1088	121	21	121	23	SRM evidence also exists from natural analogs (i.e. volcanos) as well as limited outdoor experiments (Izrael, Yu A., et al. "Field studies of a geo-engineering method of maintaining a modern climate with aerosol particles." Russian Meteorology and Hydrology 34.10 (2009): 635-638; Russell, Lynn M., et al. "Eastern Pacific emitted aerosol cloud experiment." Bulletin of the American Meteorological Society 94.5 (2013): 709-729.) [Jesse Reynolds, Netherlands]	Not Applicable - text no longer included in the FAQ
1090	121	24	121	28	SAI does not aim to stimulate cloud formation. [Jesse Reynolds, Netherlands]	Not Applicable - text no longer included in the FAQ
22776	121	30	122	40	This description is quite reasonably illustrate the inappropriateness of those dreamy engineering proposal . Please keep them. [Shuzo Nishioka, Japan]	Noted
33564	121	30	122	43	Important to have FAQs on these issues as likely to be lots of questions here. Suggest that negative emissions and SRM are addressed separately in two separate FAQs as they are separate issues [Stephen Cornelius, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. SRM was removed from the FAQ, which now only focuses on CDR/negative emissions.
37342	121	30	122	40	This paragraph sites that SRM is “unproven” and carries substantial risks. SRM is based off of the natural analog of volcanic eruptions. Eruptions that inject material into the stratosphere, including Pinatubo, Agung, and El Chichon, each served to lower global average temperature. There is further consensus in global climate models that introduction of stratospheric aerosols of efficient size would lead to global cooling. There are, however, uncertainties regarding the degree of this global cooling, regional climate impacts and changes to the hydrological cycle. [Kravitz, Ben, Douglas G. MacMartin, Michael J. Mills, Jadwiga H. Richter, Simone Tilmes, Jean-Francois Lamarque, Joseph J. Tribbia, and Francis Vitt. “First Simulations of Designing Stratospheric Sulfate Aerosol Geoengineering to Meet Multiple Simultaneous Climate Objectives: DESIGNING STRATOSPHERIC GEOENGINEERING.” Journal of Geophysical Research: Atmospheres, December 7, 2017. https://doi.org/10.1002/2017JD026874. MacMartin, Douglas G., Ben Kravitz, Simone Tilmes, Jadwiga H. Richter, Michael J. Mills, Jean-Francois Lamarque, Joseph J. Tribbia, and Francis Vitt. “The Climate Response to Stratospheric Aerosol Geoengineering Can Be Tailored Using Multiple Injection Locations: DESIGNING GEOENGINEERING.” Journal of Geophysical Research: Atmospheres, December 7, 2017. https://doi.org/10.1002/2017JD026868. Mills, Michael J., Jadwiga H. Richter, Simone Tilmes, Ben Kravitz, Douglas G. MacMartin, Anne A. Glanville, Joseph J. Tribbia, et al. “Radiative and Chemical Response to Interactive Stratospheric Sulfate Aerosols in Fully Coupled CESM1(WACCM): Stratospheric Aerosols in CESM1(WACCM).” Journal of Geophysical Research: Atmospheres, December 7, 2017. https://doi.org/10.1002/2017JD027006. Robock, Alan. “Volcanic Eruptions and Climate.” Reviews of Geophysics 38, no. 2 (May 2000): 191–219. https://doi.org/10.1029/1998RG000054. Tilmes, Simone, Jadwiga H. Richter, Michael J. Mills, Ben Kravitz, Douglas G. MacMartin, Francis Vitt, Joseph J. Tribbia, and Jean-Francois Lamarque. “Sensitivity of Aerosol Distribution and Climate Response to Stratospheric SO 2 Injection Locations: CLIMATE SENSITIVITY TO SO 2 INJECTIONS.” Journal of Geophysical Research: Atmospheres, December 7, 2017. https://doi.org/10.1002/2017JD026888.] [Joshua Horton, United States of America]	Reject. That a natural analogue exists does not mean that the technology is proven. In any case, text on SRM Is removed.
40488	121	30	121	30	“FAQ 4.2: What are negative emissions and solar radiation management?” These options are collectively known as “Geoengineering” for many people, including social groups, common public and policy makers. It will be clearer and more useful for all of them if the term is used here, clarity is always important, but even more so in the FAQ section. [Pedro Alfredo Borges Landaez, Venezuela]	Rejected - over the last years, a consensus has developed that it has not been a useful framing to summarize these completely distinct measures into one category. See also glossary for clarification.
41704	121	30	122	40	The most important characteristics of SRM/RMMs should be clear in this FAQ. They are: 1) if a combination of mitigation and carbon removal actions prove unable to keep warming below 1.5C, and if SRM could ever be made to work, then it would be the only option for keeping warming below 1.5C. This is a basic physical fact because no other method for quickly stopping the rise in global temperatures has been proposed. 2) A decade of modelling studies has indicated that moderate use of SRM would reduce many of the projected impacts of climate change for most regions on the planet. 3) But the world doesn't behave exactly as models say it will and there are large uncertainties about the full physical impacts of SRM, and its use could end up compounding the physical risks of climate change, plus there are also some projected physical side effects. 4) In addition, the socio-political implication could be even more problematic than the physical ones. [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text no longer included in the FAQ

Comment No	From Page	From Line	To Page	To Line	Comment	Response
61328	121	30	122	40	The discussion of SRM and RMM should use consistent terminology and scope throughout the report. Also, the discussion of SRM and RMM here downplays the fact that these approaches do not address CO2 deposition in the ocean and changes to ocean chemistry. (It is only mentioned in the penultimate paragraph.) This discussion could be moved up somewhat in the FAQ response. [United States of America]	Accept on consistency. We have removed SRM discussions from the FAQs so this comment is not applicable anymore.
62226	121	30	122	45	This FAQ question mixing negative and CDR with SRM is highly problematic. It mixes mitigation policies as described in the present chapter with now a list of options ranging from plantations to DAC on one side, with SRM wich the same chapter takes as "neither mitigation nor adaptation". These parts should be separate so as to respect the way the text has evolved in the SOD. From line 20 page 122 for example. [Antoine Bonduelle, France]	Taken into account. SRM was removed from the FAQ, which now only focuses on CDR/negative emissions.
1092	121	32	121	36	This paragraph should mention that SRM is included within RMM in this report. [Jesse Reynolds, Netherlands]	Not Applicable - text no longer included in the FAQ
5220	121	32	121	36	Note that the section in the report dealing with this issue uses "RMM" instead--being consistent would be appropriate. [Michael MacCracken, United States of America]	Not Applicable - text no longer included in the FAQ
12580	121	32	121	32	This is a comment relevant throughout the Special Report, as well as here. As well as the term "carbon dioxide removal" (CDR), the term "greenhouse gas removal" (GGR) is in wide use,particularly in the UK (see for instance the name of the government- and Research Council-funded project here: www.nerc.ac.uk/research/funded/programmes/ggr). While there are few proposals currently for removal of non-CO2 GHGs, there are some, and it would be useful to note somewhere in the report that GGR is a term in use to describe the same methods. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text added to include GGR.
37516	121	32	121	36	This paragraph needst to use terminology consistent with the rest; again I highly recommend using established terms and not the novel term RMM that is used elsewhere in this report. [Matthias Honegger, Germany]	Not Applicable - text no longer included in the FAQ
62042	121	33	122	40	I suggest to replace "cool global temperature" by "are two hypothetic techniques that aim to decrease the temperature at the Earth's surface"..., "remove carbon" by "remove carbon dioxide". The FAQ could also be explicit for what CDR currently exists, and skip the blue carbon part (preserving forests or restoring mangroves does not belong to the CDR debate to my knowldege). Have SRM techniques been tested in laboratories? I think that they only have been explored by computor simulations. I am surprised by the argument that SAI is intended for cloud formation (I thought that the direct effect of aerosols was intended). The FAQ for SRM is too short on geophysical uncertainties (e.g. modelling the climate effect of aerosols), too short on implications (e.g. risk of addiction in case of insufficient mitigation). The whole FAQ is not specific enough for this report and could be found as such in the AR5. I suggest to re-consider the structure of this FAQ and focus on the 1.5°C context. [Valérie Masson-Delmotte, France]	Taken into account. SRM was removed from the FAQ, which now only focuses on CDR/negative emissions.
5222	121	35	121	36	This sentence needs clarification. The uncertianty is mainly in to what extent it could actually be implemented--not in the types of results that the approaches would lead to, which all studies suggest woult be much closer to the desired temperature level that would be the case were SRM not invoked. [Michael MacCracken, United States of America]	Not Applicable - text no longer included in the FAQ
37514	121	37	108	38	Weak sentence; replace by: To reach 1.5°C solely by cutting GHG emissions, the world would need to fully decarbonize by means of a global transformation at a pace that consistently exceeds historical experiences; only during short periods in selected countries has such decarbonization been observed in the past (Michaelowa et al., 2018). Reference: Michaelowa, Axel; Allen, Myles; Fu Sha (2018): Policy instruments for limiting global temperature rise to 1.5°C – can humanity rise to the challenge?, in: Climate Policy, 18, p. 275-286 [Matthias Honegger, Germany]	Noted - This is a very relevant reference. However, these are the FAQ, which should not pre-empt any key findings. This may be easily perceived as policy prescriptive, because they are taken out of context, do not contain confidence language and a simplified writing style. We have therefore slightly adapted the sentence, but can't bring in references at this point.
12582	121	40	121	41	This sentence is potentially confusing because "negative emissions" is a term often used to describe the GHG balance of individual technologies (e.g. BECCS) rather than the global net balance. Indded, this is what the first line of the FAQ indicates. Suggest stating "net negative emissions" here, and perhaps removing the quote marks. [United Kingdom (of Great Britain and Northern Ireland)]	Accepted - revised
57004	121	43	121	44	Moral hazard/mitigation obstruction is a significant risk for both CDR and SRM. It is not the case that their risk profiles are entirely different [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, it comes forth very clearly from the 1.5°C-specific literature that there is no scope for reaching 1.5°C - even with CDR - if we don't have drastic short-term reductions in emissions as well. We know that the ethics literature is heavily biased towards SRM, extending some of their conclusions to CDR as well, but this is generally perceived as not well-founded. As this is an FAQ and not an assessment, we cannot go into this and make any judgments concerning the risks and whether they are comparable or not. Note that the text for this FAQ has been significantly revised, which also avoids this direct comparison
5224	121	44	121	44	Regarding the risks, they are indeed about fine detail about whether they would work as theory suggests, so about various engineering aspects, not really the science. [Michael MacCracken, United States of America]	Taken into account - text has been revised and states many CDR methods are currently conceptual or have not been tested at scale.
40490	121	44	121	44	“Both approaches are unproven and carry with them substantial, although very different, risks.” It is important to highlight here the potential irreversibility and wide scale of negative effects. (See, for example, Bravo. 2013. “The Political Ecology of Geoengineering”. Letras Verdes. Revista Latinoamericana de Estudios Socioambientales, 14:358-63. https://doi.org/https://doi.org/10.17141/letrasverdes.14.2013.1009. and references therein) [Pedro Alfredo Borges Landaez, Venezuela]	Noted - however, in an FAQ we cannot offer any assessment. We mention the risks and refer to 4.3.9. and cross-chapter SRM Box 4.2 for the assessment of the risks.
3768	122	2	122	2	to bring emissions down after a temporary overshoot It should be "to bring temperature down". [Yangyang Xu, United States of America]	Accepted - This sentence was misleading and has been clarified: "CDR techniques can contribute to achieving this climate target by offsetting emissions of sectors that take longer to decarbonize or by reducing atmospheric carbon concentration after overshooting the remaining carbon budget in line with 1.5°C warming."
5226	122	2	122	2	The use of the phrase "temporary overshoot" is most likely going to be a very significant understatement--in terms of both amount and duration. I'd urge being more forthright about the situation being presented. [Michael MacCracken, United States of America]	Taken into account - what was meant was "temperature" not "temporary". Sentence has been substantially revised.
32688	122	6	122	7	BECCS can also use wastes and potentially marine biomass. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - we cannot go into so much detail in the FAQs.
39300	122	6	122	10	This is misleading, and afforestation and reforestation should be at the forefront, not BECCS, considering the latest findings on mitigation and adaptation potential. See Griscom B, 2017 http://www.pnas.org/content/114/44/11645 [Lindsey Cook, Germany]	Taken into account. The text now states up front that different CDR methods are at different levels of development. BECCS is stated to be in the demonstration phase.
51048	122	6	122	12	There are a wide range of CDR technologies, many without the serious negative potential impacts of BECCS (such as indicated in the graphic on p. 37 of chapter 4). Why is BECCS always the technology that serves as poster child for CDR? This makes no sense. Why not ecosystem and forest restoration, reforestation, and other natural climate solutions? It seems as if the teleological determinism of the IAMs always leads to BECCS as the answer. [Doreen Stabinsky, United States of America]	Taken into account. The text now states up front that different CDR methods are at different levels of development. BECCS is stated to be in the demonstration phase.
61330	122	6	122	7	This paragraph on options is silent on CO2 removal in aqautic environments, including the world's oceans. Why is this overlooked, particularly when an option such as MCB is discussed in the next paragraph? [United States of America]	Noted - we have now made clear that we only talk about examples here. Section 4.3.7 assesses the wider set of CDR options, including ocean-based.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
29564	122	8			The technology of "storing underground in rock formations" should be opened better as well as possibilities and costs of this procedure in different regions and circumstances. [Finland]	Rejected - we cannot go into so much detail in the FAQs and also not give assessments, which might be perceived as prescriptive as neither comprehensive nor in context. We have added a cross-reference 4.3.8 for this information.
49472	122	8			(...) stored underground in rock formations. Another CDR technique is direct (...) ... For me it would be clearer to add "in depths of 800 m below surface or much deeper": The result would be "(...) stored underground in rock formations in depths of 800 m below surface or much deeper. Another CDR technique (...)" [Manfred Treber, Germany]	Noted - however, not relevant for the FAQ section.
32690	122	13	122	14	The same goes for A/R. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The text now states up front that different CDR methods are at different levels of development, as well as different potentials for achieving negative emissions and different associated costs and side effects.
49474	122	14			(...) require large amounts of land. (...) ... Please specify that the land is needed for the production of bioenergy (and not for CO2 storage) and add "for the production of vast amounts of bioenergie". Result: "(...) require large amounts of land for the production of vast amounts of bioenergie. (...)" [Manfred Treber, Germany]	Accepted - sentence revised accordingly.
2140	122	24			SAI is not a cloud! [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text no longer included in the FAQ
7282	122	24	122	31	This needs to be harmonized with Cross-Chapter Box 4.2. There are some inconsistencies. [Ben Kravitz, United States of America]	Not Applicable - text no longer included in the FAQ
41702	122	24	122	24	SAI does not seek to modify the amount of cloud covering the earth [Andrew Parker, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text no longer included in the FAQ
57006	122	24	122	24	It is not the case that SAI works by modifying cloud cover [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text no longer included in the FAQ
57008	122	30	122	30	salt particles, not sea-water particles [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text no longer included in the FAQ
2142	122	32	122	36	clear bias against SRM - essentially all these criticisms could be reasonably made against CDR, but aren't. [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted - we think the reviewer implicitly refers to the issue of competition for land (not sure how deployment of direct air capture would negatively affect other countries, for example). We highlight the land use issue in the CDR paragraph, so think that this is a balanced representation.
57010	122	32	122	33	Need to be clear here that SAI is not a regional approach, and thus that the most discussed form of SRM is not covered by this discussion of regional issues. That said, SAI does have regionally distinct effects. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text no longer included in the FAQ
4338	122	35			This says that marine cloud brightening does nothing about ocean acidity. This is not entirely true because if marine cloud brightening slows the release of Arctic methane it would also reduce CO2 from methane breakdown. But the acidity comment is totally irrelevant. Should we object to a proposal to reduce ocean acidity because it did nothing about Arctic ice? Should we object to the manufacture of bull-dozers because they cannot be used for brain surgery? We need different tools for different jobs and understand how to pick the best for each. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Not Applicable - text no longer included in the FAQ
2144	122	38	122	40	biased against SRM - issues with CDR (at impactful scale) are as significant [Andrew Lockley, United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, this part of the text is gone due to condensing the FAQ and splitting the descriptions of SRM and CDR in the final draft, which we hope contributes to a more balanced description of these two options.
3278	123	1	123	1	Suggestion for FAQ 4.3: It would be useful to higlight some examples of adaptaion actions, and how they differnacross regions and urban/rural areas. [Vassilis Daioglou, Netherlands]	Taken into account. Adaptation examples feature prominently in the FAQ text and the need for regional context is stated.
17170	123	14	123	16	For the reasons of the variation of mortality, level of warming should be included. [Yasushi Honda, Japan]	Noted, but the comment is unclear. This FAQ focuses on adaptation at warming levels of 1.5°C and 2°C, as mandated by the IPCC Panel, and does not go into the implications for inaction, which is too detailed for an FAQ.
48332	124			190	Include the following references suggested in former comments: Butler, C. D., and Harley, D. (2010). Primary, secondary and tertiary effects of eco-climatic change: the medical response. Postgraduate Medical Journal, 86 (1014), 230-234. Dosi, G. (1982). Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. Research Policy, 11(3), 147-162. doi:10.1016/0048-7333(82)90016-6. Dosi, G. (1988). The nature of the innovative process, in Technical change and economic theory, eds. G. Dosi, C. Freeman, R. Nelson, G. Silverberg & L. Soete (Londres: Printer Publishers), 220-238. Dosi, G. and Nelson, R. (1994). An introduction to evolutionary theories in economics. Journal of Evolutionary Economics, 4(3), 153-172. doi:10.1007/BF01236366 Freeman, C., and Perez, C., (1988). Structural crisis of adjustment, business cycles and investment behaviour. In Technical Change and Economic Theory, eds. Dosi, G., Freeman, C., Nelson, R., Silverberg, G., Soete, L. (London: Pinter), 38–66. Gardiner, S. M. (2011). Climate justice, in The Oxford handbook of climate change and society, eds. J. Drzyek, R. Norgaard and D. Schlosberg (Oxford: Oxford University Press), 309-322. Kondratiev, Nikolai D. (1935) 'The Long Waves in Economic Life', Review of Economic Statistics, 17, 105-115 Perez, C. (2010). Technological revolutions and techno-economic paradigms. Cambridge journal of economics, 34(1), 185-2. doi:10.1093/cje/bep051 Schumpeter, Joseph A. (1939:1982), Business Cycles, 2 vols., Philadelphia: Porcupine Press. [Miriam Solera Ureña, Germany]	Noted. The LAs have added references in the new draft. In this report, post-AR5 references have been used unless a pre-AR5 is seminal or extremely important for the argument."
4340	124	1	190	3	There are 66 pages of references with about 25 per page. The choice of references seems rather selective. There are a great many papers on ethics and governance by authors who have not asked me for any information but none about the engineering hardware. None of the climate models have used monodisperse spray of the size we have chosen. If anyone in IPCC is interested in this aspect of geoengineering, I suggest [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Noted, combined with comments 4342, 4344 and 4346; doi:10.1098/rsta.2008.0136 has been cited in FGD Section 4.3.8.
4342	124	1	190	3	doi:10.1098/rsta.2008.0136 from the Royal Society of London and [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Noted, see response to comment 4340

Comment No	From Page	From Line	To Page	To Line	Comment	Response
4344	124	1	190	3	doi 10.1039/9781782621225-00131 from the Royal Society of Chemistry. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Noted, see response to comment 4340
4346	124	1	190	3	I can also provide preprints about hurricane moderation submitted to the Bulletin of Atomic Scientists and about Ethics and Governance submitted to Nature. [Stephen Salter, United Kingdom (of Great Britain and Northern Ireland)]	Noted, see response to comment 4340
47414	124	15	124	16	Journal is missing from this reference [Sarah Connors, France]	Noted, corrected in Reference manager
47416	124	21	124	24	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47418	124	33	124	38	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47420	124	45	124	48	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47422	124	54	124	55	DOI: DOI10.13140/RG.2.1.3132.3122 [Sarah Connors, France]	Noted, corrected in Reference manager
48010	125	5	125	5	Kindly check: Agren (2000) reference is not placed in chapter text [Sarah Connors, France]	Noted. This reference has been removed from the final draft
47424	125	14	125	15	Information missing from this reference. Publishers are OECD, under the coalition for urban transitions [Sarah Connors, France]	Noted, corrected in Reference manager
47426	125	16	125	17	Journal ACPD is a discussions journal where the paper is still under peer review. Please update with ACP reference once paper has been published. [Sarah Connors, France]	Noted. Paper was published in Nov 2017 and the reference has been updated to reflect this.
47428	125	30	125	31	Please check correct referencing for this grey literature paper. Are there any publishers to cite? Please refer to IPCC guidelines on Grey Literature: https://wg1.ipcc.ch/guidancepaper/AR5GuidanceNotes_Literature.pdf [Sarah Connors, France]	Noted, no longer cited in FGD.
47430	125	32	125	34	Information missing from this reference. Full citation = Albers, R. A. W., Bosch, P. R., Blocken, B. J. E., Dobbelsteen, A. A. J. F., Hove, van, L. W. A., Spit, T. J. M., ... Rovers, V. (2015). Overview of challenges and achievements in the climate adaptation of cities and in the Climate Proof Cities program. Building and Environment, 83, 1-10. DOI: 10.1016/j.buildenv.2014.09.006 [Sarah Connors, France]	Noted, corrected in Reference manager
47432	128	1	128	1	Incorrect reference format: “World Bank. 2010. World Development Report 2010 : Development and Climate Change. Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/4387 License: CC BY 3.0 IGO.” [Sarah Connors, France]	Noted, corrected in Reference manager
47434	128	18	128	18	Information missing in reference: Bataille, C. et al. (2015). Pathways to deep decarbonization in Canada, SDSN - IDDRI [Sarah Connors, France]	Noted, corrected in Reference manager
48014	128	18	128	18	Kindly check: Bataille et al., 2015; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47436	128	28	128	28	Typo in author name and information missing in reference = Beatley T. (2011) Biophilic Cities: What Are They?. In: Biophilic Cities. Island Press, Washington, DC [Sarah Connors, France]	Noted. The author name was correct and missing information has been added in reference manager.
48012	128	38	128	38	Kindly check: Table 4.3, Beatly, 2011; please provide detailed reference, if possible [Sarah Connors, France]	Noted. The author name was correct and missing information has been added in reference manager.
47438	129	1	129	51	Please ensure translated English abstract of this reference is available to the TSU. [Sarah Connors, France]	Not sure which reference this is about?
48016	129	8	129	8	Kindly check: Bernauer, T., and Gampfer, R. (2015) reference is not placed in chapter text [Sarah Connors, France]	Noted. This reference has been cited in text on pg 65, lines 31-32.
48018	130	4	130	4	Kindly check; BP Global, 2016; please provide detailed reference, if possible [Sarah Connors, France]	Noted. This reference has been removed from the final draft
47440	130	18	130	19	Typo in paper title - formatting error for the apostrophe [Sarah Connors, France]	Noted, corrected in Reference manager
47442	130	57	130	57	Pubishers missing = Pureprint Group ? [Sarah Connors, France]	Not applicable - reference changed in final draft
47444	131	8	131	8	information missing. INTERNATIONAL MONETARY FUND Staff position note, Strategy, Policy, and Review Department, Financing the Response to Climate Change [Sarah Connors, France]	Noted, corrected in Reference manager
48022	131	8	131	8	Kindly check: Bredenkamp and Pattillo, 2010 is incomplete in reference list (Pg. 131, line 8) [Sarah Connors, France]	Noted, corrected in Reference manager
47446	131	25	131	25	Reference information missing - publication issue and page numbers [Sarah Connors, France]	Noted, corrected in Reference manager
47448	131	33	131	34	Journal incorrect here, should be Frontiers in Energy Research [Sarah Connors, France]	Noted, corrected in Reference manager
47450	131	44	131	44	Refrence is missing information, please correct. [Sarah Connors, France]	Noted, corrected in Reference manager
48020	131	44	131	44	Kindly check: BRTData, 2017; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47452	132	15	132	16	Please ensure translated English abstract of this reference is available to the TSU. [Sarah Connors, France]	Noted. The English abstract is on Mendeley already.
47454	132	34	132	34	Refrence is missing information, Book (not paper) published by Routledge in 2011 (not 2013). [Sarah Connors, France]	Noted, corrected in Reference manager
48024	132	34	132	34	Kindly check: Bulkeley et al., 2013; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47456	132	43	132	43	Reference information missing - journal = Stanfod Journal of Law, Science and Policy. Publication issues? Page numbers? [Sarah Connors, France]	Noted, corrected in Reference manager
48026	132	59	132	59	Kindly check: Butler et.al 2015a reference is not placed in chapter text [Sarah Connors, France]	Noted. Butler 2015a has been cited in Sec 4.2.2.1 on page 13.
47458	133	39	133	39	Reference missing information: Vol. 353, Issue 6304, aad9837 DOI: 10.1126/science.aad9837 [Sarah Connors, France]	Noted, corrected in Reference manager
47460	133	53	133	53	Reference missing information: The New Climate Economy [Sarah Connors, France]	Noted, corrected in Reference manager
47462	134	3	134	4	No news items or blog posts can be used as references in an IPCC report. Please find alternative reference or remove text. Please follow the IPCC guidelines for grey literature: https://wg1.ipcc.ch/guidancepaper/AR5GuidanceNotes_Literature.pdf [Sarah Connors, France]	Noted. Not cited in FGD.
47466	134	28	134	29	This reference does not mention climate change - is it useful to the associated text? Also, publishers are missing from this citation [Sarah Connors, France]	Noted. This reference has been removed from the final draft
48028	134	54	134	54	Kindly check: Chichilnisky and Heal (1994) reference is not placed in chapter text [Sarah Connors, France]	Noted. Not cited in FGD.
47468	134	58	134	58	Title missing in this reference. Please check this reference is valid. [Sarah Connors, France]	Noted. Not cited in FGD.
47470	134	59	134	60	Invalid Reference (China Bicycle Association): No news items or blog posts can be used as references in an IPCC report. Please find alternative reference or remove text. Please follow the IPCC guidelines for grey literature: https://wg1.ipcc.ch/guidancepaper/AR5GuidanceNotes_Literature.pdf [Sarah Connors, France]	Noted. Not cited in FGD.
47472	135	42	135	42	UNEP, not climate Analytis are the main producers of this report: https://reliefweb.int/sites/reliefweb.int/files/resources/-Africas_adaptation_gap_2__Bridging_the_gap_%E2%80%93_mobilising_sources-2015-Africa%E2%80%99s_Adapta.pdf Please add publication place to reference. [Sarah Connors, France]	Noted, corrected in Reference manager
47476	135	48	135	49	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, duplication removed.
47478	136	1	136	1	Journal and issue number missing in this referece. [Sarah Connors, France]	Noted, corrected in Reference manager
48030	136	35	136	35	Kindly check: Creutzig et al. (2017) reference is not placed in chapter text [Sarah Connors, France]	Noted, it was referenced in text on page 11 below Table 4.1 and is included in FGD.
47480	137	10	137	11	Reference is missing Journal (Energy Efficiency) and issues numbers. = Vine, D. , Buys, L. and Morris, P. (2013) The Effectiveness of Energy Feedback for Conservation and Peak Demand: A Literature Review. Open Journal of Energy Efficiency, 2, 7-15. doi: 10.4236/ojee.2013.21002. [Sarah Connors, France]	Rejected. Not the same reference, as the one that is cited. More information has been included in Reference Manager
48032	137	19	137	19	Kindly check: Davidson et al. (2006) reference is not placed in chapter text [Sarah Connors, France]	Noted. Deleted from reference list.

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47482	137	42	137	44	Information missing - World Bank Paper No. 203 [Sarah Connors, France]	Noted, corrected in Reference manager
47484	139	18	139	18	More information needed for this reference. Government of Western Australia - Department of Mineral and Petroleum. Publishing city/place? [Sarah Connors, France]	Noted, corrected in Reference manager
47486	140	6	140	7	Missing information in refence - Wolrd Bank Group Publication - where is the place of publication? [Sarah Connors, France]	Noted, corrected in Reference manager
47488	140	8	140	9	Issue number and pages missing in reference. [Sarah Connors, France]	Noted, corrected in Reference manager
47490	140	10	140	11	Full citation should be: "Eberhard, Anton; Rosnes, Orvika; Shkaratan, Maria; Vennemo, Haakon. 2011. Africa's Power Infrastructure : Investment, Integration, Efficiency. Directions in Development ; infrastructure. World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/2290 License: CC BY 3.0 IGO." [Sarah Connors, France]	Noted, corrected in Reference manager
47492	140	36	140	37	Reference is missing publishers (Springer) and place of publication. ISBN = ISBN 978-94-007-7088-1 [Sarah Connors, France]	Noted, corrected in Reference manager
47494	140	44	140	45	Publishers and place of publication missing from report reference [Sarah Connors, France]	Noted, corrected in Reference manager
47496	141	1	141	2	Publishers and place of publication missing from report reference. ASC Report No6. [Sarah Connors, France]	Noted, corrected in Reference manager
47498	141	9	141	10	Is it possible to find a reference for this database to cite rather than the webpage? If website needs to be used then please cite date accessed. [Sarah Connors, France]	Noted. This reference has been removed from the final draft
47500	141	34	141	34	Publication place needed for this report. [Sarah Connors, France]	Noted, corrected in Reference manager
47502	141	59	141	59	Date of publication is 1985, the Special Report should be a focus of updates since AR5, only citing previous literature key to the assessment. Is this reference relevant for the Special Report? [Sarah Connors, France]	Noted. This reference has been removed from the final draft
47504	143	49	143	50	This reference is entered in the wrong format (it is a paper not a book/report). Please add journal, issue number and pages numbers. Etc [Sarah Connors, France]	Noted, corrected in Reference manager
48330	143	60	144	1	Incorrect reference: Freeman, C., and Perez, C. (2000). Structural crises of adjustment, business cycles and investment behaviour. Technology, Organizations and Innovation: Theories, Concepts and Paradigms 871 To be replace by: "Freeman, C., and Perez, C., (1988). Structural crisis of adjustment, business cycles and investment behaviour. In Technical Change and Economic Theory, eds. G. Dosi,, C. Freeman, R. Nelson, G. Silverberg and L. Soete (London: Pinter), 38–66." [Miriam Solera Ureña, Germany]	Noted, corrected in Reference manager
47506	144	17	144	18	Typo in title of reference. Page number missing in reference. [Sarah Connors, France]	Noted, corrected in Reference manager
47508	144	28	144	29	Publishers and place of publication needed for this reference report. [Sarah Connors, France]	Noted, corrected in Reference manager
48034	144	37	144	37	Kindly check: Fuss et al. (2016) reference is not placed in chapter text [Sarah Connors, France]	Noted, not cited in final draft.
47510	144	59	144	60	Page missing, publishers and place of publication missing [Sarah Connors, France]	Noted, unable to find place of publication.
47512	145	13	145	16	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, duplicate reference removed in final draft.
47514	145	37	145	37	Publishers and place of publication missing in this reference [Sarah Connors, France]	Noted, corrected in Reference manager
47516	145	49	145	49	Place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
37202	145	59	145	60	Correct reference: Global CCS Institute (2016). The Global Status of CCS 2016 Summary Report. Canberra, Australia. DOI is incorrect. [John Scowcroft, Belgium]	Noted, corrected in Reference manager
47518	146	1	146	1	Publishers and place of publication missing in this reference. Refrence should be= GEA, 2012: Global Energy Assessment – Toward a Sustainable Future, Cambridge University Press, Cambridge UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria. [Sarah Connors, France]	Noted, corrected in Reference manager
47520	146	10	146	11	Date of publication is 1988, the Special Report should be a focus of updates since AR5, only citing previous literature key to the assessment. Is this reference relevant for the Special Report? [Sarah Connors, France]	Rejected. Please note that this paper does report relationships between climate action and happiness, including buying a live tree to replant and using organic or locally grown foods. So the reference is relevant for the current report
47522	146	23	146	24	Missing information in reference - The New Climate Glocbal Economy, Working paper [Sarah Connors, France]	Noted, corrected in Reference manager
47526	147	10	147	11	Missing place of publication in this reference [Sarah Connors, France]	Noted, corrected in Reference manager
47524	147	22	147	23	Missing information _ Working Paper No. 17/233 from the International Monetary Foundation [Sarah Connors, France]	Noted, corrected in Reference manager
47528	147	47	147	48	Missing part of title: 'Managing the Impacts of Climate Change on Poverty' [Sarah Connors, France]	Noted, corrected in Reference manager
47530	149	19	149	19	Information missing - who are the publishers? [Sarah Connors, France]	Noted, corrected in Reference manager
47532	149	31	149	32	Information missing - International Food and Agribusiness Management Review Volume 18 Issue 3, 2015 [Sarah Connors, France]	Noted, corrected in Reference manager
47534	149	54	149	57	Formatting error in '&' in the journal title of this reference [Sarah Connors, France]	Noted, corrected in Reference manager
47536	150	1	150	3	Formatting error in 'CO 2' in the title of this reference [Sarah Connors, France]	Noted, corrected in Reference manager
47538	150	11	150	12	Missing information = Carbon & Climate Law Review>Volume 7 (2013), Issue 2 > Pages 125 - 135 [Sarah Connors, France]	Noted, corrected in Reference manager
47540	150	55	150	55	Missing information. Full citation = ICEM (2013) USAID Mekong ARCC Climate Change Impact and Adaptation: Summary. Prepared for the United States Agency for International Development by ICEM - International Centre for Environmental Management [Sarah Connors, France]	Noted, corrected in Reference manager
47542	150	59	151	9	All report references citations have the publishers and place of pulication included in their citation. [Sarah Connors, France]	Noted, all IEA references updated in Reference Manager.
48036	151	3	151	3	Kindly check: IEA, 2017a; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
30710	151	8	151	9	This report is mentioned twice in the sources [France]	Noted, duplicate reference removed in final draft.
47544	151	8	151	9	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, duplicate reference removed in final draft.
47548	151	10	151	10	I cannot find this publication. Is this a press article? If so, this is not valid as a reference for IPCC Reports. No news items or blog posts can be used as references in an IPCC report. Please find alternative reference or remove text. Please follow the IPCC guidelines for grey literature: https://wg1.ipcc.ch/guidancepaper/AR5GuidanceNotes_Literature.pdf [Sarah Connors, France]	Noted. This is a book, ISBN and place of publication have been added.
47546	151	12	151	12	Date of publication is 1991, the Special Report should be a focus of updates since AR5, only citing previous literature key to the assessment. Is this reference relevant for the Special Report? [Sarah Connors, France]	Reject. This document was instrumental for initiating and shaping the Loss & Damage debate.
47550	151	27	151	27	Missing information = publishers, place of publication. ISBN: 978-92-95111-59-2 [Sarah Connors, France]	Noted, corrected in Reference manager
48038	151	27	151	27	Kindly check: IRENA (2015); please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47552	151	53	151	53	Place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
1608	151	57	151	58	Please correct the reference to Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, and B.A. Frew, A low-cost solution to the grid reliability problem with 100% penetration of intermittent wind, water, and solar for all purposes, Proc. Nat. Acad. Sci., 112 (49), 15,060-15,065 doi: 10.1073/pnas.1510028112, 2015 [Mark Jacobson, United States of America]	Noted, corrected in Reference manager
47554	152	2	152	2	Typo in title of paper. Spaces inbetween commas [Sarah Connors, France]	Noted, corrected in Reference manager

Comment No	From Page	From Line	To Page	To Line	Comment	Response
47556	152	60	152	60	Missing information = Inter-American Development Bank. Policy Brief No IDB-PB 261 [Sarah Connors, France]	Noted, corrected in Reference manager
47558	153	3	153	3	Missing information - published by Rocky Mountain Institute. Wat is the place of publication? Walker, Jonathan and Charlie Johnson. Peak Car Ownership: The Market Opportunity of Electric, Automated Mobility Services., Rocky Mountain Institute, 2016. http://www.rmi.org/peak_car_ownership [Sarah Connors, France]	Noted, corrected in Reference manager
48040	153	3	153	3	Kindly check: Johnson and Walker, 2016; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
48042	153	21	153	21	Kindly check: Jones et al. (2016a) reference is not placed in chapter text [Sarah Connors, France]	Noted. Cited in FGD.
47560	153	41	153	41	Suggestion to add title of law suit - Children have standing under public trust doctrine to bring climate action [Sarah Connors, France]	Noted, corrected in Reference manager
47562	154	18	154	19	The Reference Kasser and Sheldon does not seem to fit with the text it is cited with: " Yet, some climate actions can enhance quality of life, such as technology that improves living comfort and nature-based solutions for climate adaptation (Wamsler and Brink, 2014b). Further, climate action can enhance quality of life (Kasser and Sheldon, 2002; Schmitt et al., 2018; Xiao et al., 2011) as doing so is meaningful. " as this reference is not specifially on climate change. Does this reference add to the othr two already cited in this paragraph? If not, suggest removing this reference. [Sarah Connors, France]	Noted: This is the first time that behavioural anomalies/issues associated with low-carbon energy technology adopters are treated more explicitly in an IPCC (special) report. Some were partly addressed in AR5-WG3 (see Chapter 3) but several knowledge gaps were identified. This particular paper shows that loss aversion is an important component to consider in the adoption of mitigation technologies; however, it is often overlooked in policymaking. As a whole, the assessed literature from behavioural economics as applied to energy use shows that there are opportunities to complement existing technology-oriented policy mixes.
47566	154	24	154	24	Please check this reference. Is its publication date actually 2002? Does it refer to this text? ISBN: 9780195121056? Please add place of publication [Sarah Connors, France]	Noted, publication date is 2002. Corrected in Reference manager
48044	154	24	154	24	Kindly check: Kauffman, 2000; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47564	154	43	154	44	PNAS Journal should be fully spelled out [Sarah Connors, France]	Noted, corrected in Reference manager
47568	155	1	155	1	Missing place of publication from reference [Sarah Connors, France]	Noted, corrected in Reference manager
47570	156	14	156	15	Place of publication needed [Sarah Connors, France]	Noted, corrected in Reference manager
47572	156	59	156	60	Publishers missing, please add working aper No 2017-60 [Sarah Connors, France]	Noted, corrected in Reference manager
47574	157	6	157	9	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47576	157	39	157	40	publishers and place of publication missing [Sarah Connors, France]	Noted, corrected in Reference manager
47578	158	6	158	7	Biogensciences Discussion is a unpublished journal - the Discussions infers that the paper is still undergoing public peer review. Please update to Biogeosciences reference once published [Sarah Connors, France]	Noted, has been updated to Biogeosciences
47580	158	47	158	47	Missing publishers (RAND) and place of publication (Santa Monica, CA) [Sarah Connors, France]	Noted, corrected in Reference manager
48046	158	47	158	47	Kindly check: Lempert and Prosnitz, 2011; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
48048	159	41	159	41	Kindly check: Liu et al. (submitted) reference is not placed in chapter text [Sarah Connors, France]	Noted, reference not cited in FGD
47582	160	31	160	31	Publishers and place of publication missing from this reference [Sarah Connors, France]	Noted, place not available, publisher added
47584	161	1	161	1	Missing information : Climate Geoengineering Governance Working Paper Series: 013. Where is the place of publicaiton? [Sarah Connors, France]	Noted, corrected in Reference manager
48050	161	1	161	1	Kindly check: Mackerron, 2014; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47586	161	23	161	23	Missing onformation: IDDRI SciencePo. [Sarah Connors, France]	Noted, corrected in Reference manager
47588	161	24	161	28	This reference is a book chaper #1 from 978-0-521-13432-3 - Explaining Institutional Change: Ambiguity, Agency, and Power and should be properly referenced as such. The publishers are Cambridge University Press, UK. [Sarah Connors, France]	Noted, corrected in Reference manager
47590	161	32	161	34	Full reference = Mahoo H, Mbungu W, Yonah I, Recha J, Radeny M, Kimeli P, Kinyangi J. 2015. Integrating Indigenous Knowledge with Scientific Seasonal Forecasts for Climate Risk Management in Lushoto District in Tanzania. CCAFS Working Paper no. 103. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). [Sarah Connors, France]	Noted, corrected in Reference manager
47592	162	49	162	49	Missing information - publishers place? DOI = http://dx.doi.org/10.18235/0000806#sthash.Y7h4lEYY.dpuf [Sarah Connors, France]	Noted, corrected in Reference manager
47594	163	32	163	33	Formatting error in the title of the paper [Sarah Connors, France]	Editorial
48052	164	16	164	16	Kindly check: MME, 2016; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47596	164	37	164	40	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47600	165	6	165	7	Publishers and place of publication missing from reference [Sarah Connors, France]	Noted, corrected in Reference manager
47598	165	22	165	24	Reference missing issue number (3) [Sarah Connors, France]	Noted, corrected in Reference manager
47602	165	28	165	29	Reference missing information/ Full citation = Nakashima, D.J., Galloway McLean, K., Thulstrup, H.D., Ramos Castillo, A. and Rubis, J.T. 2012. Weathering Uncertainty: Traditional Knowledge for Climate Change Assessment and Adaptation. Paris, UNESCO, and Darwin, UNU, 120 pp. [Sarah Connors, France]	Noted, corrected in Reference manager
47604	165	39	165	39	Missing information. Title, Joural, Publishers, Place of publicaiton etc [Sarah Connors, France]	Noted, corrected in Reference manager
48054	165	42	165	42	Kindly check: Nemet et al. (submitted) reference is not placed in chapter text [Sarah Connors, France]	Noted, is cited in FGD
47606	165	52	165	54	Two Newma, references both with 2017 - this should be referred to as 2017a and 2017b. [Sarah Connors, France]	Editorial
47608	166	3	166	4	Journal missing in this reference: Sustainable Water Use and Management [Sarah Connors, France]	Noted, it is a book chapter and cited as such
47610	166	12	166	12	Please follow the IPCC guidelines for grey literature: https://wg1.ipcc.ch/guidancepaper/AR5GuidanceNotes_Literature.pdf [Sarah Connors, France]	Noted.
47612	166	27	166	27	Place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47614	166	58	166	59	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
48056	166	60	166	60	Kindly check: Nyantakyi-frimpong and Bezner-kerr (2015) reference is not placed in chapter text [Sarah Connors, France]	Noted, cited in text in FGD
47616	167	20	167	20	Typo in title of this reference [Sarah Connors, France]	Noted, corrected in Reference manager
47618	167	22	167	23	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47620	167	29	167	41	All report references citations have the publishers and place of pulication included in their citation. [Sarah Connors, France]	Noted, corrected in Reference manager
47622	167	54	167	54	Information missing: Olhoff, A., Bee, S., & Puig, D. (2015). The Adaptation Finance Gap Update - with insights from the INDCs. United Nations Environment Programme. Place of publication available? [Sarah Connors, France]	Noted, corrected in Reference manager
47624	168	13	168	13	Date of publication is 1994, the Special Report should be a focus of updates since AR5, only citing previous literature key to the assessment. Is this reference relevant for the Special Report? Additionally, publishers are missing as well as place of publication [Sarah Connors, France]	Noted, no longer cited in FGD
47626	168	25	168	25	Information missing. Full citation = Owen, R 2014, Solar Radiation Management and the Governance of Hubris. in RM Harrison & R Hester (eds), Geoengineering of the Climate System: Issues in Environmental Science and Technology. Royal Society of Chemistry, pp. 212-248. DOI: 10.1039/9781782621225-00212 [Sarah Connors, France]	Noted, corrected in Reference manager

Comment No	From Page	From Line	To Page	To Line	Comment	Response
48058	168	25	168	25	Kindly check: Owen (2014); please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47628	168	39	168	39	Missing place of publication [Sarah Connors, France]	Noted, corrected in Reference manager
48060	169	4	169	4	Kindly check: Perlack et al., 2005; please provide detailed reference, if possible [Sarah Connors, France]	Noted, no longer cited in FGD
47630	169	9	169	9	Missing publisher details and place of publication [Sarah Connors, France]	Noted, corrected in Reference manager
48062	169	9	169	9	Kindly check: Parson, 2017; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47632	169	16	169	18	Citation missing information. Full ref = Patel R, Walker G, Bhatt M, Pathak V. The Demand for Disaster Microinsurance for Small Businesses in Urban Slums: The Results of Surveys in Three Indian Cities. PLOS Currents Disasters. 2017 Mar 1 . Edition 1. doi: 10.1371/currents.dis.83315629ac7cae7e2c4f78c589a3ce1c. [Sarah Connors, France]	Noted, corrected in Reference manager
47634	169	43	169	46	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
48064	169	43	169	43	Kindly check: Pelling et al., (submitted) reference is not placed in chapter text [Sarah Connors, France]	Noted, accepted and cited in FGD
50612	170	13	170	14	Add reference : A.Petsonk and N. O. Keohane , Creating a Club of Carbon Markets: Implications of the Trade System, August 2015, E15 Expert Group on Measures to Address Climate Change and the Trade System, ICTSD and WEF [Jean-Yves CANEILL, France]	Reject, not added in the reference list as it is not cited in the chapter.
48066	170	48	170	48	Kindly check: Planning, 2008; please provide detailed reference, if possible [Sarah Connors, France]	Noted, no longer cited in FGD
48136	170	48	170	49	Please clarify this reference and check this is correctly formatted. [Sarah Connors, France]	Noted, no longer cited in FGD
47636	170	52	170	53	I cannot find this reference. Is this a paper or an abstract for a conference? Conferance abstracts cannot be cite in IPCC reports but Conference proceedings can. Please check this citation is correct. [Sarah Connors, France]	Noted, no longer cited in FGD
47640	171	27	171	28	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47638	171	50	171	53	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47642	172	29	172	30	Information missing: Public Admin. Dev. 32, 215–228 (2012) [Sarah Connors, France]	Noted, corrected in Reference manager
47644	172	53	172	53	Missing publishers and place of publication for this report cited: Published by: Gross National Happiness Commission, Royal Government of Bhutan. ISBN 978-99936-55-01-5 [Sarah Connors, France]	Noted, corrected in Reference manager
47646	172	54	172	54	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47648	173	2	173	7	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47650	173	12	173	13	Place of publication missing in this reference [Sarah Connors, France]	Noted, corrected in Reference manager
47654	173	21	173	22	Missing publishers information = The New Climate Economy. Place of publication available? [Sarah Connors, France]	Noted, corrected in Reference manager
48068	173	50	173	53	Kindly check: Rode et al., (2017) reference is not placed in chapter text [Sarah Connors, France]	Noted, cited in FGD
47656	173	59	173	60	Missing year and journal [Sarah Connors, France]	Noted, no longer cited in FGD
47658	174	6	174	9	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47660	174	15	174	16	Typo in second author's name. Missing information. Full citation = White, Roland; Turpie, Jane; Letley, Gwyneth Letley. 2017. Greening Africa's Cities : Enhancing the Relationship between Urbanization, Environmental Assets, and Ecosystem Services. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/26730 License: CC BY 3.0 IGO [Sarah Connors, France]	Noted, corrected in Reference manager
47662	174	32	174	32	Missing information. Full citation = Rose, Adam. 2016. Capturing the Co-Benefits of Disaster Risk Management on the Private Sector Side. Policy Research Working Paper;No. 7634. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/24208 License: CC BY 3.0 IGO [Sarah Connors, France]	Noted, corrected in Reference manager
48070	174	32	174	32	Kindly check: Rose, 2016; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47664	174	41	174	42	Can the information from this reference be found in a publication? Rather than reference a website? [Sarah Connors, France]	Noted, additional references are in this section in the FGD.
47666	175	5	175	6	Information missing. Full citation = Salvo, A., Brito, J., Artaxo, P., & Geiger, F. M. (2017). Reduced ultrafine particle levels in São Paulo's atmosphere during shifts from gasoline to ethanol use. Nature Communications, 8(1), [77]. DOI: 10.1038/s41467-017-00041-5 [Sarah Connors, France]	Noted, corrected in Reference manager
47668	175	49	175	50	Place of publication available for this citation? [Sarah Connors, France]	Noted, corrected in Reference manager
47670	176	13	176	14	Missing information: Sustainability 2014, 6, 3521-3533; doi:10.3390/su6063521 [Sarah Connors, France]	Noted, corrected in Reference manager
47672	176	15	176	16	Conferance abstracts cannot be cited in IPCC reports but Conference proceedings can. Please check this citation is correct. [Sarah Connors, France]	Noted, reference removed.
47674	176	27	176	28	Typo in the title of this reference [Sarah Connors, France]	Noted, corrected in Reference manager
47676	176	32	176	35	Repetition typo in this reference - is this reference missing issue and page numbers for the conference? [Sarah Connors, France]	Noted, corrected in Reference manager
47678	176	41	176	41	Missing information: Nature Climate Change 7, 230–231 (2017) [Sarah Connors, France]	Noted, corrected in Reference manager
47680	176	60	177	3	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
37042	177	17	177	18	This reference is incorrect (Lawrence, E.O. is *not* an author - this is the founder of our laboratory and he is not alive): Shah, N., Wei, M., Letschert, V., Phadke, A., and Lawrence, E. O. (2015). Benefits of Leapfrogging to Super-efficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning. Berkeley. It should be: Shah, Nihar, Max Wei, Virginie E Letschert, and Amol A Phadke. Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning. Berkeley, CA: Lawrence Berkeley National Labortory, 2015. LBNL-1003671. http://eta-publications.lbl.gov/sites/default/files/lbnl-1003671.pdf [Lynn Price, United States of America]	Noted, corrected in Reference manager
47682	177	23	177	23	Typo in the & of the title of the reference [Sarah Connors, France]	Noted, corrected in Reference manager
47684	177	39	177	39	Information missing. Full citation = Shine, T. and G. Campillo (2016) "The Role of Development Finance in Climate Action Post-2015", OECD Development Co-operation Working Papers, No. 31 OECD Publishing, Paris. [Sarah Connors, France]	Noted, corrected in Reference manager
48074	177	49	177	49	Kindly check: Shukla et al., 2015; please provide detailed reference, if possible [Sarah Connors, France]	Noted, added publisher, but no place available.
47686	177	59	177	59	Missing publishers and place of publication for this cited report. ISBN: 978-0-745-69156-5 [Sarah Connors, France]	Noted, corrected in Reference manager
48072	177	59	177	59	Kindly check the referencing style [Sarah Connors, France]	Noted, corrected in Reference manager
47688	177	60	178	7	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
56428	179	6	179	7	The reference is incorrect. It should be: Smithers, R.J., Shabb, K., Holdaway, E., Sanchez Ibrahim, N., Rass, N., and Olivier, J. (2017) The role of the NAP process in translating NDC adaptation goals into actionL linking NAP processes and NDCs. Bonn and Eschborn, Germany. [Richard J. Smithers, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Paragraph has been deleted in FGD.
47690	179	8	179	9	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, publisher added, place not available
47692	179	44	179	46	Date of publication is 1988, the Special Report should be a focus of updates since AR5, only citing previous literature key to the assessment. Is this reference relevant for the Special Report? Additionally, publishers are missing as well as place of publication [Sarah Connors, France]	Noted, place included, publisher not available.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
47694	180	1	180	4	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47696	180	29	180	32	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47698	180	39	180	39	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47700	180	52	180	53	Place of publication available for this reference? ISBN 978-3-319-54699-5 [Sarah Connors, France]	Noted, corrected in Reference manager
47702	180	54	180	55	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47704	181	26	181	26	Typo in the title of this reference [Sarah Connors, France]	Noted, corrected in Reference manager
48076	181	27	181	27	Kindly check: Tacoli et al., 2013; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47706	182	10	182	12	All report references citations have the publishers and place of pulication included in their citation. [Sarah Connors, France]	Noted, corrected in Reference manager
48078	182	12	182	12	Kindly check: The New Climate Economy, 2016; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47708	182	23	182	23	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47710	183	11	183	11	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, no longer cited in FGD.
48082	183	11	183	11	Kindly check: UIC, 2017; please provide detailed reference, if possible [Sarah Connors, France]	Noted, no longer cited in FGD.
47400	183	15	183	15	This reference should state the United Nations in full , not the UN. [Sarah Connors, France]	Noted, corrected in Reference manager
47712	183	15	183	50	All report references citations have the publishers and place of pulication included in their citation. [Sarah Connors, France]	Noted, corrected in Reference manager
48080	183	32	183	32	Kindly check: UNFCCC, 1992; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
48084	183	48	183	48	Kindly check: United Nations, 2015; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
48086	183	48	183	48	Kindly check: United Nations, 2017; please provide detailed reference, if possible [Sarah Connors, France]	Noted, corrected in Reference manager
47714	183	55	183	55	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, this reference has been removed from the final draft.
47716	184	4	184	4	Incorrect reference title: Leveraging Catastrophe Bonds as a Mechanism for Resilient Infrastructure Project Finance. Publishers and place of publication should be added. [Sarah Connors, France]	Noted, this reference has been removed from the final draft.
48088	184	4	184	4	Kindly check: Vajjhala and Rhodes, 2015; please provide detailed reference, if possible [Sarah Connors, France]	Noted, this reference has been removed from the final draft.
47718	185	24	185	25	Date of publication is 1997, the Special Report should be a focus of updates since AR5, only citing previous literature key to the assessment. Is this reference relevant for the Special Report? Additionally, publishers are missing as well as place of publication [Sarah Connors, France]	Noted, corrected in Reference manager
47720	185	56	185	57	Incorrect citation. Full citation = UNEP (2014) Decoupling 2: technologies, opportunities and policy options. A Report of the Working Group on Decoupling to the International Resource Panel. von Weizsäcker, E.U., de Larderel, J, Hargroves, K., Hudson, C., Smith, M., Rodrigues, M. [Sarah Connors, France]	Noted, corrected in Reference manager
47722	186	3	186	6	Repeated references, please remove duplication. [Sarah Connors, France]	Noted, corrected in Reference manager
47724	186	56	186	57	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47730	187	7	187	7	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted, corrected in Reference manager
47726	187	8	187	8	Publishers and place of publication available for this reference? Additionally, are there not non-grey literature references that could be used instead of this? [Sarah Connors, France]	Noted. Reference removed in final draft
48090	187	8	187	8	Kindly check: WBCSD, 2015; please provide detailed reference, if possible [Sarah Connors, France]	Noted. Reference removed in final draft
47732	187	13	187	14	Journal incomplete in this citation: Journal of Personality and Social Psychology 1991, Vol. 61, No. 5. 734-742 [Sarah Connors, France]	Noted, corrected in Reference manager
50610	187	18	187	19	Add reference : L. Weischer, J. Morgan and M.Patel, Climate Clubs: Can Small Groups of Countries make a Big Difference in Addressing Climate Change ?, RECIEL 21 (3) 2012. ISSN 0962-8797 [Jean-Yves CANEILL, France]	Rejected. Reference is not cited in the text so also not in the reference list.
47728	187	41	187	42	Publication place missing. = Geneva, Switzerland [Sarah Connors, France]	Noted, corrected in Reference manager
47734	188	16	188	17	Recommeneded citation (in the report itself) = BASIC experts, 2011. Equitable access to sustainable development: Contribution to the body of scientific knowledge. BASIC expert group: Beijing, Brasilia, Cape Town and Mumbai [Sarah Connors, France]	Noted, corrected in Reference manager
47736	188	51	188	51	Publishers and place of publication available for this reference? [Sarah Connors, France]	Noted. This reference is a webpage, all necessary details added.
50608	188	54	188	55	Add reference : World Bank Group (2017). States and Trends of Carbon Pricing 2017, Washington DC, November 2017 [Jean-Yves CANEILL, France]	Noted, reference is added automatically if it is cited in the main text.
48092	189	21	189	21	Kindly check: Yangka D. (submitted) reference is not placed in chapter text [Sarah Connors, France]	Noted, it is cited in the FGD.
47738	189	38	189	40	Missing information in citation. Full ref information = How Will I Be Remembered? Conserving the Environment for the Sake of One's Legacy, Lisa Zaval, Ezra M. Markowitz, Elke U. Weber, Psychological Science, Vol 26, Issue 2, pp. 231 - 236 First Published January 5, 2015 https://doi.org/10.1177/0956797614561266 [Sarah Connors, France]	Noted, corrected in Reference manager
54492	190	1	190	6	Having read through the chapters I'm still skeptical if social-cultural acceptability, or even economic, can be assessed so easily, given the capacity fo social-economic changes (and their acceptability) to change rapidly (and radicallyO. [Thomas Thornton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. See supplementary material D1 and D2 for a detailed line of sight on this theme, based on available literature. This is identified as a knowledge gap on some dimensions