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

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11015					The chapter as a whole fails to integrate important contributions about governance. Lead authors should read and integrate throughout points from the following key work: Stilgoe, J., et al. (2013). "Developing a framework for responsible innovation." Research Policy 42(9): 1568-1580; Owen, R. (2014). "Solar radiation management and the governance of hubris." Geoengineering of the Climate System 38: 212; Szerszynski, B., et al. (2013). "Why solar radiation management geoengineering and democracy won't mix." Environment and Planning A 45(12): 2809-2816. Both sets of authors challenge the notion that SRM deployment can be a legitimate object of governance, arguing that it is incompatible with democracy. Their detailed argumentation suggest that deployment may never be decided upon through "legitimate", democratic processes. These key points need to be brought into the chapter in more than a piecemeal and sketchy manner. it is worrysome that the chapter relies extensively on a small body of work while leaving out this more critical literature. The latter is more extensive than what I have reviewed here. Some of it is in the ethics section, but that section risks being ghettoized, its points insufficiently integrated in the overall text. [Michael Thompson, United States of America]	Accepted, Szerszynski, B., et al. (2013) cited, the text have been revised.
4365					Thuis chhapter should emphasize the need for data sharing and data collection at finer spatial and temporal aspects. [Shouraseni Roy, United States of America]	Noted. This is addressed in section 4.4.2 in the SOD.
4878					Consider to include a "box" on enabling CCS and BECCS. The IEA CCS Unit, GCCSI and other CCS actors can help with delivery of content. [Wilfried Maas, Netherlands]	Reject. Singling out a technology like that would be perceived as prescriptive.
1304					General comment on the whole chapter: It would be useful to have a table or graphic for policy makers and practitioners which highlights the most significant opportunities for adaptation and transformation in the move to a 1.5 degree world, together with the key barriers to implementation and co-benefits related to these. [Debra Roberts, South Africa]	Accept. A version of this will be included in the SOD.
3611					4.2.2.1 [Valentina Bosetti, Italy]	Noted
12315					I had little time to read the whole book. I read carefully the chapter 4. It is complete and clear. However, the readers that are not scientist have some difficulties to read the bibliography to find some pratical indications. At least, I suggest to insert in the case studies (box grey) pratical indications such as web sites or brochure etc. [alberto fichera, Italy]	Noted. Some web-based material may be made available.
3612					4.2.2.1 why is this section needed as a whole chapter discusses this? [Valentina Bosetti, Italy]	Noted
3613					4.2.2.2 same as above [Valentina Bosetti, Italy]	Noted
3614					As with chpater 5, it would be good to know what is this chapter about, as the executive summary read as the executive summary of the whole report. What is this chapter supposed to cover? [Valentina Bosetti, Italy]	Rejected; please refer to section 4.1.
9504					Some parts of this chapter is not yet ready for review. To judge feasibility of response measures needs solid input from Chapter 2 and 3. Still many descriptions are too genral, lengthyand not so sharply targeting to 1.5 issue. Volume needs to be decreased. [Shuzo Nishioka, Japan]	Accepted. Links between the chapters are improved and the text has been revised and sharpened.
11040					in general: discussion on the political dimension is underutilized, particularly when it comes to the political economy or the politics of climate policy measures [Oliver Geden, Germany]	Accept. We have tried to increase this part in section 4.4.
4658					This chapter contains many references to gray literature. According to IPCC discussion after AR4 the grey literature has to be (or should be) labelled in the Reports. [Radim Tolasz, Czech Republic]	Taken into account. Grey literature will be subject to clearance as per IPCC norms
7986					What about public acceptance of: genetic technologies ?, of underground reservoirs for CO2 ?, of SRM ?, of SAI ?, of MCB ? Why should these technologies be more acceptable than nuclear ? [Jean Marie Seiler, France]	Taken into account, these aspects are discussed in respectively sections 4.3.2, 4.3.8 and 4.3.9 in the SOD.
7224					The Parties undertook to achieve the Paris goal by reducing net emissions `to achieve a balance between anthropogenic sources and removals by sinks of greenhouse gases in the second half of this century'. There was no agreement to geo-engineer planetary albedo. [Anton Cartwright, South Africa]	Noted.
17214					The executive summary analyses societal behavior but does not include an analysis on the effect of the political cycles (4-5y elections followed by new governments) in achieving the long term targets. Policymakers tend to focus on aspects relevant during their short term in office and this should be pointed out given its relevance to achieve the 1.5 degree target. [Carlos Garci Soto, Spain]	Noted. No literature provided.
20799					How come there is no mention of the Climate and Clean Air Coalition (CCAC) which has been set up as the only international response to address SLCPs? It after all contains over 50 countries as partners as well as many IGOs, NGOs and research institutes. [Johan Carl Ivar Kuylenstierna, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The section on SLCPs is based on the options, and does not discuss the policy responses. Not aware of peer-reviewed literature assessing this?
9557					Some parts of this chapter is not yet ready for review. To judge feasibility of response measures needs solid input from Chapter 2 and 3. Still many descriptions are too genral, lengthyand not so sharply targeting to 1.5 issue. Volume needs to be decreased. [Shuzo Nishioka, Japan]	Accepted. Links between the chapters are improved and the text has been revised and sharpened.
14935					While I strongly agree to the inclusion of Box 4.13 on SRM, the positioning of the box and the explanation for its inclusion are one of the most important issues for SR1.5. It simply must be made crystal clear that SRM is not a climate mitigation option, and that there is considerable risk (moral hazard, sustainability, equity) in even beginning to put it on the same level as traditional mitigation or even CDR. I recognize this has been attempted in Section 4.3.7.1 but it needs to be elevated considerably. I find it problematic that in many places of Chapter 4, the phrase "mitigation, adaptation, and SRM" exists. I strongly suggest the inclusion of a table or box similar to Table S.1 from the Executive summary of the NAS reports on CLimate Intervention (2015) that clearly show at a glance why SRM is a fundamentally different beast from mitigation and CDR. [Christopher Weber, United States of America]	Accepted. Box was rewritten to be more related to 1.5C and to make more clear the status of SRM. We mention that SRM could be used only in combination with emission reduction and/or carbon dioxide removal (CDR) to partially compensate for warming in the overshoot (also known as “peak shaving”) scenarios.
20573					4.2.3.6. Would be relevant to add a bit more on this area. Thinking of my scientific field (Psychology) and also thinking of the fact that the Paris agreement will need to be implemented, it is important to use all potential tools/knowledge available to humanity. Psychology is an area of science that targets behaviour. In this area there has been some key research conducted on behaviour change and maintenance as well as on implementation (e.g. of guidelines by health care professionals). Psychology can contribute with key knowledge on behaviour change theories (many of which rely on key interactions between the person and its context and acknowledge that humans are not rational decision making machines) in order to allow the development of behavioural goals, action plans and coping plans (Sniehotta et al 2005) that can target the actual mechanisms associated with behaviour enactment (e.g. taking the bike vs taking the car). There are currently multiple SR within the area of changing health behaviours that can be useful when thinking of changing individuals behaviours (e.g. around energy use at home, around recycling, around consumerism, around transport choice). My team has published a SR that aimed at understanding what behaviour change techniques are better placed to support change to more sustainable (and healthy in some cases) transport modes (paper tittle: Efficacy of behavioural interventions for transport behaviour change: Systematic review, meta-analysis and intervention coding. Article?in?International Journal of Behavioral Nutrition and Physical Activity 11(1):133 · November 2014. DOI: 10.1186/s12966-014-0133-9). [Vera Barbosa Araujo Soares Sniehotta, United Kingdom (of Great Britain and Northern Ireland)]	taken into account, this is discussed in 4.4.5 of FOD, We now integrated this section it in the section on enabling behaviour and lifestyle change
9584					Some parts of this chapter is not yet ready for review. To judge feasibility of response measures needs solid input from Chapter 2 and 3. Still many descriptions are too genral, lengthyand not so sharply targeting to 1.5 issue. Volume needs to be decreased. [Shuzo Nishioka, Japan]	Accepted. Links between the chapters are improved and the text has been revised and sharpened.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10355					The are inconsistencies in the use of the terms Afforestation and Reforestation. In some sections only afforestation is used when it seems it refers to both, while in others both terms are used. [Maria Jose Sanz Sanchez, Spain]	Accepted. Inconsistencies are addressed and the terms are both included in the Glossary.
10356					Depite of the apparent dissadvantages of A/R and that the should not be used to substitute efforts in other sectors. Those are measures that could be key in certain regions and can allivaite ressure on natural forest. [Maria Jose Sanz Sanchez, Spain]	Noted. Prescriptive language cannot be adopted but the benefits of A/R options for other problems are acknowledged in section 4.3.3 and in chapter 5.
7793					Part two of that bibliography: Lovins A et al. (2004) Winning the Oil Endgame. Rocky Mountain Institute, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/06/RMI_Winning_the_Oil_Endgame_Book_2005.pdf Lovins A. (2005) Energy End-Use Efficiency. InterAcademy Council, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/04/OCS_Energy_End-Use_Efficiency_2005.pdf. Lovins A (2007) Advanced Energy Efficiency. Stanford U School of Engineering, https://www.youtube.com/playlist?list=PL702A1EE2F77F0504 Lovins A (2010) Integrative Design: A Disruptive Source of Expanding Returns to Investments in Energy Efficiency. https://www.rmi.org/wp-content/uploads/2017/04/OCS_Integrative_Design_Disruptive_Source_of_Expanding_ROI_in_Energy_Efficiency_2010.pdf Lovins A and RMI (Rocky Mountain Institute) (2011) Reinventing Fire. Chelsea Green (Vermont), www.rmi.org/reinventingfire Lovins A (2015) Oil-Free Transportation. Procs Am Inst Phys 1652:129–139, doi: 10.1063/1.4916175 Lovins A (2015a) Reinventing fire: Physics + markets = energy solutions Procs Am Inst Phys 1652:100–111, doi:10.1063/1.4916173 Lovins A (2017) How Big Is the Energy Efficiency Resource? Invited Essay, Clim. Chg .(in review, MS #CLIM-D-17-00599) Lovins A (2018) Mobility Without Oil. Transportation Research Board (Jan. ann. conf., accepted) Muldavin S (2010) Value Beyond Cost Savings: How to Underwrite Sustainable Properties. Green Building Finance Consortium, https://books.google.com/books?isbn=0982635702. Nagy B Farmer J. Bui Q Tramcik J (2013) Statistical Basis for Predicting Technological Progress. PloS one 8(2), https://doi.org/10.1371/journal.pone.0052669 Ogburn M Ramroth L Lovins A (2008) Transformational Trucks: Determining the Energy Efficiency Limits of a Class-8 Tractor Trailer, https://rmi.org/wp-content/uploads/2017/05/RMI_Document_Repository_Public-Reprts_T08-1_RMITransformational_Truck_Study_080709compressed.pdf Price L et al. (2017) Reinventing Fire: China—the role of energy efficiency in China's roadmap to 2050 (1-242-17). Procs ECEEE Summer Study, http://proceedings.eceee.org/visabstrakt.php?event=7&doc=1-242-17/ Worrell E et al. (2003) Productivity benefits of industrial energy efficiency measures. Energy 28(11):1081–1098, http://escholarship.org/uc/item/0013f49z Zhou N et al. (2016) Policy Roadmap to 50% Energy Reduction in Chinese Buildings by 2050. Procs ACEEE Summer Study on Energy Efficiency in Buildings, 9-1–9-12, http://aceee.org/files/proceedings/2016/data/papers/9_1132.pdf [Amory Lovins, United States of America]	Noted. See response to comment 7792
20853					How come there is no mention of the Climate and Clean Air Coalition (CCAC) which has been set up as the only international response to address SLCPs? It after all contains over 50 countries as partners as well as many IGOs, NGOs and research institutes. [Johan Carl Ivar Kuylenstierna, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The section on SLCPs is based on the options, and does not discuss the policy responses. Not aware of peer-reviewed literature assessing this?
1406					Chapter 2 has basically said that hitting 1.5°C is really difficult. (And a lot of the analyses in Chapter 4 support this. There's a section that basically says, "If everything goes perfectly, then we _might_ hit 1.5°C. Although that brings up another issue, in that this chapter has a lot of repetition of the material in other chapters.) So if you're not going to talk about SRM, you're effectively perpetuating conversations about something between a long shot and a fantasy. That seems…odd if we're talking about the fate of the planet. [Ben Kravitz, United States of America]	Noted.
1407					I think some of the treatments of SRM are unfair and wrong. For example, on page 4-7, line 18, SRM certainly _could_ compensate for all of the warming. There may be reasons why one doesn't want to do that, so say what those are. I think this treatment would be far more honest and ethical than what is currently in the report, which is effectively, "SRM is off the table." [Ben Kravitz, United States of America]	Accept. Text is revised to reflect this.
1408					I think SRM also raises a lot of the same issues that are listed as being applicable to other methods of addressing climate change, so there's no reason to treat it in a special section. [Ben Kravitz, United States of America]	Reject. SRM is neither mitigation nor adaptation, which warrants a different section.
1409					Box 4.13 is really dissatisfying. It's kind of all over the place, and I'm not sure what the main messages are or what the point of this box is. Also, some of the information is wrong – for example, cirrus thinning is not well studied, because it's fairly new. I'll refrain from offering too many detailed comments along these lines because I feel that this box format isn't the right way to go. [Ben Kravitz, United States of America]	Taken into account. Box 4.13 (in SOD Cross-Chapter Box 4.2) has been revised and shortened.
20112					Chapter 4 authors should ensure that their discussions around potential global responses to climate change are reflected and taken into account in Chapter 2 mitigation pathways. This is particularly true for the discussion of risks and adverse impacts of geoengineering technologies, which should be excluded from responsible mitigation pathways, and for possibilities of more progressive and radical emissions reductions, which should be used as a basis to develop mitigation pathways in Chapter 2. [Lili Fuhr, Germany]	Noted. This would be great but is unfortunately not feasible in the timeframe of this report.
10904					NOTE : Here are my comments for the special ipcc report on 1.5 degrees. I had unfortunately only free time to go quickly through chapter 4 pages 1 to 44 by the deadline of 24.9.2017 midnight (Saturday night), but could comment most issues that I found important. Please excuse me if I did not have time to find all references. I hope you find the comments being constructive and helpful. You can contact me if you have questions or remarks. Thanks for letting me help ipcc and cop23. Climate is our future and that of our kids. Best Regards, Beat Brunner [Beat Brunner, Switzerland]	Noted. Thank you.
9628					Some measurements about the adaptation and mitigation for the climate change may be repeated with chapter 2 ,and chapter 3 in this report,clearly distinguishing the contents in the chapter with chapter 2 and chapter 3 is important. [Jianguo Wu, China]	Accept. This could not be addressed given the tight deadlines and we are making every effort to reduce overlap in the SOD.
10912					This (text from page 11 line 19-20) should imho go into the executive summary because it is really the key : The rate is 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. [Beat Brunner, Switzerland]	Noted and taken into account in the assessment of feasibility which goes well beyond techno-economic aspects.
10913					and from page 11 line 14 : emphasizing the possibility and effects of shocks and other types of discontinuous change. [Beat Brunner, Switzerland]	Comment is unclear and is therefore not addressed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7795					Missing here and in 4.3.3.1, where it may fit better with reference to this section, is the considerable evidence that modern efficiency, like modern renewables, exhibits expanding returns (Lovins 2017). That reference provides context: “Models based on scarcity and depletion cannot generate or tolerate expanding returns—e.g., when we buy more photovoltaics (PV) and wind¬power, they get cheaper, so we buy more, so they get cheaper. IEA’s wind and PV forecasts thus respectively rose 5× and 19× since 2000 without catching up with reality. Fundamental physical and commercial phenomena have made PV costs drop steeply for decades, not rising in a single year. Modern energy efficiency too can get bigger but cheaper, not just through mass-produced widgets like LEDs but also because integrative design spreads rapidly, substitutes brains and information for hardware, and depletes nothing but stupidity. / In short, today’s energy transition exhibits not the Ricardian economics of scarcity, like diminishing returns to farmland and minerals, but the complementary modern economics of abundance, with expanding returns (Arthur 1999, 2004; Nagy et al. 2013). These flow from mass manufacturing of fast granular technologies with rapid learning, network effects, and mutually reinforcing innovations. More broadly, today’s emergent paradigm for profitable climate stabilization envisions an energy-and-land-use transformation not slowed by incumbents’ inertias but sped by insurgents’ ambitions (Rockström et al. 2017; Abramczyk et al. 2017) “ Missing here and in 4.3.3.1, where it may fit better with reference to this section, is the considerable evidence that modern efficiency, like modern renewables, exhibits expanding returns (Lovins 2017). That reference provides context: “Models based on scarcity and depletion cannot generate or tolerate expanding returns—e.g., when we buy more photovoltaics (PV) and wind¬power, they get cheaper, so we buy more, so they get cheaper. IEA’s wind and PV forecasts thus respectively rose 5× and 19× since 2000 without catching up with reality. Fundamental physical and commercial phenomena have made PV costs drop steeply for decades, not rising in a single year. Modern energy efficiency too can get bigger but cheaper, not just through mass-produced widgets like LEDs but also because integrative design spreads rapidly, substitutes brains and information for hardware, and depletes nothing but stupidity. / In short, today’s energy transition exhibits not the Ricardian economics of scarcity, like diminishing returns to farmland and minerals, but the complementary modern economics of abundance, with expanding returns (Arthur 1999, 2004; Nagy et al. 2013). These flow from mass manufacturing of fast granular technologies with rapid learning, network effects, and mutually reinforcing innovations. More broadly, today’s emergent paradigm for profitable climate stabilization envisions an energy-and-land-use transformation not slowed by incumbents’ inertias but sped by insurgents’ ambitions (Rockström et al. 2017; Abramczyk et al. 2017) “ [Amory Lovins, United States of America]	Noted. Bottom up evidence of technology and innovation transitions will be referenced in a section 4.4 (on technology and innovation) and specifically on efficiency in buildings in the section on urban transitions. The points on cost reductions are taken into account in other sections with due references.
20103					Since AR5, the IPCC has been criticised for the use of BECCS in RCP scenarios. Now, it broadens the consideration of other geoengineering technologies, including a long list of CDR "options." Some techniques are either just theoretical, untested or full of risks, like SRM, others have already been shown to have unacceptable impacts. Specifically, ocean fertilization is included in the adopted list of banned marine geoengineering technologies by the London Protocol of the London Convention on the Prevention of Marine Pollution by Dumping of Wastes. Only small-scale legitimate research experiments are exempted after thorough scientific peer review ascertaining the eligibility. How can the IPCC inlcude such a technology as an "option"? [Lili Fuhr, Germany]	Taken into account. We are indeed calling CDR options as such, and SRM not. We then assess their feasibility which for the case of ocean fertilisation is low from a legal perspective. .
933					A great deal of emphasis is given to greening urban environment. I think that the amount of emphasis on each section should be proportionate to its relative contribution to greenhouse gas emissions. Those activities that create more emissions should receive more emphasis. Therefore, I think the electric power sector and possible increases in renewable energy and the efficiency of existing plants, as well as CCS, should receive more emphasis. As an introduction to each section, it would be nice if the reader was reminded of the overall emissions worldwide that the sector being discussed is responsible for. For example, the electric power sector is responsible for ~30% overall GHG emissions while land use and deforestation is also responsible for ~30%. Having these numbers for context would allow the reader to prioritize these reduction opportunities. [Elizabeth Aldrich, United States of America]	Accepted; the balance of sections has been reconsidered for the SOD.
19623					missing reference in list. Agren 2000; [Doreen Stabinsky, United States of America]	Editorial, reference appeared in line 32 on page 101, had collapsed with previous reference. To be checked before publication.
9898					General comment on chapter 4 - A chapter that discusses the global response to climate change may as well include a section on the issues and concerns of climate refugees and the way forward. [Shipra Shah, Fiji]	Accepted- A section has been added on Human migration (Section 4.3.6.5)
2735					Chapter 4 appears to be more innovatively and strategically structured than other chapters, which enhances readability. However, my overwhelming impression is that it is largely urban-biased. This risks neglecting the critical rural-urban interactions, as well as the huge areas of rural vulnerability in many countries with very high rural populations currently, and for the interim. A better engagement with rural issues and responses is necessary to underpin statements on ecosystem services and the large majority of food production. [Penny Urquhart, South Africa]	Accepted; text is rebalanced for the SOD, based on available literature.
20147					See Corner and Pidgeon (2010) on more social and ethical implications of SRM: Corner, A./Pidgeon, N. (2010) Geoengineering the Climate: The Social and Ethical Implications, in: Environment: Science and Policy for Sustainable Development, Vol. 52, No. 1: Is intentional large-scale manipulation of the climate ethical at all? Whose agreement and consent would need to be sought? [Lili Fuhr, Germany]	Noted. We are focussing on recent papers and findings, in particular related to 1.5 C. Please note also that we are limited in space and can't address all issues related to SRM. But ethical section of chapter 4 was revised and trying to cover a wide range of ethical aspects mentioned in the literature
20154					Geoengineering also does nothing to challenge the systems of production and consumption that might be considered unsustainable for reasons other than greenhouse gas emissions associated with them. Corner, A./Pidgeon, N. (2010) Geoengineering the Climate: The Social and Ethical Implications, in: Environment: Science and Policy for Sustainable Development, Vol. 52, No. 1 [Lili Fuhr, Germany]	Noted. We are focussing on recent papers and findings, in particular related to 1.5 C. Please note also that we are limited in space and can't address all issues related to SRM.
934					In general, the section 4.3.2 seems to move from mitigation options in the electrical power sector with little discussion of how climate change will affect renewable energy resources like hydro. Should more emphasis be on how these renewables will be impacted by climate change? The focus of the section seems to be on the contribution of these technologies to mitigation; however, as the section moves into land and ecosystems in 4.3.3, the focus is more on adaptation of these systems to climate change. Perhaps adaptation and mitigation should be separate sections with each of the sections appearing in both and addressed separately. [Elizabeth Aldrich, United States of America]	Noted. We have deliberately tried to assess adaptation and mitigation together throughout the chapter, but energy systems indeed gravitates towards mitigation (though adaptation in the electricity sector is in there) and the land transition gravitates towards adaptation. We try to balance but the literature and the characteristics of the land, energy etc systems require this focus.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20135					Chapter 2 mentions a cumulative 710-900 GtCO2 to be removed via CDR over the course of the 21st century. Burns/Nicholson 2017 Bioenergy and carbon capture with storage (BECCS): the prospects and challenges of an emerging policy response, in J Environ Stud Sci, DOI 10.1007/s13412-017-0445-6: "Delivery of a relatively modest 3 gigatons of carbon dioxide equivalent negative emissions annually from BECCS would require conversion of a land area of approximately 380–700 million hectares in 2100, translating into 7–25% of agriculture land and 25–46% of arable and permanent crop area (smith et al. 2016; Williamson 2016). The range of land demands would be 2–4 times larger than land areas that have been classified as abandoned or marginal (Smith et al. 2016). This would be in the face of rising demands for food that will require 10–20% more cropland over the course of the next few decades (Creutzig 2017). (Smith et al. 2016 Biophysical and economic limits to negative CO2 emissions. Nat Clim Chang 6:42-50. https://doi.org/10.1038/ nclimate2870; Williamson 2016 Scrutinize CO2 removal methods. Nature 530(7589):153-55); Creutzig F (2017) Govern land as a global commons. Nature, 546:28–9. https://doi.org/10.1038/546028a --- Environmental and social implications of model assumptions must be drawn conclusions from! [Lili Fuhr, Germany]	Taken into account – First of all note that the 3 Gt number from Smith et al. (2016) is carbon (not CO2), which brings it in line with the calculations for land requirements given here. Second, chapter 2 assesses pathways to 1.5°C, however most of them do not include other technologies for CDR than land-based (BECCS, AR) causing the bias perceived here. Chapter 4 in turn assesses the bottom-up knowledge on all currently discussed CDR options (also non-land-based) including their environmental and socio-economic implications. This assessment has been deepened for the SOD (see also new synthesis figure with side effects in the former section 4.3.6). Additional material (land- and water footprints etc.) has been covered in the box on land-based CDR in chapter 3. Finally, chapter 5 assesses the interaction with SGDs in more depth, which goes beyond the scope of chapter4.
20136					Impact of large-scale BECCS on food prices: "Demands on land of this magnitude could substantially raise prices on basic food commodity crops (Barrett 2014). One recent assessment that incorporates strict protection of forest ecosystems projects large-scale BECCS deployment could result in the rise of food price indices of 82% in Africa, 73% in Latin America, and 52% in Asia Pacific (Popp et al. 2011). This could imperil food security for many of the world's most vulnerable, with many families in devel- oping countries already expending 70–80% of their income on food (De Schutter 2013; US Government Accounting Office 2011). One recent study indicated that even modest increases in bioenergy development could increase the number of mal- nourished children in sub-Saharan Africa by 3 million, with an 8% decline in calorie availability (Ewing and Msangi 2008)." quoted from Burns/Nicholson 2017 Bioenergy and carbon capture with storage (BECCS): the prospects and challenges of an emerging policy response, in J Environ Stud Sci, DOI 10.1007/s13412-017-0445-6; Barrett S (2014) Solar geoengineering's brave new world: thoughts on the governance of an unprecedented technology. Rev Environ Econ Policy 8(2):249–269. https://doi.org/10.1093/reep/reu011; Popp A et al (2014) The effect of bioenergy expansion: food, energy, and environment. Renew Sust Energ Rev 32:559–578; De Schutter O (2013) Note on the impacts of the EU biofuels policy on the right to food, United Nations Office of the high commissioner, Mandate of the special rapporteur on the right to food, Apr 23, 2013; U.S. Government Accounting Office (GAO) (2011) Climate engineering: technical status, future directions, and potential responses, GAO-11- 71; Ewing M, Msangi S (2008) Biofuels production in developing countries: assessing tradeoffs in welfare and food security. Environ Sci Pol 12: 520–528 [Lili Fuhr, Germany]	Taken into account – potential upward pressure on food prices due to large-scale BECCS deployment had been mentioned already in the FOD. More recent research actually also points into the other direction. The SOD gives a more balanced account of the food price discussion. Please also note that this effect is due to the bioenergy component of BECCS, the assessment of which is thus allocated to 4.3.3 and not to the CDR section (former 4.3.6).
6086					Feels not as well balanced as pervious chapters, specifically on CCS it seems to focus more on the potential negatives rather than solutions and the positives. [Tim Dixon, United Kingdom (of Great Britain and Northern Ireland)]	Noted. We have looked at that text again.
6087					On CCS overall, this chapter seems to over-rely on one paper by Coninck and Benson (2014) which was not published in the CCS expert literature. [Tim Dixon, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The references are expanded.
20167					Chapter 2 and chapter 4 authors should look at Kreidenweis et al. (2016) Afforestation to mitigate climate change: impacts on food prices under consideration of albedo effects, Environmental Research Letters, 11, dx.doi.org/10.1088/1748-9326/11/8/085001 for the impacts of large-scale afforestation on global food prices [Lili Fuhr, Germany]	Taken into account – Kreidenweis et al. is covered by the assessment and included in the potentials, cost distributions and side effects on food security of large-scale afforestation visualized in Figure 4.3.8. Please note that space constraints keep us from discussing every estimate in the literature separately in the text.
20423					This chapter has a lot of (too many?) boxes. [Olivier Boucher, France]	Taken into account; the Cross-Chapter boxes have appeared as additional boxes at the end of the chapter as 4.12, 4.13, 4.14 and 4.15. For the SOD they are named correctly. However, case studies in the boxes are per approved plenary outline.
20688					Either for Section 4.4 or 4.5, the topic of Monitoring and Evaluation needs to be discussed, it could also be done through a case study (or the existing ones, for example, on how they've been evaluated, how they've applied results, etc.) [Debora Ley, Guatemala]	Rejected. Although important, it's not a 1.5C-specific issue.
20137					Large-scale BECCS and displacement: "Efforts to develop feedstock for bioenergy can also result in displacement of the poor from land, which can undermine food security, as well as livelihoods, political power, and so- cial identity (Catula et al. 2008; Kartha and Dooley 2016). Some proponents of BECCS have contended that pressures on food production and prices could be substantially ameliorated by using "degraded" or "abandoned" land for expansion of bioenergy feedstock. However, the reality is that hundreds of millions may rely on these lands for income and sustenance (Smolker and Ernsting 2012)." quoted from Burns/Nicholson 2017 Bioenergy and carbon capture with storage (BECCS): the prospects and challenges of an emerging policy response, in J Environ Stud Sci, DOI 10.1007/s13412-017-0445-6; Catula L, Dyer N, Vermeulen S (2008) Fuelling exclusion? The biofuels boom and poor people's access to land, International Institute for the Environment and Development and Food and Agriculture Organization of the United Nations, IIED Order No: 12551IIED; Kartha S, Dooley K (2016) The risks of relying on tomorrow's 'negative emissions' to guide today's mitigation action, Stockholm Environment Institute. SEI Working Paper No 2016-08; Smolker R, Ernsting A (2012) BECCS (Bioenergy with Carbon Capture and Storage): climate saviour or dangerous hype?, 1–25. http:// www.biofuelwatch.org.uk/wp-content/uploads/BECCS-report.pdf [Lili Fuhr, Germany]	Taken into account – the reference to Burns and Nicholson (2017) has been included in former section 4.3.6. Please note that working papers and reports that have not undergone peer-review cannot be included at this point.
20138					Large-scale BECCS and water footprint: "BECCS could imperil the right to water in some regions of the world given its Bvery large water footprint, even when implemented at a relatively modest scale of between 1.1 and 3.3 gigatons of carbon dioxide equivalent per year (Smith 2016). By 2100, BECCS feedstock production at scale could require approximately 10% of the current evapotranspiration from all global cropland areas (Smith et al. 2016), or of the same magnitude as all current total agricultural water withdrawals (Bonsch et al. 2016; Chaturvedi et al. 2015). This is at a time that when global water withdrawals are projected to increase by 20% and the number of people experiencing water shortages could grow by billions (Delucchi 2010). Moreover, 800,000 humans currently die annually as a consequence of contaminated drinking water (UN Water 2017). Large deployment of BECCS could exac- erbate this threat by further degrading water quality by salinization, and from fertilizer and pesticide runoff associated with production of bioenergy feedstocks (Delucchi 2010)." quoted from Burns/Nicholson 2017 Bioenergy and carbon capture with storage (BECCS): the prospects and challenges of an emerging policy response, in J Environ Stud Sci, DOI 10.1007/s13412-017-0445-6; Smith P (2016) Soil carbon sequestration and biochar as negative emission technologies. Global Change Biol 22(3):1315–1324. https:// doi.org/10.1111/gcb.13178; Bonsch M, Humpeno?der F, Popp A, Bodirsky B, Dietrich JP, Rolinski S, Biewald A, Lotze-Campen H, Weindl I, Gerten D, Stevanovic M (2016) Trade-offs between land and water requirements for large- scale bioenergy production. GCB Bioenergy 8(1):11–24. https://doi. org/10.1111/gcbb.12226; Chaturvedi V, Hejazi M, Edmonds J, Clarke L, Kyle P, Davies E, Wise M (2015) Climate mitigation policy implications for global irrigation water demand. Mitig Adapt Strateg Glob Chang 20(3):389–407. https://doi.org/10.1007/s11027-013-9497-4; Delucchi MA (2010) Impacts of biofuels on climate change, water use, and land use, 1195(1):28–45; UN Water, Wastewater (2017) The Untapped Resource, 1–198 [Lili Fuhr, Germany]	Noted – the water footprint had already been included in the FOD, in former section 4.3.6. It is now systematically covered in the box on land-based CDR in chapter 3.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20139					Large-scale BECCS and biodiversity loss: "Many of the most propitious areas for bioenergy devel- opment are also characterized by high levels of biodiversity, with a large share of endemic species (Beringer et al. 2011). Recent research indicates that large-scale BECCS deployment could also have profound impacts on biodiversity, primarily due to potential land conversion (Searchinger and Heimlich 2015; Smith and Torn 2013). More specifically, BECCS could Bvastly accelerate the loss of primary forest and natural grassland, (Williamson 2016), resulting in the loss of up to one-fifth of natural forests, grasslands and savannahs (Creutzig 2017). This could precipitate habitat loss for many species, and ultimately, massive changes in species richness and abundance (Wiltshire and Davies-Barnard 2015). Indeed, Williamson concluded that large-scale deployment of BECCS could result in a greater diminution of terrestrial species than temperature increases of 2.8 °C above pre-industrial levels (Williamson 2016)." quoted from Burns/Nicholson 2017 Bioenergy and carbon capture with storage (BECCS): the prospects and challenges of an emerging policy response, in J Environ Stud Sci, DOI 10.1007/s13412-017-0445-6; Searchinger T, Heimlich R (2015) Avoiding bioenergy competition for food crops and land, World Resources Institute, 1–44; Smith L, Torn M (2013) Ecological limits to terrestrial biological carbon dioxide removal. Clim Chang 118(1):89–103; Williamson P (2016) Emissions reduction: scrutinize CO2 removal methods. Nature 530(7589):153–155; Wiltshire A, Davies-Barnard T (2015) Planetary limits to BECCS negative emissions, AVOID2, Version 1.1; Creutzig F (2017) Govern land as a global commons. Nature, 546:28–9. https://doi.org/10.1038/546028a [Lili Fuhr, Germany]	Taken into account – Impacts on biodiversity are now explicitly mentioned, see also synthesis figure of former section 4.3.6. Please note that a lot of the suggested literature had already been covered in the FOD. Please also note that this effect is due to the bioenergy component of BECCS, the assessment of which is thus allocated to 4.3.3 and not to the CDR section (former 4.3.6).
2795					The overall chapter is too long, especially the last 60 pages of text. Apart from the box and text on SRM which are far too long, topics are addressed very superficially. [Erik Haites, Canada]	Taken into account; the chapter is as per the approved plenary page length, but text has been revised and tightened in the SOD.
4854					The chapter is light on showing the elements supporting the strengthening and implementation of CCS and BECCS as part of the the global response. What is needed for first mover demonstration projects in different sectors, for replication deployment in these sectors and for the rapid build out consistent with the forecasted CCS & BECCS deployment rates [Wilfried Maas, Netherlands]	Rejected. Such road mapping type of advice would be prescriptive.
19705					Zero Carbon Zero Poverty: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Mary Robinson Foundation, 2015. Online at http://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Taken into account in chapter 5. Note that this source is not peer-reviewed.
20140					On BECCS and disruption in nitrogen cycle: "BECCs deployment could require more than doubling fertilizer inputs (Creutzig 2014), exacerbating environmental degradation associated with anthropogenic perturbation of the nitrogen cycle. Current human fixation of atmospheric nitrogen exceeds sustainable levels by 75% (Kartha and Dooley 2016). This results in serious environmental impacts, including large-scale anoxia in oceans, eutrophication of streams and rivers, and changes in nutrient health in forests (Kartha and Dooley 2016; Bernhard 2010). Large-scale deployment of BECCS could require as much as 75% of global annual nitrogen production (Buck 2016), Benhancing the pressure on the planetary boundary for biogeochemical flow (Boysen et al. 2016)." quoted from Burns/Nicholson 2017 Bioenergy and carbon capture with storage (BECCS): the prospects and challenges of an emerging policy response, in J Environ Stud Sci, DOI 10.1007/s13412-017-0445-6; Creutzig F (2014) Economic and ecological views on climate change mitigation with bioenergy and negative emission. Glob Change Biol Bioenergy 8(1):4–10; Buck HJ (2016) Rapid scale-up of negative emissions technologies: so- cial barriers and social implications. Clim Chang 139(2):155–177; Bernhard A (2010) The nitrogen cycle: processes, players, and human impact, Nature Education Knowledge Project, https://www.nature. com/scitable/knowledge/library/the-nitrogen-cycle-processes- players-and-human-15644632; Kartha S, Dooley K (2016) The risks of relying on tomorrow's 'negative emissions' to guide today's mitigation action, Stockholm Environment Institute. SEI Working Paper No 2016-08 [Lili Fuhr, Germany]	Noted – due to space constraints we cannot go too deeply into all the biogeochemical processes involved in the different technologies .However, the fertilizer issue had already been flagged in the FOD (former section 4.3.6) and is now systematically displayed in the table of the box on land-based CDR in chapter 3. Note that Creutzig et al. (2014) had already been referenced in the FOD and non-peer-reviewed working papers cannot be included as evidence at this point.
20141					Chapter 4 authors need to draw conclusions from the above comments and references, highlighting sustainable development incompatabilities of large-scale BECCS and, similarly, afforestation, making it very clear to policy-makers that these impacts (food prices, land-use change, fertilizer use, water footprint, displacement…) would be the expectable consequences and implications. Chapter 4 authors should make it clear to Chapter 2 authors that pathways relying on large-scale deployment of BECCS to draw CO2 from the atmosphere at an order of magnitude of 700-900 GtCO2 cumulatively are incompatible with global sustainable development and fundamental principles of the international community such as human rights and ecosystem integrity. [Lili Fuhr, Germany]	Noted – Chapter 4 authors have assessed all CDR options along the feasibility criteria laid out in chapter 1 and emphasized by the reviewer. Side effects have been highlighted (even more systematically in the SOD now) and the interaction with sustainable development are covered in chapter 5. It is important to note that chapter 2 does not produce pathways, but assesses published pathways. That these mostly feature land-based CDR (BECCS, AR) is an outcome of the assessment, but nothing that can be changed by chapter 2 authors in their function as IPCC authors. Finally, chapter 4 also points out that the land footprint mentioned by the reviewer is not a helpful indicator because it does not specify which type of land is used: actually, using the best available agricultural land and thus jeopardizing food security would result in a LOW land footprint.
20145					Chapter 4 authors should make clear to readers and policy-makers that what has been researched in terms of risks of SRM is very limited, and most risks associated with such a large-scale intervention in the Earth system are totally unknown. This is in part due to the fact that most, if certainly not all, scientists working on SRM are themselves SRM proponents, which leads to a distortion of SRM research and discourse. See McCormack et al. 2016 Key impacts of climate engineering on biodiversity and ecosystems, with priorities for future research, in: Journal of Integrative Environmental Sciences, Vol. 13, Issue 2-4, http://dx.doi.org/10.1080/1943815X.2016.1159578 and the knowledge gaps in relation to biodiversity and ecosystem consequences, such as impacts relating to climatic changes, changes affecting marine ecosystems, changes affecting the deep ocean, large-scale terrestrial habitat disturbance or destruction and alteration of soil properties [Lili Fuhr, Germany]	Accepted, reference added, text of SRM Box revised
20149					Environmental Modification Convention (passed by the United Nations in 1977) bans the use of weather modification for military or other hostile use. Research on geoengineering has its roots in military strategies developed for weather modification. Geoengineering proposals may well violate the terms of this treaty. See Corner, A./Pidgeon, N. (2010) Geoengineering the Climate: The Social and Ethical Implications, in: Environment: Science and Policy for Sustainable Development, Vol. 52, No. 1 and M.C. MacCracken (2006) Geoengineering: Worthy of Cautious Evaluation", Climatic Change 77, pp. 235-243 and Robock, Alan, 2008: 20 reasons why geoengineering may be a bad idea. Bull. Atomic Scientists, 64, No. 2, 14-18, 59, doi:10.2968/064002006 [Lili Fuhr, Germany]	Noted. We are focussing on recent papers and findings, in particular related to 1.5 C. Please note also that we are limited in space and can't address all issues related to SRM. Concerning paper by Robock: we are addressing the most crucial impacts from his list and also those which covered by literature
20156					(...) history shows us that complex technical and environmental systems often fail because of unanticipated interactions between their component parts, while the processes of societal oversight typically are insufficiently sensitive to emerging warning signs. Corner, A./Pidgeon, N. (2010) Geoengineering the Climate: The Social and Ethical Implications, in: Environment: Science and Policy for Sustainable Development, Vol. 52, No. 1 and B. A. Turner and N. F. Pidgeon. Man-Made Disasters (Oxford, UK: Butterworth-Heinemann, 1997); European Environment Agency, Late Lessons from Early Warnings: The Precautionary Principle 1896–2000, Environmental Issue Report no. 22 (European Environment Agency, Copenhagen: 2001). [Lili Fuhr, Germany]	Noted. We are focussing on recent papers and findings (in general, after AR5), in particular related to 1.5 C. Please note also that we are limited in space and can't address all issues related to SRM.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
17598					A general comment for the chapter is that it should reflect the growing literature on supply-side approaches to climate policy, i.e. policies and measures that limit the production of fossil fuels. This is relevant in several parts of the chapter, in particular those that discuss the systemic aspects of rapid transformation, energy system transition etc. The concept of lock-in is well established (e.g. Unruh, G., Energy Pol (2000), 28:817-830; Erickson, P. et al., Environ Res Let (2015), https://doi.org/10.1088/1748-9326/10/8/084023) and highlights how there is a need to actively mitigate against investments that could make it more difficult to achieve ambitious emissions pathways in the future. In the economic litereature, there is a growing recognition that actively constraining the production of fossil fuels could be effective in certain cases (Harstad, B., J. Pol Econ (2012), https://doi.org/10.1086/665405 ; Fæhn, T. et al., Energy J. (2017), https://doi.org/10.5547/01956574.38.1.tfae). A forthcoming special issue of Climatic Change will discuss supply-side policy more in depth, and this should be considered for a more thorough discussion in the report. [Bård Lahn, Norway]	Taken into account, partly. Literature on reducing production of fossil fuels is (surprisingly) sparse. Lock-in is addressed in section 4.2. Stranded assets are discussed in 4.4.6.
20161					There are approaches to bind CO2 that combine technological readiness, low cost and clear environmental co-benefits, such as ecosystem restoration (forests, conservation agriculture, coastal restoration). Field, C.B./Mach, K.J. (2017) Rightsizing carbon dioxide removal, in: Science, Vol. 356, No. 6339, pp. 706-707; see also Latawiec, A.E. et al (2015) Creating space for large-scale restoration in tropical agricultural landscapes, in: Fron Ecol Environ, 13(4): 211-218, doi:10.1890/140052 [Lili Fuhr, Germany]	Taken into account - We are happy that we can build on new literature that emerged after the FOD on ecosystems restoration (Griscom et al. 2017), which demonstrates that the mitigation potential could even be higher and we also explicitly mention the co-benefits now. Please note that (a) ecosystems restoration is further allocated to 4.3.3. in the SOD and that (b) blue carbon etc. had already been covered in the former 4.3.6 in the FOD
20163					For its latest report, the Intergovernmental Panel on Climate Change (IPCC) analyzed about 900 scenarios from about 30 integrated assessment models. These models determine a cost-effective mix of technologies, based on estimated technology costs and on climate policy, including carbon pricing. Of the 116 scenarios with a 66% or better chance of limiting global warming to 2°C by 2100, 101 include CDR, mostly BECCS, in the technology mix for the second half of the 21st centur. Across these scenarios, the median commitment to carbon dioxide removal from BECCS in 2100 is about 12 billion tons of CO2 per year, equivalent to more than 25% of current CO2 emissions. This is truly massive use of a technology with little real-world experience and poorly known economics. The requirements for land and water are large but uncertain. Based on relatively optimistic assumptions about future yields, this BECCS commitment corresponds to 0.4 to 0.7 billion ha of productive land; more conservative assumptions yield a land requirement of 1.2 billion ha. This range is about 25 to 80% of total current global cropland or up o 8% of Earth's land area. Converting land on this staggering scale would pit climate change responses against food security and biodiversity protection. Massively expanding managed land for CDR could crash through the planetary boundary for sustainable land use. Field, C.B./Mach, K.J. (2017) Rightsizing carbon dioxide removal, in: Science, Vol. 356, No. 6339, pp.706-707. -- Chapter 2 authors should make the implications of the assumptions made in the models very clear to readers and policymakers. See also J. Röckström et al., Ecol. Soc. 14, 32 (2009) on planetary boundaries, W. Steffen et al., Science 347, 1259855 (2015), Smith et al. 2016 Biophysical and economic limits to negative CO2 emissions, in: Nature Climate Change 6, 42-50, doi:10.1038/nclimate2870 [Lili Fuhr, Germany]	Taken into account in the assessment of the impacts, the feasibility assessment, and chapter 5.
20165					See Boysen, L.R.,W. Lucht, D. Gerten, V. Heck, T. M. Lenton, and H. J. Schellnhuber (2017), The limits to global-warming mitigation by terrestrial carbon removal, Earth's Future, 5, doi:10.1002/2016EF000469 for an analysis of the profound trade-offs of Terrestrial CDR (tCDR) including loss of natural ecosystems, reductions in food production, and adverse effects of heavy fertilizer application. The authors also conclude that tCDR is not a viable option for countering unabated anthropogenic greenhouse gas emissions, and even in the RCP2.6 scenario, the tCDR amount needed to hold the 2°C warming line requires massive inputs including extensive irrigation. Chapter 4 authors should make it clear to Chapter 2 authors as well as readers and policymakers that current models that rely on tCDR are not compatible with global sustainable development. [Lili Fuhr, Germany]	Noted – Chapter 4 authors have assessed all CDR options along the feasibility criteria laid out in chapter 1 and emphasized by the reviewer. Side effects have been highlighted (even more systematically in the SOD now) and the interaction with sustainable development are covered in chapter 5.
972					I don't have really any comments on this chapter in part because the text is not complete and mainly because I had a very hard time figuring out the purpse anhd center of gravity for the analysis. It is truly massive in length yet most of the text covers topics that I could have seen covered in other chapters. The text never grapples in a central, organized way with the topic implied in its title--strengthening and implementing the global response. i think a much clearer division of labor is needed with other chapters (esp chapter 2, regarding which chapter shoudl handle practical issues of scaling up different options) and it needs a tighter set of arguments about what is most important for scaling up the global response. i am also concerned that the title, at least, implies that this is the chapter where the study of governance issues should be handled. A pretty substantial barrier to strengthening the globa response is the lack of incentrives and structures for getting that done. other than some passing references to institutions there is actually very little discussion of institutional organization. And nearly all of the whole fields of international political economy, international relations and international law--fields centrally about these problems--are ignored but for some odd passing paragraphs such as p.50 lines 19-25. The discussion of institutions and policies also probably needs a careful scrub to distinguish between normative findings (eg p54, lines 17-18) from those that are strongly rooted in the literature. My overall impression is that section 4.4 is probably most squarely on point. Section 4.5 could be (based on its title) but it seems to be quite sprawling and not so much a review of the literature as a set of comments (albeit with many subsections incomplete). [Victor Davd, United States of America]	Noted. We have certainly tried to improve the structure and to include more relevant text on policy issues and incentives.
11477					In sum, Chapter 4 pays inadequate attention to governance and other responses in the Global South, treating these implicitly as matters for the sustainable development agenda (and thus Chapter 5). The North and Northern consumers are treated as global norms. There is not a lot in the chapter that I think fundamentally wrong but there is a lot that requires qualification to provide insight into both its relevance and its limitations. It is not that we cannot generalize from social and institutional research but we do need to be clear about what we can generalize to, and not attempt to follow the lead of sciences that can unproblematically be generalized globally. [Stewart Lockie, Australia]	Accept. This is not our intention. We have a section on governance that uses examples and literature from all over. Also, the section on institutional capacity is key.
1003					A few miscellaneous final thoughts. -- Consider adding "and sub-national" after "national" strategically throughout the document in order to reinforce the idea that the ideas apply to states and regions, as well as nations and cities. -- Spell check sometimes-hyphenated terms for consistency (e.g., C40/C-40 and sub national/sub-national). -- Annotate the Box listings in the Table of Contents. Let the reader know, for example, that Box 4.15 provides examples of institutional cooperation (among governments, multilateral institutions, private organizations and NGOs). It's seven and a half pages long with five case studies, which the reader of the TOC would never guess from the one-word title "Adaption". [Stephen Wiel, United States of America]	Taken into account; sub-national may be added as appropriate if supported by relevant literature. Editorial; spell checks will be done. Table of contents per IPCC style guide. The title of Box 4.15 (SOD Cross-Chapter Box 4.3) now better reflects the contents (Risks, adaptation interventions, and implications for sustainable development and equity across five systems: Arctic, Caribbean, Mekong Delta, Amazon, and cities)

Comment No	From Page	From Line	To Page	To Line	Comment	Response
995					Wow! What an impressive piece of work. I have just a few touch-up suggestions. In Chapter 2, page 25, lines 16-18 state, "Integrated assessment models include a wide variety of supply- and demand-side mitigation options, as well as measures that achieve CDR from the atmosphere (see also Chapter 4 for a bottom-up discussion of these mitigation technology option)." Therefore I turned to Chapter 4 expecting to find a systematic and comprehensive assessment of these "mitigation technology option (sic)". I was specifically looking for those specific mitigation technology options within my expertise, and so I did a search for the following terms: -- energy efficiency (especially, buildings, appliances and equipment) -- utility demand-side management -- urban heat island mitigation (cool roofs and pavements) First let me tell you of my findings and then suggest what I would like to see. FINDINGS Let's start with energy efficiency. I expected to find energy efficiency addressed in Section 4.3 "Assessment of current and emerging (adaptation and mitigation) options". It was there in Section 4.3.2 on page 19, lines 13-15, which stated: "Demand-side options in the energy sector, including energy efficiency in buildings, transportation and industry, are discussed in Section 4.3.4." I found reference to building performance in Section 4.3.4.1.5, but without elaboration. Instead, the entire treatment of energy efficiency options seems to be contained in Section 4.4.7.2 titled "Coordinating long run expectations: a matter of credibility and consistency of incentives", which has a good treatment of the subject. (See suggestion 1 below) Then there's utility demand-side management – or rather there isn't. I found nothing in the document that addresses utility companies helping their customers avoid waste and reduce their energy consumption. Utility companies and their regulators are key players in national, sub-national and local efforts to implement energy efficiency and greenhouse gas mitigation. (See suggestion 2 below) As for urban heat island mitigation, it is addressed in Section 4.3.4.1.2 but only in terms of biophilic urbanism. Cool roofs and cool pavements are an essential urban heat island mitigation strategy and I found nothing about them anywhere in the document. (See suggestion 3 below) SUGGESTIONS 1. Add a second paragraph in Section 4.3.4.1.5 (on p. 4-27 at line 32) listing the options for improving building and housing performance (carbon prices, appliance and equipment standards and labels, building codes, grants, subsidies, loans, feed-in tariffs, information campaigns, utility regulation, voluntary programs, energy or greenhouse gas reduction targets) and refer the reader to Section 4.4.7.2 for a discussion of these items. 2. Add a Section 4.3.2.6 Utilities, their regulation and demand-side management (on p. 21 at line 31). I know of no single source of material for this paragraph. If you'd like my assistance, I would be happy to make calls to colleagues at RAP and other organizations in search of a global perspective and even draft a paragraph for you.	Noted. Thank you for those detailed suggestions. In the SR1.5, we were assigned to look at options (mitigation and adaptation) that are either 1.5C-specific or need a significant update since the AR5. Though significant options, the suggestions here have been treated extensively in AR5.
7096		47		48	Note that it says "several" but only one example is given. Good to list all? [Érika Mata, Sweden]	Rejected; unclear which section this comment refers to.
4867					This chapter fails to grasp the evidence presented in Chapter 2 and instead portrays an overly optimistic picture of the transition to a 1.5C society. With current warming exceeding 1C and a carbon budget around 300 Gt presented in Chapter 2, warming above 1.5C may be locked in before the end of the 2020s. The Paris Agreement will be slow to react given its 5 year turnaround structure, presenting a challenge that is not conveyed in this chapter. [Wilfried Maas, Netherlands]	Taken into account. The SOD reflects better linkages between Ch2 and Ch4 (e.g. Table 4.1) and this is further improved in the Final Draft. The reviewer's point is also considered in the Cross-chapter box 4.1 on NDCs.
1079					We need a more balanced chapter. The chapter is perhaps the clearest of all three I read (2,3,4). It is very much centered in explaining the key role BECCS will need to play if we really attempt to reach any 1.5 degrees scenarios. However I am worried the AFOLU sector role assessment is superficial and dismisses some of the new and ongoing findings about the role forests and oceans play and will need to play in reaching the emssions targets. One third of emissions are absorbed by forests as they are and this needs be recognized as part of the solution. Particularly because any 1.5 degrees solution will definitively need of forests to reach its goals. The way the secvtor is treated in the chapter, this is not really apparent or reinforced and seems to assume these services as a given. yes, the idea of afforestation/reforestation is pretty much there. However this does not go into the qualities of such processes to be succesful yet some caveats are consistently mentioned nor the role of preserbation of carbon stocks as well as their services. My point here is: This is the proven concept by nature and the system we know "best" (still learning a lot though via REDD+ capacity building) and the proven one: photosynthesis is a provent effitient process. yes, a lot of uncertainties remain but, not as many as with BECCS implementation. This takes me to a following point. A lot of the needs for BECCS implementation as well ass unknowns are left aside and need be explained as well [naikoa aguilar-amuchastegui, United States of America]	Taken into account – This is a valid comment. Please note that the assessment for the AFOLU section had not been completed during the FOD thus giving a superficial impression. Afforestation had only been dealt with in the context of its ability to withdraw CO2 from the atmosphere in the former section 4.3.6. In the SOD, we now include an assessment of ecosystems restoration and avoided deforestation. We are happy that we can build on new literature that emerged after the FOD as well on that (Griscom et al. 2017), which demonstrates that the mitigation potential could even be higher and we also explicitly mention the co-benefits now.
5438					It is suggested that this chapter is somehow restructured. The various 1.5oC scenarios identified in chapter 3, box 3.12 could be a starting point. The next step should be to explain the treatment of SRM which limits the scenarios considerable. The next step would be to focus on those scenarios that offer a significant reduction of climate change risks. And then the information included now in chapter 4 should be presented. But it need to be put into a clear narrative and logic storyline, e.g. by following the above suggestions. [Klaus Radunsky, Austria]	Taken into account; the narrative of the chapter has been strengthened in the SOD, with less overlap with Chapter 2, while the linkage with Chapter 3 will be further improved for the Final Draft. However, the specific suggestion was challenging to fit with the approved outline for Chapter 4 and is therefore rejected.
5439					Chapter 4 should clearly identify what is necessary to move along reasonable scenarios and what has to be done to avoid to move into scenarios that result in significant higher risks. [Klaus Radunsky, Austria]	Noted.
6722					There are many sections and specific statements in this chapter, especially those relating to CDR and SRM proposals, that are either far too definitive or far too little qualified, or both. Many of the statements made about the potential application and effectiveness of SRM techniques as 'options' in this chapter, for example, stand in stark contrast to the more qualified and specific analysis of the same techniques provided in chapter 3 (e.g. section 3.7.3 on pages 3-119 to 3-121, which concludes that the risks of SAI deployment, even for low levels of application, would outweight any benefits based on current state of knowledge). To have such a contrasting and much more positive outlook on SAI and other proposed SRM techniques in chapter 4 introduces clear inconsistencies and the potential for misunderstanding and misinterpretation. [Jennifer Morgan, Netherlands]	Taken into account. In the feasibility assessment of options, SRM techniques, or in the SOD named 'radiation modification measures', have not been assessed as 'options', given the greater uncertainties. Instead, they are only assessed against the feasibility characteristics. Consistency with Chapter 3 needs to be checked.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
17742					Limited mention of government networks/associations such ICLEI etc as catalysts for norm formation and climate resilient development pathways. [Afua Adu-Boateng, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. In the header of section 4.4, new text is included: "The emergence of polycentric loci of climate action and the transnational and subnational networks that link these efforts (Abbott, 2012), offer the opportunity to experiment and learn from different approaches, thereby accelerating the process led by national governments (Cole, 2015a; Jordan et al., 2015)." Also, refer to SOD section 4.4.1 where the ICLEI and other networks/associations are mentioned as examples.
7510					We recommend to include case studies also from Europe and Northern America since to be few from this part of the world. Countries in this part of the world also needs motivation and to learn from other countries in similar economic and social situations about how to mitigate emissions. [Øyvind Christophersen, Norway]	Taken into account. We strived for a good balance between regions and some examples of Europe appear in Box 4.1 and Box 4.5. Inclusion of additional case studies for Europe and Northern America has been considered but we are constrained by the (non-)availability of peer-reviewed literature for relevant case studies.
7511					Please consider to use the language for consistent treatment of uncertainties according to the IPCC guidance for Lead Authors more extensively for statements in the executive summary as aproprate. [Øyvind Christophersen, Norway]	Accepted.
7512					Please consider discussing reduction of transport activity as a mitigation option [Øyvind Christophersen, Norway]	Accepted, has been considered in section 4.3.4.2
7513					Please consider discussing future potential for autonomous transport both for freight and passenger transport. [Øyvind Christophersen, Norway]	Accepted, we have added text on driverless cars in section 4.3.4.4
7515					Consider adding a discussion of to what extent important assumptions in the models are simplifications, and how for example lack of perfect foresight, perfectly credible long-term climate mitigation goals, and perfect rationality in the real world could be handled in policy. [Øyvind Christophersen, Norway]	Rejected. Although this comment is very important, this discussion belongs to Chapter 2 and is outside the scope of this Chapter.
17746					Considering the important role that small and medium sized cities play in urbanisation(the fastest growing urban areas in Africa are small and medium sized towns)Wisner et al. 2015 Cities & Towns Africa.pdf We need to consider and highlight climate policy responses in small towns of the Global North (e.g http://www.ippr.org/files/publications/pdf/city-systems_June2016.pdf) and Global south (Shackleton, C. M., et al. How important is green infrastructure in small and medium-sized towns? Lessons from South Africa. Landscape Urban Plan. (2016),) [Afua Adu-Boateng, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Relevant point but in a report this broad and generic, a focus beyond urban to small-town urban is getting too detailed.
7514					Consider adding a more detailed discussion of market failures and barriers. The chapter considers global carbon pricing, but seems to lack a theoretic basis for a more comprehensive mitigation policy portfolio. Examples of elements which you could consider for inclusion are: technological lock-in, political risk of investment in low carbon technologies due to lack of credibility of long-term mitigation goals, effects of learning-by-doing, scaling effects, imperfect information in financial markets, asymmetrical information between consumers and producers, research and development as a common good, the standing on shoulders effect, and knowledge diffusion. This chapter should also address more technology specific marked failures and barriers, such as the formation of natural monopolies in the CCS-chain, or the problem of integrating renewable energy sources such as solar and wind in deregulated energy markets. [Øyvind Christophersen, Norway]	Noted. We received earlier comments that we should be 1.5C-specific in this report. We are also severely constrained in page limits. A barrier / feasibility analysis is included in section 4.5.
5729					Chapter 4 may be combined with Chapter 5, because the global responses should be in line with the SDGs. [Hong Yang, Switzerland]	Rejected; Chapter as per agreed plenary outline.
5730					Much of the text in Chapter 4 is too general and lack specific adaption measures that are targeting at limiting to 1.5C warming. Also contents in some sub-sections are repetitive and piecemeal. It lacks a main string to connect all the sections. [Hong Yang, Switzerland]	Accepted. Text has been revised and rewritten for the SOD, taking this into account.
20837					Missing from chapter 4 is any consideration of the potential for reducing emissions via reduced material waste / lower material consumption by individuals (although the circular economy is briefly mentioned in section 4.3.4.3 on industry). [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. In the SOD, Industrial systems has become a separate section (4.3.5) with more consideration for materials, for example in the subsection 4.3.5.2 Bio-based and circularity.
18030					Climate services play an important role in strengthening climate mitigation and adaptation efforts, thus I believe it needs to be mentioned explicitly in this chapter. Please, see my specific comments below. [Annamaria Lehoczky, Spain]	Accepted, climate services are included in section 4.3.3.1.
1418					Overall, I feel like large parts of this report do not focus on the +1,5C target specifically, it is more like an intermediate AR6 but less detailed. This is maybe due to the lack of studies focusing on that target but I'm afraid that this work and the forthcoming AR6 will be too similar [Philippe Roudier, France]	Noted. 1 November 2017 is the deadline for paper submissions, to be considered for inclusion in the SR1.5. We are still expecting additional relevant literature that is specific to 1.5C.
4756					Many literature entries are quoted in the format "author, year", while many others in the format "author year" without comma inbetween. Please establish one format (in accordance to the rest of the Report). [Valentino Piana, Italy]	Editorial.
7577					Overall, I have the feeling strong statements are done, especially in the executive summary, for which I wonder how much hard evidence there is for these statement, see examples above. [Andries Hof, Netherlands]	Taken into account. A clearer line of sight is under development, and will further improve from the SOD to the Final Draft.
15013					This chapter must be significantly revised in terms of scope and tone. IPCC reports should be neutral with respect to policy, although they may need to deal objectively with scientific, technical and socio-economic factors relevant to the application of particular policies. The assessments are policy-relevant but not policy-prescriptive: they may present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options, but they do not tell policymakers what actions to take. Authors should be careful when using tems such as "necessary," "prerequsite," "needed," "require," and "must" to describe their findings as this crosses the line on the IPCC's mandate to policy advocasy. The authors may wish to note views that have been presented in the literature, but they should not make statements as IPCC authors that prejudge the policy process. Where specific policies or approaches are mentioned, they should be treated as case studies, and objective analysis of the positive and negative impacts of specific policies may follow, if supported by the scientific literature. Much of the information presented is not rooted in literature specfically relevant to 1.5 degrees. Therefore the information in this chapter, should it remain in the report at all, should be reframed to be specific to the scientific understanding of enabling changes to limit warming to 1.5 degrees. Information relevant to the strengthening the global response to the broader climate change challenge should be reflected in the full assessment reports not in this special report. [Farhan Akhtar, United States of America]	Accepted. We have done a check on this and have hopefully caught all instances.
2483					This chapter should come earlier. Separate out parts on people/groups vs. finance, health, etc. Or at least highlight sections that focus on people, not institutions. There are some interesting and relevant stories/case studies that get lost in all the economic info, etc. [Lisa Lucero, United States of America]	Rejected. As per approved plenary outline in terms of location.
1204					Ch4 managed to pull together a tremendous amount of literature in a very short time period that captures important key messages regarding the implementation of response measures for limiting warming to 1.5C - well done! As with all chapters, further work is needed to improve the flow and clarity of the chapter storyline. While one can readily interpret the chapter storyline in the Table of Contents, it is much harder to follow when reading the individual sections. Better signposting would help here. The storyline should also be explicitly outlined in section 4.1. [Petra Tschakert, Australia]	Accepted. We have tried to outline the storyline more explicitly in 4.1 and also start the 4.x sections with a chapeau indicating it.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6569					This chapter does not really produces an assessment of a global response, but it is mostly sectoral, partial and case-study specific . This is not necessarily a problem if the message is precisely to say that global response cannot be given but only one based on discrete examples of actions and instruments that work which can help to meet the 1.5ºC target following the Paris 'mind shift' (in contrast to the one-single global top-down approach which failed in Copenhangen. 'Global', in contrast to 'worldwide' or to 'large at planetary /humankind scale' refers mainly to 'interconnected'. However, at present, this report: 1. Omits the characterisation of several global systems crucial for meeting the 1.5 target, such as global trade systems, global information systems or even the important role played large-scale military systems and military R&D and investments. 2. It does not show clearly the interconnections between different global systems so as to assess synergies and trade-offs between different kinds of interventions and the possible systems of global solutions which could be implemented to harness various global systems dynamics as to meet the 1.5ºC challenge (see the emerging Global Systems Science) and 3. No additional or new global integrated targets or a transformative integrated narrative is included in this chapter specifically targeted to the 1.5 challenge and linked to discussions in section 2.5.1 and table 2.13 in Chapter 2 (which only focuses on few modelling climate and SSPs combinations, and not on global societal transformations and how to implement them (like for instance, a narrative which could inform about how much fossil fuels should be kept in the ground to limit global fossil-fuels demand and how this should be combined with concrete positive policy measures and an engaging discourse at a global level (despite few scant ideas such as the notion of 'unburnable oil and stranded assets is partially addressed in the chapter). [J. David Tabara, Spain]	Taken into account. On point 1, the peer-reviewed literature is limited. On point 2, synergies and trade-offs are included in the next draft. On point 3: This point is repaired through Table 4.1.
6570					The chapter may require providing a clearer distinction between the understanding of 'conventional' versus 'transformative' adaptation and mitigation strategies. The chapter only talks about 'transformative adaptation' but omits the role of 'transformative mitigation'. Transformation is mostly an autonomous dimension related to achieving sustainability or in current policy practice, the SDGs. Hence, many of the technological 'solutions' and innovations which are often put forward as candidates to meet the 1.5ºC challenge if not aligned to achieve sustainability and support / be supportive of institutional change are conventional in nature, despite its large-scale ambition -and therefore likely to create even greater and more difficult to solve problems. [J. David Tabara, Spain]	Taken into account in section 4.2.
6571					The chapter requires more emphasis in characterising distributed agency and the attendant responsibilities derived from this agency. In other words, and with the exception of local actors and cities, at present the report focuses to much on 'what is the problem' rather than on systematically characterising and assessing 'who is the solution' - e.g. who should pay or could benefit from implementing such solutions or not implementing them, including future generations. For instance, the role of corporate responsibility is missing, while some large corporations constitute some of the largest potential players in GHG reduction -even largest than some states. Emerging literature is growing this regard, e.g. by Karen O'Brian or at the EU project IMPRESSIONS, see for instance, last chapter of Berry, P.M., Betts, R.A., Harrison, P.A. and Sanchez-Arcilla, A. (Eds.) 2017. High-End Climate Change in Europe. Available at http://highendclimateresearch.eu/ ; but there are many others from political science. [J. David Tabara, Spain]	Taken into account , mainly in section 4.4.3 in the SOD (on governance).
1205					There is quite significant overlap on response options (esp. mitigation, and land-based transitions) with Ch 5 (5.4) and also Ch2. To be discussed at LAM3. Much less so on adaptation. [Petra Tschakert, Australia]	Accepted, for discussion at LAM3 and is improved in next versions.
6581					Consider trying to put a much further attention to the the literature on social and sustainability learning in the report and also in particular in section 4.4.12 - as the whole point of this report seems to be that we need to engage in a social learning process. this current subsection focus on technical and policy systems while omitting the role of cultural and social systems dynamics; besides extensive work by Ostrom you may consider, for instance: Tàbara, J. D. & Chabay, I. 2013. 'Coupling human information and knowledge systems with social-ecological systems change. Reframing research, education and policy for sustainability'. Special Issue on "Responses to Environmental and Societal Challenges for our Unstable Earth (RESCUE)". Environmental Science and Policy, 28: 71-81; Tàbara, J. D. and C. Pahl-Wostl 2008. Sustainability Learning in Natural Resource Use and Management. Ecology and Society, 12 (2): 3. [online] URL: http://www.ecologyandsociety.org/viewissue.php?sf=28;31. Tàbara, J. D., Dai, X., Jia, G., McEvoy, D., Neufeldt, H., Serra, A., Werners, S., and West, J. J. 2010. 'The Climate Learning Ladder. A pragmatic procedure to support climate adaptation'. Environmental Policy and Governance, 20:1-11; mostly because the 1.5C° challenge can be seen as a 'social learning race' against time, not just a technological problem (see Tàbara, J. D. 2013. 'Social learning to cope with global environmental change and unsustainability'. In: Stewart Lockie, David A. Sonnenfeld, and Dana R. Fisher (eds). The Routledge International Handbook of Social and Environmental Change. London and New York: Routledge, pages 253-265) [J. David Tabara, Spain]	Noted. Social learning race against time, that's a good one. It is - briefly - addressed in section 4.2.2
4309					I really do not see the logic of a long sub-section from 4.4.1 to 4.4.5 in a chapter containing section 4.3 (with a key "Energy system transitions" burried in a subsection…4.3.2). A major change in chapter structure, or even a chapter division , should be considered. At least, you should try to bring together "technical subsections" (like those re-appearing from 4.4.6 "recent innovations and their impact on 1.5 ºC" closer together with the subsections of 4.3. [Abanades Carlos, Spain]	Rejected. The logic follows the broad plenary approved outline and a focus on system transitions to enable the 1.5C transition. However, it is noted that the storyline should be made clearer.
10210					An impressively developed capture, covering new ideas and material. I like its logical layout. Generally the text read too much like a review and not an asesssment, but I'm sure this will improve [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Thank you and we focussed on improving this for the SOD.
14056					There is an imbalance between mitigation and adaptation. It is not clear where adaptation is actually discussed [Elvira Poloczanska, Germany]	Accepted. We strive for a good balance between mitigation and adaptation and this has been improved in the SOD.
4298					The current draft of this chapter requires a major change because it is an essential part of the report. I only note 3 major general comments here (more details below): 1. It should contain much more quantitative infomation (efficiencies, cost, scales, estimates of magnitudes of mitigation potential or more examples of specific projects or reference cases where these are estimated) 2. It should contain more graphics, conceptual process schemess etc. instead of so much generic and rather rethoric pieces of text about societal aspects, that may fit better in other chapters (i.e. Ch 1) 3. It should avoid overlap with other chapters (specially regarding Ch2 vs current section 4.2 (similar titles ¡) and simplify the index/chapter structure. [Abanades Carlos, Spain]	Partly accept. 1. Only qualitative information from peer-reviewed literature can be included. Some of the information requested by the reviewer can be found in Chapter 2. 2. More graphics have been included in the SOD and will be further refined for inclusion in the Final Draft. 3. Accepted, Section 4.2 has been reshaped to avoid overlaps with Chapter 2: the revised section includes Table 4.1 on sectoral policy targets based on Chapter 2.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
5595					The title of the chapter is not fully reflected in the content of the chapter and in the way it is presented. Changes in titles and of position of text portions, together with substantial extension of certain materials, are necessary. The chapter does not describe the current global response to climate change, so it is ill-positioned to propose its strengthening and its implementation. The chapter has a lot of pages on sectoral responses but almost nothing on international (i.g. bilateral and multilateral) responses to climate change. It relegates UNFCCC and NDCs to a very remote box, on par to cursory empirical local evidence. To partially improve things, the following raccomandations are issued. Box 4.12 should be moved as autonomous chapter 4.3 just before the current 4.3 (current page 16) and relabeled "The current international reponse to climate change" with integrative text to correspond to this broader title, including 1. a wider analysis of the more than 2000 pages of NDCs and 2. all key themes of the Paris Agreement and accompanying institutions (both within and outside the UNFCCC). The current 4.3 title ("Assessment of... options") should be renamed as "Assessment of current options for enhancing the ambition of NDCs and of multi-stakeholder partnerships". [Valentino Piana, Italy]	Taken into account. FOD Box 4.12 is a Cross-Chapter Box and has been labelled as such correctly in the SOD, titled 'Consistency between nationally determined contributions and 1.5C scenarios'. It has been revised and reshaped for the SOD, taking into account the points of the reviewer. Text on bilateral/multilateral contributions has been added in section 4.4.1 on International governance.
5602					Too little attention is paid to Small Island Developing States in the Pacific region in the whole chapter, even if they face an existential threat whan the threshold of 1.5C is overcome or overshoot, with the risk, or even the certainty, of being wiped out from the map by sea level rising and face inhabitability conditions, due to salted water intrusion, sea flooding, coral reef ecosystem collapse, leading to decisive losses in income and protein sources (more on that at p. 65 and at p. 73 of ch. 3, where however adaptation measureas are not explored, only the impacts). Which is the global response in front of all this? Do solidarity arise with innovative agreements and practices or are they left behind, as early warning to all other victims of climate change damages and losses? The chapter makes no analysis of their National Adaptation Plans and does not assess their technical and financial feasibility. The chapter does not explore what the existing literature on the subject has been elaborating and should be integrated by its analysis, including, but obviously not limiting to, the following: Adapting to climate change in the Pacific: the PACC programme http://www.sprep.org/attachments/Publications/CC/PACC_Programme.pdf ; http://www.pacificdisaster.net/dox/FRDP_2016_Resilient_Dev_pacific.pdf ; Community-based adaptation to climate change: A review of good practices in the Pacific (2011); Tonga Climate Change Policy A Resilient Tonga by 2035 https://www.pacificclimatechange.net/sites/default/files/documents/5.%20Tonga%20Climate%20Change%20Policy%202016.pdf https://docs.lib.noaa.gov/noaa_documents/CoRIS/PICSF_outcomes-and-report.pdf https://ojs.aut.ac.nz/pacific-journalism-review/article/view/210 (2017, DOI: 10.1007/s11852-017-0531-7) and its bibliographical sources, as well as many article in Regional Environmental Change journal (e.g. DOI:10.1007/s10113-016-0991-6) and others responding to the call for papers by Thomas, Schleussner and Kumar on 1.5C and Small Island Developing States. Please also consult the following websites: http://www.sprep.org/pacc (including http://www.sprep.org/pacc/publications/technical-reports) and https://www.pacificclimatechange.net/ http://www.pacificdisaster.net/pdn2008/ , https://www.cddjournal.org/article/view/vol02-iss2-4 and more in general http://www.sustainablesids.org/ https://www.odi.org/sites/odi.org.uk/files/resource-documents/11053.pdf [Valentino Piana, Italy]	Partly accepted. Text has been added to case study Box 4.3: Indigenous knowledge and community adaptation with a specific mention of the challenges of the Pacific Islands, with a cross-reference to Chapter 3. National Adaptation Plans are discussed in Cross-Chapter Box 4.1, however note that we do not have peer-reviewed literature available on the NAPs of specific countries and are restricted by that.
17384					There is very little focus on the removal or reduction in fossil fuel subsidies - either direct, indirect or incidental. This lack of a clear, level playing field is a major barrier to the uptake of an low carbon pathway. OECD Companion to the Inventory of Support Measures for Fossil Fuels 2015, Published on September 21, 2015 [Gavin Allwright, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account; reduction or removal of fossil fuel subsidies are discussed in SOD sections 4.4.5 and 4.4.6. OECD has been cited in section 4.4.5.
14057					Synergies and trade-offs of mitigation and adapation are not sufficiently addressed [Elvira Poloczanska, Germany]	Accepted. This will be included in later versions of the chapter.
17385					No investigation of potential for alternative financial tools to leverage capacity development, investment and deployment of solutions. [Gavin Allwright, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. In SOD section 4.4.6 on Enabling Climate Finance, a sub-section has been added: "4.4.6.3 Combining new financial instruments to address the basic needs and adaptation challenges"
14058					Many sections have too many subheadings (up to the fifth level) [Elvira Poloczanska, Germany]	Accepted, fifth level headings have been removed in the SOD.
20202					Use more recent status report of GCCSI (e.g. 2016); GCCSI report for 2017 will probably be issued before the publication of this special report and update txt wherever relevant [Ton Wildenborg, Netherlands]	Accepted. Global CCS Institute (2017). The Global Status of CCS 2016 Summary Report is cited in SOD. We are updating this as we go along
14059					Many references are missing in the reference list [Elvira Poloczanska, Germany]	Accepted, has been fixed.
10229					Adding summary figures and Tables would really help [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, for the SOD several figures and tables have been added.
7895			134		Overarching Comment. In many respects this 1.5 degree report is simply an update of the AR5. However, the data in most cases do not exist to indicate how the deployment of adaptation and mitigation options would need to be different in a 1.5 vs. 2 degree world. However, the report states in 4.1 that "This chapter discusses the implementation opportunities and challenges associated with a 1.5°C warmer world, from both mitigation and adaptation perspectives." While the chapter does this, it would be better served it made clearer recommendations on what options are the most feasible - technically, economically, and socially/politically. Table 4.1 provides examples of empirical measures. I understand a universal feasibility assessment is not possible, as the chapter emphasizes. While it would be impossible to rank options based on their feasibility in any numerical sense, it would be good to at least qualitatively indicate the most promising/necessary mitigation and adaptation options. As such, I don't think the chapter accomplishes it goal of assessing feasibility. A figure would be useful, perhaps stylistically something like the famous 'burning embers' figure. For mitigation options, it would also be useful to have a figure/table that summarizes the abatement potential of each option. This is something that the Project Drawdown has done well. [Westphal Michael, United States of America]	Party accept. The feasibility of adaptation and mitigation options is assessed in the SOD, using a set of indicators for the three dimensions of feasibility as outlined in section 4.3.1. Figures showing the assessment will be developed for the SOD. Clear recommendations would be considered policy prescriptive and are not in the mandate.
7900			134		The chapter introduces disruptive change, but throughout mostly uses the phrase transformative change. It would be helpful to stick to one term and clearly define it, including measures. See Westphal and Thwaites for one definition of transformation: Westphal and Thwaites. 2016. "Transformational Climate Finance: An Exploration of Low-Carbon Energy". World Resources Institute. [Westphal Michael, United States of America]	Accept. Text will be checked for consistent use.
11138					Throughout this chapter there are some interpretations of the Paris Agreement that may differ from the interpretations of some Parties. Care should be taken to avoid making blanket interpretations of the Paris Agreement and its provisions. [Michiel Schaeffer, Netherlands]	Accepted, this will be checked throughout the chapter.
11139					Several times the difference in the extent of transformation necessary for 1.5 compared to that for 2 deg is highlighted, but it should also be emphasised that assessments of the required change in energy systems / institutions etc. often do not consider the effects of climate change on mitigation options and development. [Michiel Schaeffer, Netherlands]	Accepted. In section 4.3.1, this text was edited to reflect this point: "Feasibility assessments are enhanced where they consider different exposure to climate impacts and differences in attitudes towards the future, that arise from socio-economic status, gender and culture"

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11140					The sections referring to SLCPs are misleading, frankly. The root cause is the lumping together of several substances under the SLCP umbrella, while these have very different characteristics, climatic effects, co-emission relations with CO2 and policy measures to achieve reductions. Often in this chapter, SLCPs are mentioned as beneficial for some purpose or another, while the particular benefit only applies to one or two of the substances lumped together and not to all the others. This seems scientific bad practice and is unhelpful for policy purposes. [Michiel Schaeffer, Netherlands]	Accept. Will look at instances where we discuss SLCPs and make sure we don't overgeneralise.
18760					Please make sure all papers under review, inaccessible grey literature, and foreign language abstracts translated to english that are used in Chapter 4's FOD and SOD are uploaded to a clearly identified folder in DM. [Wilfran Moufouma Okia, France]	Accepted.
11096					Throughout the discussion of SRM, the draft gives the impression that the current state of knowledge, regarding both science and policy, is more advanced—and more unfavorable—than is actually the case. As we see things, knowledge about solar geoengineering remains in its early stages and is characterized by considerable uncertainty, yet the limited evidence that does exist suggests that SRM could be a highly beneficial climate policy tool if carefully used in combination with other strategies, in particular emissions mitigation. Several examples illustrate this point. [Joshua Horton, United States of America]	Taken into account. We attempt to give a balanced account and will continue to look at this in the SOD.
7355					Replace the text "low carbon technologies" with "low emissions technologies". [Eleni Kaditi, Austria]	Accept. Text revised.
7357					Replace the text "low carbon transition" with "low emissions transition". [Eleni Kaditi, Austria]	Accept. Text revised.
6194	1		100		This is probably obvious to the authors but the chapter is currently very patchy, with some sections full and reasonable coherent, others highly fragmentary. There is quite a lot of material that is pretty generic and ought to be made more focused on the challenge of 1.5C specifically. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; storyline and narrative have been improved for the SOD and where possible, with a stronger focus on 1.5C specific literature.
7791	1		134		Please see the bibliography of p28 otentially new or unfamiliar references that I will attempt to upload. If you do not receive it, please email amory@rmi.org immediately with instructions where to email it. The rest of my comments refer to its contents. It contains a mix of peer-reviewed journal articles and other publications in resepcted venues, including some major book-length studies that are far too long for that format but are etensively peer-reviewed and of proper quality and rigor. Your Draft's current references include some sources not in peer-reviewed journals (e.g. Seba 2014, Christensen 1997) and are considerably less deep and detailed. [Amory Lovins, United States of America]	Noted. Grey literature will be assessed as per IPCC guidelines
7648	1		134		Please see the bibliography of p28 otentially new or unfamiliar references that I will attempt to upload. If you do not receive it, please email amory@rmi.org immediately with instructions where to email it. The rest of my comments refer to its contents. It contains a mix of peer-reviewed journal articles and other publications in resepcted venues, including some major book-length studies that are far too long for that format but are etensively peer-reviewed and of proper quality and rigor. Your Draft's current references include some sources not in peer-reviewed journals (e.g. Seba 2014, Christensen 1997) and are considerably less deep and detailed. [Amory Lovins, United States of America]	Noted. Grey literature will be assessed as per IPCC guidelines
6195	1		100		Overall, the one significant absence in the chapter, given its role in the special report as a whole, is the lack of a careful consideration of, and review of appropriate literature, the political challenge of pursuing the 1.5C target. That is, we know roughly what technologies are involved, and how quickly they need to be deployed, and we can quantify how much needs therefore to be made up by behavioural change - transport mode switching, etc. But what will determine whether or not these changes can be realised will be securing the policies, investments, and rapid social change involved against political backlash. The only real discussion of this, beyond the odd mention in passing, is in the discussion on p63 on 'public support' (which is a subsection in the section on behavioural change, whereas the issues there are not specific to behaviour change), and this is rather inadequate, as explained in a comment on that passage. But we can say much more specific things about what the political challenges will be, and there is plenty of literature that could be used to support these claims. 1. resistance can be expected from incumbent economic interests who will lose out from the rapid transition through their 'stranded assets'. There is now a substantial literature on that (some of which is mentioned here in other ocntexts) but also a very large literature on corporate lobbying on climate change which could be brought to bear on that question (see work variously by Peter Newell, Matthew Paterson, David Levy, Ans Kolk, and others). Some of this has been incorporated into the socio-tecnhical transitions literature (see for example Geels, Frank W. 2014. Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. Theory, Culture & Society 31:21–40). 2. resistance can be expected by those particularly attached to high carbon practices - driving, flying, and so on. The literature on this is perhaps less well developed but at least some elements from Bulkeley, Harriet, Matthew Paterson, and Johannes Stripple, eds. 2016. Towards a Cultural Politics of Climate Change. Cambridge: Cambridge University Press, could be used to think about this. 3. we can expect conflicts over the distributive conflicts over the rapid transition. Much of this is well-known but needs to be understood not only ethically - as a question of whether some will lose out from cliamte policy - but politically, in terms of whether and how this might block the rapid transition involved in pursuing 1.5C. There are already cases of this playing out, especially over conflicts over energy price rises. Leah Stokes (Stokes, Leah. 2013. The Politics of Renewable Energy Policies: The Case of Feed-in Tariffs in Ontario, Canada. Energy Policy 56:490–500.), for example shows how this worked in relation to Ontario's feed in tariff, which still threatens to derail climate policy there. Other cases as in Australia are well known. And of course these differnt sources of political backlash can combine (again, the Australian carbon pricing case is paradigmatic). Integrating a discussion of these literatures and themes explicity would enable a much sharper analysis of the things that governments seeking to pursue policy towards 1.5C woudl have to consider if they were serious about that goal, and thus enhance the policy-relevance of the chapter significantly. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accept, this is further addressed in section 4.4.3 as well as in section 4.4.5 and 4.4.6. We also address it in the feasibility assessment in 4.5.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7792	1		134		I will now try to paste that bibliography here in case I can't upload it in one Word document. Here it is in two pieces (plus some possible detritus at the end of the first box, cell 15B or 16B—Excel was never designed for such use!): Additional references; any of mine not immediately available will be emailed on request to amory@rmi.org (my private address; my published address is ablovins@rmi.org). A bug in your spreadsheet seems to be preventing the Chapter column in row 17 from entering, so the second half of the bibliography is not uploading; I'll try it again at the end of the spreadsheet. Abramczyk M et al. (2009) Positive Disruption. Rocky Mountain Institute (RMI), https://www.rmi.org/wp-content/uploads/2017/08/RMI_Report_Positive_Disruption_2017.pdf Arthur WB (1999) Complexity and the economy. Science 284:107–109 (1999) Arthur WB (2004) Complexity and the Economy. Oxford University Press Bendewald M et al. (2014) Deep retrofit value guide for owner occupants. https://www.rmi.org/insights/calculate-present-deep-retrofit-value-owners-managers/ Bendewald M Miller D Muldavin S (2015) Deep retrofit value guide for investors. https://www.rmi.org/insights/reports/calculate-present-deep-retrofit-value-investors/ Cramer D, Lovins A (2004) Hypercars®, Hydrogen, and the Automotive Transition. Intl J Veh Design 35(1/2):50–85, www.rmi.org/rmi/Library/T04-01_HypercarsHydrogenAutomotiveTransition Creutzig F et al. (2017). The underestimated potential of solar energy to mitigate climate change. Nature Energy 2, 17140ERI (Energy Research Institute of the National Development and Reform Commission), Lawrence Berkeley National Laboratory, Energy Foundation China, and Rocky Mountain Institute (RMI) (2017) ????: ?? ??2050???????????????? (Reinventing Fire: China). Executive Summary in English at https://www.rmi.org/wp-content/uploads/2017/05/OCS_Report_ReinventingFireChina_2016.pdf, in Chinese at http://rmi-china.com/static/upfile/news/nfiles/RF%20China%20Executive%20Summary%20-%20CN%20FINAL_1104.pdf, in Japanese at http://www.renewable-ei.org/en/activities/reports_20170131.php; 3-vol reports in press from ERI and RMI European Climate Foundation (2010) Roadmap 2050. http://www.roadmap2050.eu Griscom B et al. (2017) Natural pathways to climate mitigation. PNAS, in press. IEA (International Energy Agency) (2010) Capturing the Multiple Benefits of Energy Efficiency. http://www.iea.org/publications/freepublications/publication/Captur_the_MultiplBenef_ofEnergyEficiency.pdf IEA (2017) Energy Efficiency Market Report 2017. In press, https://www.iea.org/eemr17/ Lovins A. & L.H. (1991) Least-Cost Climatic Stabilization. Annu Rev Energy Envt 16:433–531 Lovins A. (1995) The Super-Efficient Passive Building Frontier. ASHRAE J 37(6):79–81, https://www.rmi.org/wp-content/uploads/2017/09/E95-28_SuperEffBldgFrontier.pdf Lovins A et al. (2004) Winning the Oil Endgame. Rocky Mountain Institute, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/06/RMI_Winning_the_Oil_Endgame_Book_2005.pdf Lovins A. (2005) Energy End-Use Efficiency. InterAcademy Council, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/04/OCS_Energy_End-Use_Efficiency_2005.pdf. Lovins A (2007) Advanced Energy Efficiency. Stanford U School of Engineering, https://www.youtube.com/playlist?list=PL702A1EE2F77F0504 Lovins A (2010) Integrative Design: A Disruptive Source of Expanding Returns to Investments in Energy Efficiency. https://www.rmi.org/wp-content/uploads/2017/04/OCS_Integrative_Design_Disruptive_Source_of_Expanding_ROI_in_Energy_Efficiency_2010.pdf Lovins A and RMI (Rocky Mountain Institute) (2011) Reinventing Fire. Chelsea Green (Vermont), www.rmi.org/reinventingfire [Amory Lovins, United States of America]	Noted, with appreciation. Most of these references are seminal works cited in earlier IPCC assessments. 1.5C relevant literature in the post-AR5 period will be considered

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7836	1		134		I will now try to paste that bibliography here in case I can't upload it in one Word document. Here it is in two pieces (plus some possible detritus at the end of the first box, cell 15B or 16B—Excel was never designed for such use!): Additional references; any of mine not immediately available will be emailed on request to amory@rmi.org (my private address; my published address is ablovins@rmi.org). A bug in your spreadsheet seems to be preventing the Chapter column in row 17 from entering, so the second half of the bibliography is not uploading; I'll try it again at the end of the spreadsheet. Abramczyk M et al. (2009) Positive Disruption. Rocky Mountain Institute (RMI), https://www.rmi.org/wp-content/uploads/2017/08/RMI_Report_Positive_Disruption_2017.pdf Arthur WB (1999) Complexity and the economy. Science 284:107–109 (1999) Arthur WB (2004) Complexity and the Economy. Oxford University Press Bendewald M et al. (2014) Deep retrofit value guide for owner occupants. https://www.rmi.org/insights/calculate-present-deep-retrofit-value-owners-managers/ Bendewald M Miller D Muldavin S (2015) Deep retrofit value guide for investors. https://www.rmi.org/insights/reports/calculate-present-deep-retrofit-value-investors/ Cramer D, Lovins A (2004) Hypercars®, Hydrogen, and the Automotive Transition. Intl J Veh Design 35(1/2):50–85, www.rmi.org/rmi/Library/T04-01_HypercarsHydrogenAutomotiveTransition Creutzig F et al. (2017). The underestimated potential of solar energy to mitigate climate change. Nature Energy 2, 17140ERI (Energy Research Institute of the National Development and Reform Commission), Lawrence Berkeley National Laboratory, Energy Foundation China, and Rocky Mountain Institute (RMI) (2017) ????: ?? ??2050???????????????? (Reinventing Fire: China). Executive Summary in English at https://www.rmi.org/wp-content/uploads/2017/05/OCS_Report_ReinventingFireChina_2016.pdf, in Chinese at http://rmi-china.com/static/upfile/news/nfiles/RF%20China%20Executive%20Summary%20-%20CN%20FINAL_1104.pdf, in Japanese at http://www.renewable-ei.org/en/activities/reports_20170131.php; 3-vol reports in press from ERI and RMI European Climate Foundation (2010) Roadmap 2050. http://www.roadmap2050.eu Griscom B et al. (2017) Natural pathways to climate mitigation. PNAS, in press. IEA (International Energy Agency) (2010) Capturing the Multiple Benefits of Energy Efficiency. http://www.iea.org/publications/freepublications/publication/Captur_the_MultiplBenef_ofEnergyEficiency.pdf IEA (2017) Energy Efficiency Market Report 2017. In press, https://www.iea.org/eemr17/ Lovins A. & L.H. (1991) Least-Cost Climatic Stabilization. Annu Rev Energy Envt 16:433–531 Lovins A. (1995) The Super-Efficient Passive Building Frontier. ASHRAE J 37(6):79–81, https://www.rmi.org/wp-content/uploads/2017/09/E95-28_SuperEffBldgFrontier.pdf Lovins A et al. (2004) Winning the Oil Endgame. Rocky Mountain Institute, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/06/RMI_Winning_the_Oil_Endgame_Book_2005.pdf Lovins A. (2005) Energy End-Use Efficiency. InterAcademy Council, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/04/OCS_Energy_End-Use_Efficiency_2005.pdf. Lovins A (2007) Advanced Energy Efficiency. Stanford U School of Engineering, https://www.youtube.com/playlist?list=PL702A1EE2F77F0504 Lovins A (2010) Integrative Design: A Disruptive Source of Expanding Returns to Investments in Energy Efficiency. https://www.rmi.org/wp-content/uploads/2017/04/OCS_Integrative_Design_Disruptive_Source_of_Expanding_ROI_in_Energy_Efficiency_2010.pdf Lovins A and RMI (Rocky Mountain Institute) (2011) Reinventing Fire. Chelsea Green (Vermont), www.rmi.org/reinventingfire	Noted. See response to comment 7792

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7837	1		134		Part two of that bibliography: Lovins A et al. (2004) Winning the Oil Endgame. Rocky Mountain Institute, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/06/RMI_Winning_the_Oil_Endgame_Book_2005.pdf Lovins A. (2005) Energy End-Use Efficiency. InterAcademy Council, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/04/OCS_Energy_End-Use_Efficiency_2005.pdf. Lovins A (2007) Advanced Energy Efficiency. Stanford U School of Engineering, https://www.youtube.com/playlist?list=PL702A1EE2F77F0504 Lovins A (2010) Integrative Design: A Disruptive Source of Expanding Returns to Investments in Energy Efficiency. https://www.rmi.org/wp-content/uploads/2017/04/OCS_Integrative_Design_Disruptive_Source_of_Expanding_ROI_in_Energy_Efficiency_2010.pdf Lovins A and RMI (Rocky Mountain Institute) (2011) Reinventing Fire. Chelsea Green (Vermont), www.rmi.org/reinventingfire Lovins A (2015) Oil-Free Transportation. Procs Am Inst Phys 1652:129–139, doi: 10.1063/1.4916175 Lovins A (2015a) Reinventing fire: Physics + markets = energy solutions Procs Am Inst Phys 1652:100–111, doi:10.1063/1.4916173 Lovins A (2017) How Big Is the Energy Efficiency Resource? Invited Essay, Clim. Chg .(in review, MS #CLIM-D-17-00599) Lovins A (2018) Mobility Without Oil. Transportation Research Board (Jan. ann. conf., accepted) Muldavin S (2010) Value Beyond Cost Savings: How to Underwrite Sustainable Properties. Green Building Finance Consortium, https://books.google.com/books?isbn=0982635702. Nagy B Farmer J. Bui Q Tramcik J (2013) Statistical Basis for Predicting Technological Progress. PloS one 8(2), https://doi.org/10.1371/journal.pone.0052669 Ogburn M Ramroth L Lovins A (2008) Transformational Trucks: Determining the Energy Efficiency Limits of a Class-8 Tractor Trailer, https://rmi.org/wp-content/uploads/2017/05/RMI_Document_Repository_Public-Reprts_T08-1_RMITransformational_Truck_Study_080709compressed.pdf Price L et al. (2017) Reinventing Fire: China—the role of energy efficiency in China's roadmap to 2050 (1-242-17). Procs ECEEE Summer Study, http://proceedings.eceee.org/visabstrakt.php?event=7&doc=1-242-17/ Worrell E et al. (2003) Productivity benefits of industrial energy efficiency measures. Energy 28(11):1081–1098, http://escholarship.org/uc/item/0013f49z Zhou N et al. (2016) Policy Roadmap to 50% Energy Reduction in Chinese Buildings by 2050. Procs ACEEE Summer Study on Energy Efficiency in Buildings, 9-1–9-12, http://aceee.org/files/proceedings/2016/data/papers/9_1132.pdf Part two of that bibliography: Lovins A et al. (2004) Winning the Oil Endgame. Rocky Mountain Institute, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/06/RMI_Winning_the_Oil_Endgame_Book_2005.pdf Lovins A. (2005) Energy End-Use Efficiency. InterAcademy Council, https://d231jw5ce53gcq.cloudfront.net/wp-content/uploads/2017/04/OCS_Energy_End-Use_Efficiency_2005.pdf. Lovins A (2007) Advanced Energy Efficiency. Stanford U School of Engineering, https://www.youtube.com/playlist?list=PL702A1EE2F77F0504 Lovins A (2010) Integrative Design: A Disruptive Source of Expanding Returns to Investments in Energy Efficiency. https://www.rmi.org/wp-content/uploads/2017/04/OCS_Integrative_Design_Disruptive_Source_of_Expanding_ROI_in_Energy_Efficiency_2010.pdf Lovins A and RMI (Rocky Mountain Institute) (2011) Reinventing Fire. Chelsea Green (Vermont), www.rmi.org/reinventingfire Lovins A (2015) Oil-Free Transportation. Procs Am Inst Phys 1652:129–139, doi: 10.1063/1.4916175 Lovins A (2015a) Reinventing fire: Physics + markets = energy solutions Procs Am Inst Phys 1652:100–111, doi:10.1063/1.4916173 Lovins A (2017) How Big Is the Energy Efficiency Resource? Invited Essay, Clim. Chg .(in review, MS #CLIM-D-17-00599) Lovins A (2018) Mobility Without Oil. Transportation Research Board (Jan. ann. conf., accepted) Muldavin S (2010) Value Beyond Cost Savings: How to Underwrite Sustainable Properties. Green Building Finance Consortium, https://books.google.com/books?isbn=0982635702. Nagy B Farmer J. Bui Q Tramcik J (2013) Statistical Basis for Predicting Technological Progress. PloS one 8(2), https://doi.org/10.1371/journal.pone.0052669 Ogburn M Ramroth L Lovins A (2008) Transformational Trucks: Determining the Energy Efficiency Limits of a Class-8 Tractor Trailer, https://rmi.org/wp-content/uploads/2017/05/RMI_Document_Repository_Public-Reprts_T08-1_RMITransformational_Truck_Study_080709compressed.pdf	Noted. See response to comment 7792
18602	1	1	1	1	Everywhere there is "[ref]" replace with a Mendeley link [Wilfran Moufouma Okia, France]	Accepted.
3110	1	1	100	35	Dear CLA/LA s; thank you for an interesting, clean and informative read. My final overarching comment is that the document feels heavy on SRM and light on mitigaiton policy to achieve 1.5C. While far from the only source but one of the more comprehensive, I believe the already referenced Stern N, Stiglitz (2017): report of the High Level Commission on carbon pricing; Carbon Pricing Leadership Coalition, https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices/ could be used more thouroughly throughout the document, especially in terms of recommended price levels, what carbon pricing can and cannot do, and complementary policies. At minimum I recommend a review of the executive summary. [Christopher Bataille, Canada]	Accept. We have reduced the SRM parts and increased section 4.4.7 and 4.4.8 which are on (mitigation) policy.
1478	1	1	100	55	The chapter is well written and covers a great deal of ground succinctly. Obviously there are severe space constraints and so reference to other IPCC ARS and SRs is appropriate in terms of avoiding repetition and too much detail. That said, for me there was insufficient discussion of education, knowledge exchange and capacity buidling given how vital these are to both mitigation and adaptation success. I would also urge the authors to give full coverage to adaption via migration under a 1.5 degree scenario. The sections on carbon finance were well written and very interesting, but the direct relevance to 1.5 degrees (as opposed to general discussion of climate financing) wasn't always obvious - I would suggest that these sections are revised to make more overt the barriers and opportunities finance represents for the 1.5 target (contrasting with RCP 4.5 etc where appropriate). [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Accept, language on this is included in several sections, such as 4.4.5 in the SOD.
15012	1	7	1	7	The Paris Agreement has one long term temperature goal. Not a target or targets. [Farhan Akhtar, United States of America]	Accept. Language revised.
1206	2		3		Table of contents: 4.3 looks like it is mainly about different transitions - adaptation is barely reflected here; how do short-lived climate pollutants fit into transitions/options? [Petra Tschakert, Australia]	Taken into account. We've improved the balance of adaptation into systems transitions. We realise that not everything that we needed to discuss (also CDR, SRM) fitted the outline but still feel a systems transitions approach holds value.
5731	2	8	2	15	Section 4.2 Pathways compatible with 1.5C and Section 4.3 Assessment of ..options contain some repeating information stated in Chapter 2. Should be streamlined for concision. [Hong Yang, Switzerland]	Accepted; hand-over between chapters will be improved for further drafts.
4750	2	17	2	17	Lack of a letter in a word. Add the initial "l" to compose the word "leadership" at the beginning of the line. [Valentino Piana, Italy]	Editorial.
7866	2	17	2	18	Leadership and lifestyles (missing 'l') [Yana POPKOSTOVA, France]	Editorial.
9089	2	26			Matching Section 4.3 structure with 3.5.3 would better establish the cross-chapter linkage (as commented above) [Suchandra Bardhan, India]	Noted. Chapters are modified in parallel so chapter 3 is a moving target for chapter 4, and vice versa, because of tight timelines. We will eventually reconcile the chapters.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
711	2	26	2	39	Section 3 of chapter 4 is supposed to give an "assessment of current and emerging options". It is outrageous that nuclear energy is not even mentioned while 63 Gwe power of nuclear reactors are under construction, 168 are planned and 400 are proposed (World Nuclear Association). Several sustainable reactors of the fast neutrons breeding type are in the industrial development stage in Russia, China and India (with a project in France). Research is very active on high temperature and molten salt reactors within the GEN4 international collaborative program. Is this absence in chapter 4 due to ignorance or to ideologocal bias? Furthermore Nuclear energy may be an extremely important element for limiting the GMST as can be seen in a recent article "How much can nuclear energy do abour global warming" (Int. J. Global Energy Issues, Vol. 40, Nos. 1/2, 2017). In any case I urge the lead authors to complete the list of authors by real experts in Nuclear Power. [Herve Nifenecker, France]	Accept. We have included a subsection on nuclear in the energy transitions section.
7867	3	5	3	7	Section 4.3.4.1.3. - sustainable water and environmental services - the section description flags a missed opportunity of the report to concentrate on the Food-Energy-Water nexus. This is a considerable gap and the report authors will be well advised to fill-in the gap, rename the section to 'Sustainable food-energy-water management' and reflect the new emphasis throughout the text and in the respective subsection. [Yana POPKOSTOVA, France]	Accepted, text has been added to section 4.3.4.5
749	3	35	3	35	Right justified leaving dots on left instead of right [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial.
13159	4		6		The Executive Summary presents many general statements, which sometimes seem trivial. It would be very useful to provide a systematic information about what works und under which conditions, what are the barriers and how to address them. [Christiane Textor, Germany]	Noted. We are trying to take this valuable comment into account.
10544	4	1	100	55	Format. The chapter is too long., too broad and too fragmented. It tries to cover a wide range of issues, jumping from one point to another without much depth in many sections,which comprise of brief paragraph(s). Some boxes (e.g., 4.12) are irrelevant, but larger than some important sections, such as green infrastructure. You should be more focused on suscint analyzing only the important points and with depth. Terminology. There is some terminology that is not appropriate in some parts, such as "implementing SD", or implementing mitigation. [Jose Antonio Puppim de Oliveira, Brazil]	Noted. The chapter was not too long, by the way.
10545	4	1	100	55	Scope. It is not clear the 1.5C degree scope. Most of the sections of chapter could be written for 3C, 2C or 1C or 1.3C. You should be clear what 1.5C (and not 2C or 3C) would require of extra efforts in different aspects.. [Jose Antonio Puppim de Oliveira, Brazil]	Accepted.
10546	4	1	100	55	Disciplinarity. There is a heavy technical and "economicist" focus. Need to include a broad range if the discussions, particularly from the policy/public administration and political economy perspective. [Jose Antonio Puppim de Oliveira, Brazil]	Accepted. Section 4.4 has been improved taking this into account.
1537	4	6	11	20	? [Section 4.2.1 (page 4-11, lines 6-20)]: Is best to cite Geels' work on 'technological transitions'. In its traditional formulation, Geels' multi-level perspective (of technological transitions) implies that niche formation and, more generally, transition dynamics are shaped by interactions between actors who operate at the same spatial scale. However, a growing body of evidence suggests that the actors that influence transition dynamics actually operate at different spatial scales (Binz et al. 2012). This is arguably worth mentioning in the text, as the spatial dimension (international dynamics in particular) is most relevant to the subject of the section. Binz, C., Truffer, B., Li, L., Shi, Y., & Lu, Y. (2012). Conceptualizing leapfrogging with spatially coupled innovation systems: The case of onsite wastewater treatment in China. Technological Forecasting and Social Change, 79(1), 155-171. [Fatemeh Bakhtiari, Denmark]	Accept. Geels is indeed cited. We thought the Binz reference was a bit too specific.
7868	4	6	4	9	Transnational governance of the energy transition is an important, potentially the most primordial issues we should examine within the pathway to 1.5 degrees. While the focus is well-placed, I regret the limited examination of theories for effective transnational governance in the energy field, a more coherent and in-depth understanding in terms of the multiple levels, sectors and challenges to constructing such a governance framework and the important concept of democratic deficit or how to ensure that the transnational energy governance framework we aim to develop would be both sustainable and conducive to solving the world energy trilemma (access, sustainability and security), inclusive and synergetic in view of the different stakeholders involved as well as catering to the particular national/stakeholder sensitivities, but also endowed with a solid democratic license. [Yana POPKOSTOVA, France]	Noted. We need to be policy-relevant, and theories are often too academic. We have tried to address the multi-level governance in the section on governance (4.4.3 in SOD).
750	4	11	4	11	Right justified leaving dots on left instead of right [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Text revised.
1538	4	18	43	23	? [Section 4.4.1.2 (page 4-43, lines 18-23)]: 'Public awareness' is a necessary, but by no means sufficient condition for "policy and technological changes". While the draft does not intend to say that public awareness is a sufficient condition, the wording is misleading, in spite of the last sentence in the paragraph: the second sentence in the paragraph reads as though the notion of 'technological transitions', as coined by Geels and colleagues, is driven mainly by 'public awareness'. This would be an oversimplification, of course. There is some literature on the role of bottom-up leadership with regard to technological transitions. Berkhout et al. (2004) argue that Geels' 'multi-level perspective of technological transitions' suffers from a bias toward "bottom-up change models". In his response to this criticism, Geels (2011) concedes that bottom-up approaches (fuelled by increased public awareness) are only one of several drivers of policy and technological changes. In short, it seems to me that 'public awareness' is not a 'systemic element of enabling environments' – at least not one that is comparable to the other elements that you list in the section, notably mega-trends and knowledge partnerships. Be that as it may, and on a much less significant note, I feel that you need to find a more suitable reference for the first sentence in the paragraph, as Blanchet's paper from 2015 focuses narrowly on (public awareness about) energy policy in Berlin. Berkhout, F., Smith, A., Stirling, A., 2004. Socio-technological regimes and transition contexts. In: Elzen, B., Geels, F.W., Green, K. (Eds.), System Innovation and the Transition to Sustainability: Theory, Evidence and Policy. Edward Elgar, Cheltenham, pp. 48–75. Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. Environmental innovation and societal transitions, 1(1), 24-40. [Fatemeh Bakhtiari, Denmark]	Accepted - text significantly revised to reflect this point. Have added a "public discourse on climate change" to awareness. Have benefit of new Geels et al 2017 paper.
13101	4	25	4	25	Typo - Box 4.9 and …… are not justified or aligned (formatting issue only) [Veryan Hann, Australia]	Accept. Text revised.
751	4	25	4	25	Right justified leaving dots on left instead of right [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Text revised.
10547	4	41	100	55	Implementation gap is not sufficient, as the NDCs commitments are not enough to even get to the 2C. We need first to hve more ambitious commitments as well. [Jose Antonio Puppim de Oliveira, Brazil]	Noted. We are noting the implementation gap as well as the NDC emission gap to 1.5 or 2C.
3610	4	46		51	How can this statement be written in the same report where one whole chapter is devoted to models assessment of decarbonization pathways? " In addition, such extrapolation is done using scenarios and models over relatively long time periods (typically several decades) assuming different growth rates and patterns " Add something like: which is indeed the topic of a full chapter of this report. I understand here and in subsequent parts of this intro the idea is to criticize the IAM literature. But it cannot be done here, it should be done as a caveat in chapter 2. Otherwise the reader is left utterly confused. [Valentina Bosetti, Italy]	Accept. Relation to and alignment with chapter 2 is improved in the SOD.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10909	6				Permitting regulations policies for renewable energies should never be more stringent, costly, delayed for replacing a fossils-powered device (heating/vehicle/industry) by a renewables-powered device, than to replace the existing device by a similar fossils-powered device (which often is considered as maintenance and does not require any permitting). [Beat Brunner, Switzerland]	Reject. It is not clear to what phrase the comment is referring. And it seems to want to introduce prescriptive and overly specific language for an ES
10911	6				This (text from page 9 line 25-27) should imho go into the executive summary since it's a major change from AR5: The transition to a 1.5°C world by 2050 leaves almost no temporal flexibility for lags in implementation, unless massive penetration of cheap carbon dioxide removal technologies becomes possible. (which is not the case yet) [Beat Brunner, Switzerland]	Taken into account, but this is and should be addressed in chapter 2. The phrase in the introduction also builds on chapter 2.
10905	6		8		Executive summary is the part that should be the most polished and easy to read and understand by non-scientific politicians and give them in their hands a tool for immediate actions. Proposal of Introduction paragraph for executive summary : To limit global warming to 1.5°C, all countries must/should : 1. Accelerate and upscale massively sustainable development, energy transition, and climate mitigation and adaptation actions. 2. To do so, encourage, facilitate and mainstream sustainable development and clean and cheap energy transition. 3. ... All those measures will be much easier and much less costly if done immediately to aim limiting to 1.5°C than with 2.0°C. [Beat Brunner, Switzerland]	Reject. Giving a policymakers to-do list would be introducing prescriptive language.
10906	6		8		Executive summary Layout : Should be made more appealing to read. Lots of similar-looking paragraphs, no graphs, same interligns, no sub-sections make it hard to read. [Beat Brunner, Switzerland]	Noted. We were told to use such a format.
10211	6		8		ES reads really well, maybe slightly too policy perscriptive in places. Care with superlatives needed and use of words such as siginifcance [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Thank you, and we try to take the comments into account.
19316	6	1	8	16	Well written executive summary. [Marco Mazzotti, Switzerland]	Thank you.
7869	6	2	6	12	…the implementation of far-reaching, multi-level, multi-disciplinary, multi-actor and cross-country and sectoral climate mitigation and adaptation actions…. Current national pledges on mitigation and adaptation, even if fully implemented, are inadequate… The creation of broad public-private-scientific partnerships and strategic engagement with private stakeholders would be decisive to implement and go beyond current ambition cost-effectively and in a manner which is sustainable, inclusive and resilient to changed political priorities, and which maintains a solid democratic license. [Yana POPKOSTOVA, France]	Noted - Care has been taken to avoid policy prescriptive language.
5732	6	4	6	5	Better use 'sustainable development goals, instead of initiatives which are not clearly defined. [Hong Yang, Switzerland]	Reject. We have been assigned to look at sustainable development. A closer and more specific examination of the SDGs in the context of 1.5C happens in chapter 5.
12274	6	4	6	6	This first sentence sounds rather obvious to me. I hope the next draft can say something that is more concrete that adds more new insight. Although well known, the first or second unbold sentence would work better. [Jan Fuglestvedt, Norway]	Taken into account. We have strengthened the sentence to go beyond the obvious. We considered that starting with the NDC sentence without context would be too sudden.
5440	6	5	6	5	It seems more appropriate to say: .., integrated with sustainable development initiatives, facilitates the transition to a 1.5oC world. [Klaus Radunsky, Austria]	See response to 12274.
6572	6	5	6	5	Consider substituting 'can' by 'is needed'. 'Can' seems a too vague word in the present conditions, because it does not say how much it can or it cannot... A more precise and blunt statement may be required. [J. David Tabara, Spain]	See response to 12274.
1106	6	6			Meeting the temperature target does not really depend on adaptation -> delete. [Rob Swart, Netherlands]	Reject, but the reviewer is right that the sentence did not make sense. See response to comment 2227
11055	6	6	20	21	Be more specific about the expression "consistent": does this mean the necessary speed of change has been observed over longer periods of time (how long?) and larger geographical scales (where?)? [Jakob Wachsmuth, Germany]	Taken into account, this language was indeed not excessively clear. It has been revised into "have been observed historically".
2227	6	6	6	6	It needs to be clarified how pledges on adaptation influence how plausible it is that the long-term temperature target of the Paris Agreement is attained. [Kenneth Möllersten, Sweden]	Accept. "and achieve its adaptation goals" added to the sentence.
16381	6	6	6	9	I would like to suggest that the assessment needs to give an quantitative estimate of how adequate the present commitments are, namely that to achieve a maximum increase of 1.5 to 2 C, emissions of CO2 and other GHGs would need to be phased out within about two decades [or whatever the number is--but it is not very far in the future], indicating that about all that has happened to date is for emissions to stop growing--a nice first step, but a long path ahead. [Michael MacCracken, United States of America]	Noted. This question is extensively discussed in chapter 2's ES.
1025	6	7	6	8	It is described that "To strengthen the global response, national governments would need to significantly raise their level of ambition --- ". Whether or not governments would be able to raise their level of ambitions are real and serious concern. This chapter, in order to become more policy relevant, should search and refer to political ecnonomy papers discussing on this crucial point. [Mitsutsune Yamaguchi, Japan]	Taken into account - these aspects are now covered in Section 4.4.3, and also later on in the Executive Summary of the SOD
7516	6	9	6	10	Please consider to remove the quotation signs. [Øyvind Christophersen, Norway]	Editorial - changed in SOD
1107	6	9	6	11	This sentence is an obvious but also political statement-> delete. If kept, why not add for balance that also industrailized countries will have large financial and tecnological challenges? [Rob Swart, Netherlands]	Accept. Text is amended to reflect this point in the SOD executive summary
18788	6	9	6	11	The references to finance in the Executive Summary should reflect an increased emphasis on shifting both public and private finance to be compatible with low/no-carbon and climate resilient pathways. Rather than just 'support' for countries, this will involve ensuring that a wide range of investments that are not specific to climate, such as those in infrastructure, are steered so that they enable countries to pursue those pathways. For example, the findings in the report by the Global Commission on the Economy & Climate demonstrate the need for this shift. [David Waskow, United States of America]	Taken into account - Section 4.4.6 uses the GCEC report and other literature to discuss different investments. Text in the ES has been amended.
18821	6	9	6	11	The references to finance in the Executive Summary should reflect an increased emphasis on shifting both public and private finance to be compatible with low/no-carbon and climate resilient pathways. Rather than just 'support' for countries, this will involve ensuring that a wide range of investments that are not specific to climate, such as those in infrastructure, are steered so that they enable countries to pursue those pathways. For example, the findings in the report by the Global Commission on the Economy & Climate demonstrate the need for this shift. [David Waskow, United States of America]	Taken into account - Section 4.4.6 uses the GCEC report and other literature to discuss different investments. Text in the ES has been amended.
19704	6	9	6	11	Without international support developing countries, particularly the Least developed countries will not be able to implement their NDCs and pursue 1.5 pathways. See research by the Mary Robinson Foundation in box below. [Tara Shine, Ireland]	Taken into account - covered in Cross-chapter box 4.1 on NDCs and added to the Executive Summary of the SOD
16382	6	9	6	9	I would suggest there also needs to be a sentence in here about steps that developed countries must take. Perhaps even indicating that the investment of all nations needs to be comparable to the expenditures currently being devoted to national security, and this would be appropriate given the very significant threat being posed by the growing impacts of climate change. [Michael MacCracken, United States of America]	Reject. There is insufficient basis for such a statement, in the chapter nor in the peer-reviewed literature.
5441	6	11	6	11	It seems more appropriate to say: .., for which currently local, national and international resources are insufficient. [Klaus Radunsky, Austria]	Accept - Text edited to add national.
1108	6	13			What is the evidence that even 1.5 degrees requires "transformative" adaptation? This suggests the message that even under 1.5 degrees massive adaptation is required, so why boter about mitigation? [Rob Swart, Netherlands]	Taken into account. The new text gives further explanation, including that adaptation is even needed at 1C.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7517	6	13	6	13	We think it is difficult to understand what "adaptation imperatives" means. If it is the same as "adaptation needs", please substitute. [Øyvind Christophersen, Norway]	Accept. Text edited from adaptation imperatives to adaptation needs
14060	6	13	6	13	transformative adaptation' should be defined, is it the same as 'transformational adaptation', is definition consistent with other chapters? [Elvira Poloczanska, Germany]	Accept. We are now using 'transformational adaptation' which is also defined in the IPCC AR5 WGII and SR 1.5 glossary (as a sub-term of adaptation).
7573	6	13	6	14	What is transformative adaptation? [Andries Hof, Netherlands]	Accept. We are now using 'transformational adaptation' which is also defined in the IPCC AR5 WGII and SR 1.5 glossary (as a sub-term of adaptation).
7896	6	13	6	14	Transformative adaptation is never defined. See comment below on defining this term and the use of disruptive change. [Westphal Michael, United States of America]	Accept. We are now using 'transformational adaptation' which is also defined in the IPCC AR5 WGII and SR 1.5 glossary (as a sub-term of adaptation).
16383	6	13	6	14	This type of phrasing and comparison, saying adaptation will be less at 1.5 C than 2 C, is fine, but needs to be accompanied by a must stronger statement of the adaptation challenges at 1.5 C--indeed indicating that adaptation will simply not be possible to a good number of impacts at 1.5 C (e.g., preserving existing coastal boundaries and low lying islands, avoiding the impacts of significant biodiversity loss at this level of warming, shifting precipitation zones, growing risk of very extreme weather, exciting carbon and methane feedbacks, and more). The phrasing here just does not convey the risk the world is taking by allowing the global average to increase to 1.5 C, much less to stay there indefinitely as is implied in much of the analysis in this report. [Michael MacCracken, United States of America]	Accept. Text has been amended.
5733	6	13	6	19	The key messages in the bold text and the elaboration in the plain text seem to be inconsistent. Also the meaning of the bold text is not clear. [Hong Yang, Switzerland]	Taken into account - the text has been revised significantly for consistency and clear line of sight.
7870	6	13	6	20	While adaptation finance volumes have increased in quantitative terms strictly, qualitative gaps in resource distribution and effect as well as in current adaptation finance persist which in combination with ineffective monitoring mechanisms undermine transformative action. [Yana POPKOSTOVA, France]	Accept and taken into account in the ES text.
5442	6	14	6	14	It seems more appropriate to say: …on vulnerable systems and regions across the world also in a 1.5oC world. [Klaus Radunsky, Austria]	Taken into account in the revisions of this paragraph.
16384	6	15	6	15	And it might be noted that at 1 C and just current emissions, a further warming of order 0.5 C is built into the system and the changes occurring (like loss of mass from ice sheets and glaciers and associated sea level warming and rise are not nearly at equilibrium with the current atmospheric composition). This sentence just does not convey the seriousness of the situation that the world has gotten itself into. [Michael MacCracken, United States of America]	Accept. The point on 1C is included, the other points are part of the ES of chapter 3.
14061	6	17	6	17	Chap 1 also refers to community knowledge, local knowledge, traditional knowledge. Need consistency [Elvira Poloczanska, Germany]	Accept. The text has been amended to include traditional and local knowledge systems. We choose to use “indigenous knowledge” as opposed to “traditional” because of the pejorative label of “traditional” when applied to knowledge systems with its connotations of being static, unchanging, and pre-modern knowledge.
19706	6	17	6	18	Note that indigenous knowledge and community participation are also critical for mitigation. See examples of what can happen when the right to participation of local communities is not respected in mitigation action (wind, hydro, solar). Case studies available form the Human Rights and Buiness Resource Centre: https://business-humanrights.org/en/case-studies-renewable-energy [Tara Shine, Ireland]	Accept. The text has been amended to reflect the role of Indigenous knowledge systems for adaptation and mitigation.
14062	6	18	6	19	Refer here also to ‘maladaptation’ [Elvira Poloczanska, Germany]	Accept - with a reference to cross-chapter box 4.3
1109	6	19			What is the evidence that even ineffective monitoring undermines action? Can't action without monitoring be effective? [Rob Swart, Netherlands]	Noted. Of course action can be effective without monitoring, but learning and wider application, where appropriate, is less likely without it. Text revised to clarify that gaps in monitoring undermine the potential of adaptation finance to be effective.
918	6	21	4	22	I did not find this statement to be properly substantiated in the text of this Chapter. [David Infield, United Kingdom (of Great Britain and Northern Ireland)]	Noted. It is in section 4.2, but clarification is needed. See response to comment 969.
1110	6	21	6	22	This doesn't seem to be true over long time spans and large areas (e.g. global), so add "for some areas during limited periods of time"? [Rob Swart, Netherlands]	See response to 969.
20319	6	21	6	22	Statement not clear. In my view, a much more accelerated deployment of various low-carbon technologies is needed, illustrated also in section 2.3.4.1.3 "Pace of change" and Figure 2.14 in Chapter 2. [Marine Gorner, France]	Accept. See comment 969.
7574	6	21	6	22	In the main text this statement is much more nuanced; it depends on the metric used. [Andries Hof, Netherlands]	Accept. See comment 969.
2228	6	21	6	22	Since BECCS is an energy technology this statement encompassess the BECCS deployment rates found in the modelling. This report does not explicitly analyse the rates of change in CDR based on historical observations. In fact, it does not refer to any historical observations at all that are relevant to BECCS, like e.g. experiences of nuclear power deployment. [Kenneth Möllersten, Sweden]	accept. We don't intend to make statements on BECCS specifically. Text is revised to indicate it's about rates of change of emissions.
7897	6	21	6	22	The rates of change in energy technology deployment found in the modelling of emission pathways for 1.5°C are consistent with those observed historically. This is not discussed at all in Section 4.3.2. I only see mention that solar energy and onshore wind energy are on track to reach a 2°C pathway, [Westphal Michael, United States of America]	Reject. The reference for this statement is to section 4.2.2.1.
12275	6	21	6	23	The first sentence here says consistent rates, but next sentence says scale is larger - and this is an essential difference. Does this mean that the first sentence applies for some regions or sectors only? And also for shorter periods, I would think. Some clarifciations is needed here, I think. [Jan Fuglestvedt, Norway]	Accept. See comment 969.
4866	6	21	6	27	Disagree with this statement. The rate of deployment for 1.5C exceeds all previous energy transitions, factoring in the time it takes to scale up technologies and see them mature to the point of very large scale commercial uptake. This statement gives a misleading and incorrect view of the challenge ahead, as does much of Chapter 4. [Wilfried Maas, Netherlands]	Noted. We are certainly trying to give a fair and literature-based account of the challenging nature of limiting temperature rise to 1.5C. This specific statement has been softened, see also response to comment 969.
969	6	21	6	27	top line statement here seems disconnected from chapter 2, this chapter and the reality. Are these rates of change really consistent with those observed historically in a similar context and scale? [Victor Davd, United States of America]	Accept. The text has been amended to make the paragraph consistent, to clarify what is meant, and to reflect the underlying sections better.
7871	6	21	6	28	While the rates of change in energy technology deployment found in the modeling of emissions pathways for 1.5 are consistent with those observed historically, the scale of the required energy, land and urban transitions is larger and require strategic and consistent coordination across actors in a radical discordance to ad-hoc or coincidental changes observed in the past. This is critical because the success of simultaneous energy, land and urban transitions would ultimately depend on behavioral and lifestyle changes, accelerated innovation and effective policies and governance. The bottomline is that mitigation actions with the potential to stay below 1.5 C and adaptation options that allow for coping with the 1.5 C world are interlinked and this interlinkage has to be recognised across the institution, policy and governance-building entities. [Yana POPKOSTOVA, France]	Noted. We are assessing these options in the same sections for that reason in section 4.3. And we make the statement that they are related already in the ES - so not clear what precisely the suggested change is.
7068	6	22		23	Unclear meaning of "scale". Geographical, as that actions are needed globally? [Érika Mata, Sweden]	Accept. "Geographical and economic" added.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16385	6	23	6	23	Saying "is larger" seems like a significant understatement. To stay below 1.5 C likely requires going to zero fossil fuel emissions within a couple of decades, and that would require changing over of order the source of supply for 80% of global energy. Suggesting this is just larger thus hardly conveys the magnitude of the change that is needed. [Michael MacCracken, United States of America]	Reject. The point that the change made - e.g., from 100% sailing ships to almost 100% motorised ships for international freight traffic - has been shown before, but the point here is that the size of the system (amount of people, buildings, industrial production installations, economic value) is much greater.
14990	6	23	6	23	is larger -- how much larger? Can we use more a more consistent descriptor here in IPCC terms, e.g., likelihoods? [Farhan Akhtar, United States of America]	Reject. Although we accept that it's desirable to elaborate on this, the answer is not easily given in the limited space we have in the ES.
16386	6	24	6	26	I'm confused by the objective--is it not just staying below 1.5 C and, given the level of impacts at 1.5 C, returning back to less than about 0.5 C? Yet this sentence also talks about staying at 1.5 C, a level it really makes no sense to sustain. In addition, is it not the case that if we are able to do enough to stay under 1.5 C, the implications of doing this will then pull the temperature back down to below 1.5 C over time unless actions are taken to sustain that level of warming, which would make no sense. The rate at which the temperature drops may then be faster or slower depending on whether Carbon Dioxide Removal is enhanced or not. [Michael MacCracken, United States of America]	Taken into account. Most pathways show overshoot - so adaptation for 1.5C would be necessary. We have now also included the point that adaptation at 1C is necessary too.
1111	6	29			Which "the" energy transition. The required energy transition? [Rob Swart, Netherlands]	Noted. This is explained in the paragraph and paragraphs that follow.
7519	6	29	6	29	Jurisdictions in this sentence might be challenging to understand. Is it an option to delete jurisdictions around the world, or replace it with systems? [Øyvind Christophersen, Norway]	Accept. Text amended to regions instead of jurisdictions
7872	6	29	6	31	The energy transition is taking place in many sectors and jurisdictions across the world at various speeds and intensity, but the pace in energy-intensive industries, waste management and international transport is progressing at a slower pace overall. [Yana POPKOSTOVA, France]	Reject. Not sure how this edit would improve things
7518	6	29	6	36	Please consider to list the "many sectors" the first sentence refer to in which energy transition already "is taking place". The paragraph gives examples of reneweable energy production "systems" where transformation "seems to be underway", and compare these with sectors like Industry, Buildings, Transport and Waste where the transition is hampered by barriers. Please consider whether these differences in terms used are intentional. [Øyvind Christophersen, Norway]	Accept. While this section talks to the electricity sector, as the reviewer mentions, we accommodate this a few paragraphs down, in the urban section which talks about households and transport.
3692	6	30	6	31	Seems to mix together two changes that are different: wind and PV are already at price parity; energy storage still needs to come down significantly in price. Consider a separate sentence for energy storage; or find another phrasing [Harald Winkler, South Africa]	Accept. Text revised to differentiate this better.
14243	6	31	6	31	“In solar energy, wind energy and energy storage systems, a transformation seems to be underway.” China has been adding a tremendous amount of capacity to their grid. China has been planning a tremendous amount of nuclear power plants in the coming decades which is also a transformation worthy of mention in this report. [Jason Donev, Canada]	Reject. Although some countries have been adding some nuclear capacity, the current cost developments and capacity additions of nuclear cannot possibly be compared to those of wind and solar PV.
14063	6	34	6	34	And cultural – industries have cultures, values influence organsational decisión making [Elvira Poloczanska, Germany]	Reject. This is much less the case in industry compared to e.g. buildings and transport. At least, not aware of literature on this.
19289	6	34	6	35	It would be interesting to explicit the nature of barriers in the buildings sector in the Executive Summary [Charlotte Vailles, France]	See response to comment 19070
19070	6	34	6	35	Specify what kind of barriers buildin sector faces (technical, social, economic, infrastructure, whatever) [Miriam Solera Ureña, Germany]	Noted. This is discussed in the next paragraphs.
996	6	35			Add the word "current" after "but" to read "but current barriers prevent this transformation". [Stephen Wiel, United States of America]	Noted. Comment became obsolete after moving text to urban section in ES and changing text.
14064	6	35	6	35	What barriers? This statement is rather vague. [Elvira Poloczanska, Germany]	Accept. Statement removed. Discussed on buildings moved to urban section.
1112	6	38			could-> "can" [Rob Swart, Netherlands]	Accept. Text changed.
7069	6	38			If I remember correctly, the role(/need of) of changing behavior was presented as uncertain in Chapter 3 (which I found surprising) [Érika Mata, Sweden]	Noted, will be checked with chapter 3. There is ample evidence in chapter 4 that changes in behaviour are needed across the board
7873	6	38	6	40	Global land use transitions, in combination with changes in behavior, could enhance future mitigation. It is crucial to manage the process according to strict rules and guidelines to avoid agriculture and forest systems change that could prove adversarial to the overall ecosystem health, potentially causing critical food, water and livelihood security challenges, [Yana POPKOSTOVA, France]	Reject. This would make the text prescriptive.
14065	6	41	6	41	The term ecosystem health is debatable suggest ecosystem integrity and functioning including loss of species [Elvira Poloczanska, Germany]	Accept (partially), the term ecosystem health was substitute by ecosystem equilibrium.
2736	6	41	6	44	Recommend re-phrasing so as to avoid the impression that adaptation and mitigation arealways two discrete processes. On the ground, they are often part of the same development intervention. Ecosystem-based adaptation in particular very often combines adaptation and mitigation. This necessary integration, increasingly although inadequately recognised in the literature, could usefully be threaded throughout the chapter. [Penny Urquhart, South Africa]	Accept. The SOD includes a section in the ES that explicitly goes into combining mitigation and adaptation options and their pros and cons.
11459	6	44	6	45	Consumer behaviour is one of a number of factors that influence meat consumption. [Stewart Lockie, Australia]	Noted. Text revised to say "diets". An assessment of factors that drive diets was regarded as outside of the scope of the report.
12276	6	44	6	45	Is it possible to be a bit more specific here and not so general saying changes may reduce the pressure? [Jan Fuglestvedt, Norway]	Accept (partially). Text on behavioural change specified. Pressure on land is clear enough, we feel.
4790	6	45	6	45	reduce pressure, yes, but also replace pressure by other burdens on the environment due to more (and more intensive) agriculture [Marcel Wissenburg, Netherlands]	Accept, "sustainable intensification" added as a qualification to this statement.
997	6	47		55	Move this paragraph about local and regional governments to line 13 so that it follows immediately after national governments. That way those of us who are focused on coordination/harmonization/integration among government levels won't think you're overly focused on national governments. [Stephen Wiel, United States of America]	Taken into account. In a revision of the ES outline, we moved the paragraph on governance up. Multi-level governance is emphasised in this paragraph.
7898	6	47	6	48	Rapid, systemic transitions in urban areas will be a defining element in an accelerated transition to a 1.5 degree world. In general, the chapter lacks specificity on urban adaptation and mitigation actions, specially in terms of buildings. See below. [Westphal Michael, United States of America]	Accept - the text in Section 4.3.4 has been edited significantly with clear contributions to urban adaptation and mitigation action. Sections 4.3.4.2 and 4.3.4.5 discuss buildings in detail. Also see Section 4.3.6 which has sections on building codes.
7875	6	47	6	49	Given the growing urbanization tendencies, rapid, systemic transitions in urban areas will be a defining element in an accelerated transitions to a 1.5C world. [Yana POPKOSTOVA, France]	Reject. Addition not needed for the point (we are very limited on words)
3982	6	49			led by local and regional governments that are aligned' and supported by national government too …(need all levels of government working together) [Barbara Norman, Australia]	Accept. Text amended to add 'supported by national governments'.
998	6	50			Add the words "and reduce urban heat islands" after the words "to alter urban form". [Stephen Wiel, United States of America]	Accept. Have amended text to add 'and reduce urban heat islands' (though this is moved to a combined mitigation/adaptation paragraph in the ES.
6723	6	52	6	52	We are all part of Nature and all hold a stake in its future. We can not assume Nature, water, land air etc to be resources and services. Nature and “ecosystems” should be protected for its intrinsic value. [Jennifer Morgan, Netherlands]	Taken into account, though the comment can be seen as prescribing a vision of nature that may not be shared universally. In any case, the text is changed to focus on adaptation options more and less on the general statement.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7874	6	55	6	55	…be overcome. {4.3.4} The Food-Energy-Water nexus issue should increasingly be considered as such, a nexus, and water, energy and water management integrated, thereof moving away from siloed and patchy approaches to governance in these sectors to a holistically integrated Food-Energy-Water collective strategy that builds management and governance methodologies and tools from a paradigm of compliance with the decarbonisation, SDGs and 1.5 pathway ambitions. Only an integrated FEW governance through a prism of 1.5C pathway could bolster a workable and effective energy transition governance framework. [Yana POPKOSTOVA, France]	Reject the addition because of prescriptive language, absence of a clear reference for this in the chapter, and lack of space.
10212	7	1	7	12	Regulation on balck carbon could curb BC without transformation - so don't get last part of bold bullett. Also unrivallad too strong as cutting Nox and SO2 might be just as helpful [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. The point is that if the transitions in 4.3 succeed - and they are all needed for 1.5C - SLCP would be reduced automatically.
4872	7	1	7	13	Include a separate key message on the dependence on rapid start of the CCS industry , given its role for Fossil CCS and BECCS in the 1.5 scenarios. [Wilfried Maas, Netherlands]	Accept (partially). Sentence on CCS included in the paragraph on energy transition (which is the section where CCS is discussed). However, the point that BECCS depends on it is not made specifically - constraints for its feasibility are named.
19290	7	1	7	13	I am not sure to understand the structure of this paragraph : why are measures to reduce short-lived pollutants and options to remove the CO2 from the atmosphere presented together? [Charlotte Vailles, France]	Accept. Separated in the new version.
4791	7	1	7	13	This bit (part. Lines 6-7) fails to take into account that for some countries the benefits of cooperation may be (far) outweighed by the benefits of the actions contributing to emission of CO2 and other climate pollutants; some countries simply habe no interest in climate control. [Marcel Wissenburg, Netherlands]	Noted. Fair point, but this paragraph is not about the political economy of climate change mitigation. This picture, by the way, seems to be shifting somewhat as impacts are becoming firmer and more widespread.
11460	7	1	7	13	There is a degree of repetition in this paragraph. Rather than repeating generic observations (i.e. that there are contraints), be specific. List the primary opportunities to remove CO2 and identify the main constraints. [Stewart Lockie, Australia]	Accept. In the new paragraph this is done more explicitly. But space is limited.
16387	7	1	7	2	I would suggest that there are new, potentially cost-effective (relative to incremental impact costs) approaches emerging for removing CO2 from the atmosphere that could be significantly scaled up. For this reason, I'd suggest that at least the major constraints measured here be enumerated in the sentence--and perhaps some indications of prospects be listed. [Michael MacCracken, United States of America]	Taken into account. The non-bold text in this paragraph does exactly that. Unfortunately in the ES, we don't have too much room to go into more detail.
970	7	1	7	4	would be useful to disentangle the findings on CDR from those on SLCPs. And given the HUGE attention to CDR (BECCS notably) in chapter 2 to have just a single sentence on this option seems too thin. There is a big literature on feasibilty under 2 degree scenarios; that should be addressed here or in chapter 2, with governance here. [Victor Davd, United States of America]	Accept. CDR and SLCPs separated. In the paragraph on CDR, all that we feel should be said on CDR is said.
7520	7	2	7	8	Please consider moving the description of SLCFs to a separate paragraphe as it does not seem to fit here where you talk about net CO2. Also please do not refer to report chapters in headline statements. [Øyvind Christophersen, Norway]	Accept. Paragraphs moved.
7521	7	3	7	3	Please make sure that near term climate forcers are named the same way throughout the report. We think it is the first time that we have heard mentionging about SLCPs in an IPCC report, so a definition is recommended. [Øyvind Christophersen, Norway]	Taken into account. Definition (and distinction from SLCFs) is given in section 4.3.7.
5916	7	3	7	4	Suggest changing the sentence to "As a consequence measures to reduce short-lived climate pollutants (SLCPs) must be implemented." [Aage Stangeland, Norway]	Reject. This is not only a prescriptive statement, it changes the meaning.
7876	7	3	7	4	Measures to reduce SLCPs will be conditional on the success of the land, energy and urban transitions. [Yana POPKOSTOVA, France]	Reject. This is not a true statement - there can be separate measures to reduce SLCPs.
18789	7	3	7	8	The discussion of SLCPs in the Executive Symmary should be separated from the discussion of net removal of CO2. [David Waskow, United States of America]	Accept. This is implemented.
18790	7	3	7	8	The discussion of SLCPs in the Executive Symmary should address the role of SLCPs in driving temperature past the 1.5C threshold in the near-term and the options for addressing those pollutants. [David Waskow, United States of America]	Reject. Most of what this comment asks for is done in chapter 2. The options are in this chapter and are discussed in section 4.3.7.
18822	7	3	7	8	The discussion of SLCPs in the Executive Symmary should be separated from the discussion of net removal of CO2. [David Waskow, United States of America]	Accept. This is implemented.
18823	7	3	7	8	The discussion of SLCPs in the Executive Symmary should address the role of SLCPs in driving temperature past the 1.5C threshold in the near-term and the options for addressing those pollutants. [David Waskow, United States of America]	Reject. Most of what this comment asks for is done in chapter 2. The options are in this chapter and are discussed in section 4.3.7.
3693	7	4	7	6	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, but because of an omission on our side, this was not implemented in the SOD. We will take this into account into the following rounds.
16388	7	5	7	5	Do you really mean "fast emissions reductions" or instead "a fast response to emissions reductions" due to their relatively short atmospheric lifetimes [Michael MacCracken, United States of America]	See response to 12277.
12277	7	5	7	5	Re "fast emission reductions": Do you mean easy and quick to implement? If so, say that clearly (since it is often pointed to fast responses in the atmosphere when SLCF mitigation is discussed). [Jan Fuglestvedt, Norway]	Accept, but because of an omission on our side, this was not implemented in the SOD. We will take this into account into the following rounds.
6196	7	6	7	6	too strong a claim here really about political feasibility. Suggest changing to 'may enhance'. It is possible that producing such other benefits might improve the support for climate policy, but there are plenty of counter-examples, such as the current problem over urban air quality in the UK which is the result of an earlier generation of climate policy triggering shifts from petrol to diesel. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accept, but because of an omission on our side, this was not implemented in the SOD. We will take this into account into the following rounds.
11056	7	7	11	13	Mention risks and benefits, e.g. by saying "[...] the need to considered, both with regard to their potential and with regard to their sustainability impacts." [Jakob Wachsmuth, Germany]	Accept, risks and impacts are addressed explicitly in the SOD ES.
2737	7	8	7	10	Are these indeed technically feasible at the scale required? This is not an area of expertise of mine, but I have read publications suggesting the opposite, or that we do not yet know enough to state this, e.g. Larkin et al 2017 [Penny Urquhart, South Africa]	Noted. They are considered technically feasible but we note lots of other constraints that affect the scale.
21172	7	8	7	10	broaden AR to include ecosystemrestoration more generally [David Cooper, Canada]	Reject. We base this statement on the outcomes of the modelling in chapter 2, which takes into account AR but not ecosystem restoration.
15687	7	8	7	13	BECCS is not proven to be technically feasible. See http://www.biofuelwatch.org.uk/2016/beccs-report-hbf/ [Elenita Daño, Philippines]	Reject. We are not saying that it's 'proven' technically feasible. The reference provided is not a peer-reviewed source.
15688	7	8	7	13	None the mentioned options "NEED" to be considered.There are many other options,and all these are just unproven theoretical technological technofixes [Elenita Daño, Philippines]	Accept. Prescriptive language is revised.
15440	7	8	7	13	BECCS is not proven to be technically feasible. See http://www.biofuelwatch.org.uk/2016/beccs-report-hbf/ [Elenita Daño, Philippines]	Reject. We are not saying that it's 'proven' technically feasible. The reference provided is not a peer-reviewed source.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14118	7	9	7	9	Please use another acronym than AR, which is assessment report in the IPCC context [Elvira Poloczanska, Germany]	Taken into account –to repair this, the convention was adopted to use AR – when standing for Assessment Report – only in conjunction with the number of the report, i.e. in the former section 4.3.6 "AR5". We hope this avoids the confusion validly pointed out here. We also don't refer to the abbreviations in the ES.
16389	7	11	7	11	With respect to "seem high"--with respect to what. Yes, much less expensive now to reduce emissions, but as the costs of those rise and the costs of impacts increase, at what point does high changeover to feasible? [Michael MacCracken, United States of America]	Accept. See comment 15645
19317	7	11	7	11	I suggest calling it DACCS: Direct Air Capture with Carbon dioxide Storage [Marco Mazzotti, Switzerland]	Noted. Abbreviation removed here. We are using both DACS and DACCS in the report (see Glossary in SOD).
7877	7	11	7	11	…costs of direct air capture and storage remain high. [Yana POPKOSTOVA, France]	Noted. Text amended which makes this comment obsolete.
9459	7	11	7	11	Say (DACCS) no (DACS) and add 'carbon' for direct air carbon capture and storage. So it will be easy to grasp that it is associated with CCS. There are different categories of CCS : fossil CCS, industry CCS (terminologies used in Chapter 2, BECCS and DACCS, depending on where the CO2 is captured from. [Isabelle Czernichowski-Lauriol, France]	Noted. Abbreviation removed here.
19291	7	11	7	13	The statement "need to be considered" could be specified. [Charlotte Vailles, France]	Taken into account. This statement is prescriptive and was removed.
21173	7	11	7	13	need to distinquish between (SCS, blue carbon) and ocean fertilization. The latter is regulated by international law London convention. [David Cooper, Canada]	Noted. Text revised makes this comment obsolete.
18693	7	12	7	12	What is ocean weathering? [Wilfran Moufouma Okia, France]	Taken into account. Amended to remove ocean weathering and only keep terrestrial weathering. See chapter for explanation (4.3.8)
543	7	13	7	13	…need to be considered. I would suggest to change to "…are options but have side effects as well. For example, biochar results in air pollution so creates a health problem. [Mark Jacobson, United States of America]	Accept, text revised significantly to take into account this and other comments.
7878	7	13	7	13	…ocean iron fertilization, and other greenhouse gas removal (GGR) techniques need to be evaluated, {4.3.6} [Yana POPKOSTOVA, France]	Noted. Text amended which makes this comment obsolete.
12279	7	15		15	I feel the word "concern" is not precise enough. I think you may need to use a few more words here; e.g. something along the lines of "broad set of challenges related to ethics and governance". [Jan Fuglestvedt, Norway]	Accept. We agree and have amended the text to "The uncertainties surrounding various solar radiation management measures, hereafter called radiation modification measures (RMMs), including technological immaturity, lack of physical understanding, efficiency to limit global warming, and ability to scale, govern and legitimise, constrain their responsible implementation."
9687	7	15	7	15	This paragraph confuses uncertainty with concern. We could interpret the GeoMIP model results as showing that the uncertainty level is rather low for low-deployment scenarios. On the other hand, people are concerned about slightest deployment of SRM. [Masahiro Sugiyama, Japan]	Accept - We agree and have amended the text to "The uncertainties surrounding various solar radiation management measures, hereafter called radiation modification measures (RMMs), including technological immaturity, lack of physical understanding, efficiency to limit global warming, and ability to scale, govern and legitimise, constrain their responsible implementation." However, it should also be said that modelling results are not a guarantee for effectiveness.
20490	7	15	7	18	In Chapter 3 SAI is used for Statospheric Aerosol Injection, not aerosols injection; that is the more normal usage. More importantly, there are various strong statements in this paragraoh which are not evidenced (it is also, oddly, the only para in the executive summary that does not reference specific parts of the chapter as the foundation for its assertions). It seems a priori unlikely that SAI could not compensate for part of the temperature rise: all studies show SRM having some negative effect on temperature. Regardless of whether it could in principle do so, it is unnecessary, indeed verging on irrelevant, to ask whether SRM could compensate for all the temperature rise: no-one is suggesting that it should. Current discussions of SRM by people who might be seen as proponents universally stresses the need for it to complement, not replace, emissions reduction. It is true that there are concerns about research in SRM (of which there is, as it happens, very little) diverting political attention. There are also concerns about the level of research into SRM being insufficient (see eg Shepherd 2009). Without any attempt to assess the relative merits of these concerns, why include one set but not the other? It is true there are moral hazard issues surrounding SRM; but there are also moral hazard issues with CDR (see Geden 2015; also my comment on Chapter 2 page x line x above). Again, why highlight one not the other? While it seems likely that wide implementation of SRM would be "controversial for reasons of justice, equity and ethics" it is a leap to say this is necessarily the case – an implementation explicitly designed with issues of justice, equity and ethics to the fore, and which satisfied such requirements, is not necessarily impossible. And the idea that a country might, through doing something, "inflict harmful impacts on other geographies" does not make doing that thing "socially infeasible". It may make it morally indefensible, and it will also make it problematic and probably destabilizing in terms of international relations. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Accept. See responses to comments 10213 and 3068. For the other parts, text has been revised.
4395	7	15	7	18	This is not true. While no question there are many issues, the analogy with large volcanic eruptions gives essentially 100% certainty that SAI could reduce global mean temperatures by at least some amount. Agree that conclusion is unclear for MCB. [Douglas MacMartin, United States of America]	Accept. See response to comment 10213
1028	7	15	7	22	By reading this paragraph, authors seem to stress the controversy of SRM. I share the same view. It should be treated with caution. However, as discussed in Box 4.12 in pp. 81-85, current NDCs are not on track to 1.5 (and even) 2 degree target. If exceeding these threshold is deemed to be "dangerous" in the context of the article 2 of the UNFCCC, we have to avoid those situations by all means. Here we have to compare risk of climate change exceeding 1.5 or 2 degree and still unknown risks of SRM. This risk-risk trade-off way of thinking whould be inserted here. [Mitsutsune Yamaguchi, Japan]	Noted. It goes too far to discuss this in the ES, but we will take it into account in the x-chapter box.
5444	7	15	7	22	It seems important to mention also risks associated with SRM including the need to deploy it for the lifetime of CO2 in the atmosphere - which is in the range of several millenia. It would be important to stress that the IPCC made a focus on those scenarios that make sense in the context of a risk management approach. Therefore, scenarios that address climate change risks but enhance other risks in an uncontrollable manner, had not been fiurther considered. The usefulness and adequacy of a risk management approach has already been communicated in AR4 and AR5. [Klaus Radunsky, Austria]	Accept. Point taken into account in the new paragraph.
11862	7	15	7	22	The paragraph on SRM in the Executive Summary could be clearer. For instance, is it saying that SRM could not compensate for temperature rise as a technical matter (which seems false, at least for moderate temperature increases), or that it would face social feasibility constraints in doing so (which seems true)? And the explanation of the moral hazard could be clearer. [David Morrow, United States of America]	Accept. Paragraph is revised completely, though the point on moral hazard is actually contested and therefore not included here.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
3694	7	15	7	22	Suggest that governance challenges posed by SRM are added in this para. I see the next para goes into governance, but there are specific challenges of SRM - which your last sentence hints at [Harald Winkler, South Africa]	Accept - We agree and have amended the text to "The uncertainties surrounding various solar radiation management measures, hereafter called radiation modification measures (RMMs), including technological immaturity, lack of physical understanding, efficiency to limit global warming, and ability to scale, govern and legitimise, constrain their responsible implementation."
10213	7	15	7	22	Why can't SRM account for all temp rise and what temperture rise do you refer to - I think SAI of mirrors can go to high Wm-2 [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Text revised to modify this statement.
752	7	15	7	22	There is no forward citations for this paragraph {???} missing which is discussed in Box 4.13 and section 4.3.7 [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Apologies for the omission to refer to the appropriate sections. Done in the SOD.
19707	7	15	7	22	Explain why there is a particular focus on SRM. [Tara Shine, Ireland]	Noted. SRM is only one of the many paragraphs in this chapter and is therefore represented in the ES. We have in the SOD reduced the emphasis by shortening the text in both the chapter and the x-cutting box.
3068	7	15	7	22	Strong opinions are voiced about SRM in the summary without supporting chapters/sections for reference. I suggest you reference 4.3.7 and espcially box 4.13. especially regards to ocean acidification and potential ozone damage [Christopher Bataille, Canada]	Accept. Apologies for the omission to refer to the appropriate sections. Done in the SOD.
18694	7	17	7	17	aerosol injection [Wilfran Moufouma Okia, France]	Accept. Term has been removed from the ES.
4396	7	18	7	18	What planned research is being referred to here? (Is there any?) [Douglas MacMartin, United States of America]	Taken into account. Statement removed.
7879	7	18	7	20	…temperature rise. SRM could potentially also divert political attention away from conventional mitigation, and thus create a moral hazard around accelerating implementation of mitigation options and create controversy for reasons of justice, equity and ethics. [Yana POPKOSTOVA, France]	Reject. See responses to e.g. comment 15648.
16392	7	18	7	20	This statement is quite one-sided--there have also been a number of studies showing no effect and even that the propsect of SRM might help to drive greater mitigation. In that the level of warming that would really help to moderate major impacts is likely roughly 0.5 C so that we are already over it, there is a need in my view to be taking all actions possible to get back to a lower temperature increase in order to avoid a range of irreversible changes and commitments to long-term sea level rise, etc. In any case, the real question is whether using SRM to counteract the overshooting of a particular temperature level would lead to a better or worse outcome than without SRM. Much of current research has been focused on using SRM as a sudden, emergency response to very large and unacceptable outcomes whereas what would make much more sense to be gradually ramping up SRM to limit future warming and gradually pull back toward below 0.5 C, phasing it out as not only emissions come down but as CDR is phased up to remove the excess CO2 that has been emitted. [Michael MacCracken, United States of America]	Taken into account. Text in ES is significantly shortened and this statement is removed.
16390	7	20	7	21	This sentence seems quite problematic. The question that I think is appropriate to be assessed is whether the world's nations would be better off having the GHG effect without SRM versus the GHG effect partially offset by SRM. How is that the GHG effect alone would not raise much greater issues of "justice, equity and ethics" that for GHG with SRM, given that virtually all plausible SRM implementations bring the climate departures back toward the baseline, unperturbed situation. All SRM researchers favor as much mitigation as possible and generally view SRM as a supplement to and not a substitute for mitigation, and use of SRM as a way to shave off potential overshoots of temperature levels that are causing unacceptable impacts (this report seems to consider that level as 1.5 C; considering the temperature increase above which quite serious impacts became evident or were committed to, a level of about 0.5 C would seem a more appropriate choice (as Hansen et al. have documented). So, with SRM bringing the climate back toward its present or earlier state, generally within the range of current natural variability, how is this a worse situation than allowing GHGs to take the temperature to well above the level where there are severe impacts occurring? I just do not accept this explanation. [Michael MacCracken, United States of America]	Accept. Text revised as it is prescriptive.
919	7	20	7	21	It is also environmentally risky. [David Infield, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Text added.
14066	7	21	7	21	ALL options have ethical implications, not just SRM. This is not stated in Executive Summary [Elvira Poloczanska, Germany]	Accept. Text has been revised to balance this as the literature on ethics around SRM is so strong that it needs to be reflected in the ES
12278	7	21	7	21	I think "governance" should be mentioned here as well. [Jan Fuglestvedt, Norway]	Accepted - We agree and have amended the text to "The uncertainties surrounding various solar radiation management measures, hereafter called radiation modification measures (RMMs), including technological immaturity, lack of physical understanding, efficiency to limit global warming, and ability to scale, govern and legitimise, constrain their responsible implementation."
16391	7	21	7	22	This sentence is not only quite speculative, but not at all clearly the case. As the IPCC radiative forcing approach suggests, reducing the radiative forcing over any significant region (such as via sulfate aerosols, tropospheric ozone) has a tendency to reduce overall global warming, which would be likely to be beneficial to all (given that warming is generally deleterious to everyone). If some particular country wants to make the effort to cool the global climate, how would this be seriously harmful to others. Now, it could be that a nation might try to exert a regional influence to favor only its region, but it is interesting that this report does not recognize that such regional influences are even possible (were they to be doing this, then we could be researching the potential to moderate regional impacts as I have suggested in a paper (see, for example, MacCracken, M.C., 2016: The rationale for accelerating regionally focused climate intervention research, Earth's Future 4, 649-657, doi:10.1002/2016EF000450). I just do not see how this statement can thus be justified, much as unilateral action would be far less preferable to multilaterally planned actions. [Michael MacCracken, United States of America]	Reject. It is uncertain whether such an intervention would be beneficial to all. Moreover, in defence of the sentence, it does not say that the unilateral action would be done in order to inflict harm on others. In any case, the sentence is removed in the next version.
21174	7	21	7	22	and geopolitivally infeasible [David Cooper, Canada]	Taken into account. We are referring to the ability to govern in the chapeau of the new para on SRM.
9688	7	21	7	22	Moriyama et al. (2016) (cited in the main text) show that it is rather difficult for stakeholders to conduct SRM unilaterally (but it still is easy for major powers to do it unilaterally). [Masahiro Sugiyama, Japan]	Accept. Text on unilateral action is removed.
1113	7	22			This sentence contradicts itself. If a single country can act, it is not infeasible in any way. Maybe undesirable for other countries. [Rob Swart, Netherlands]	Accept. Sentence removed.
12301	7	22	7	22	I suggest inserting "and politically" before "infeasible". [Jan Fuglestvedt, Norway]	Taken into account. In the assessment framework, we include political feasibility under institutional feasibility. This is the term that is mentioned in the ES of the SOD.
5443	7	22	7	22	It is suggested to substitute "geographies" by "regions". [Klaus Radunsky, Austria]	Noted. This sentence has been edited out, making this comment obsolete.
7880	7	22	7	22	The last sentence is very important and an additional phrase is needed here in the executive summary and at least a paragraph in the extended text below on why self-interest-driven action could impact adversely other geographies - how it will be done; why; the statement needs to be supplanted by arguments and facts, otherwise it stays there completely unscientifically-wise. [Yana POPKOSTOVA, France]	Noted. We have removed this sentence although we have retained the potential social infeasibility.
14067	7	22	7	22	Socially unacceptable, rather than 'infeasible'? [Elvira Poloczanska, Germany]	Reject. We use the social feasibility as a term in our feasibility assessment framework.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7640	7	24			Political leadreship has multiple effects inlcuding influencing government climate policies and influencing public attitudes to climate change. This point is present in the existing draft, to a great extent, but could be added here. Further evidence for this is suggested for the main body of the report in my subsequent comments. [Conor Little, Denmark]	Accept. This point is made in the SOD ES.
10214	7	24	7	24	Must? Really to policy preceriptive ? [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Revised to may.
12280	7	24	7	24	1.5 C consistent world is not precise; although I think I understand what you mean. Would be good with an improved wording. [Jan Fuglestvedt, Norway]	Accept. Text changed in SOD ES (1.5 compatible)
7881	7	24	7	25	Governance in a 1.5C consistent world must be able to create an enabling environment for policy and technology options, scientific innovation and commercialisation, behavioral changes and innovation, [Yana POPKOSTOVA, France]	Noted. The addition is already implied in "innovation".
20246	7	24	7	28	My comments below will address the knowledge gap between the authors of this report and the public. My focus is on how the golobal museums sector comprising 55 000 museums in 202 countries can conribute to faciitating greater public awarenss and improved education. [Morien Rees, Norway]	Noted
18695	7	24	7	30	Sounds policy presepctive - use of the word should [Wilfran Moufouma Okia, France]	Accept, see response to comment 12280.
18792	7	24	7	30	Coordinated sectoral policies should also include the incorporation and integration of the Sustainable Development Goals as part of the coordination and coherence required in order to achieve the necessary enabling environment, particularly for SPS1 referrerd to in Chapter 2 of the 1.5C Special Report. [David Waskow, United States of America]	Noted - Taken into account in Ch 5
18825	7	24	7	30	Coordinated sectoral policies should also include the incorporation and integration of the Sustainable Development Goals as part of the coordination and coherence required in order to achieve the necessary enabling environment, particularly for SPS1 referrerd to in Chapter 2 of the 1.5C Special Report. [David Waskow, United States of America]	Noted - Taken into account in Ch 5
14991	7	24	7	30	Would be helpful here to bring in private sector component, e.g., role of governance in facilitating private sector action, role of private sector in utilizing/implementing governance mechanisms [Farhan Akhtar, United States of America]	Accept. We have included a reference to non-state actors and refer to industry.
19708	7	24	7	30	The application of a rights based approach and rights informed climate action is missing. [Tara Shine, Ireland]	Noted. This is addressed in Chapter 5.
6197	7	26	7	26	This may be discussed explicitly below, but what the term 'accountable multilevel governance' means is far from obvious. Part of the point of thinking about governance in multilevel terms is that it highlights that there is neither a single site of governance, nor a single community to which such governance might be held 'accountable' [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The term is retained (and further elaborated) because 4.4.3 (in the SOD 4.4.1) argues that some degree of accountability is needed, especially in 1.5C contexts. The enhanced need for accelerated action requires activity and hence multilevel governance at all scales that is both responsive and accountable
6573	7	26	7	26	Consider replacing 'sectoral policies' by 'cross-sectoral', as otherwise this seems to be at odds with the first line of the executive summary where 'cross-sectoral' is mentioned. And in fact the main barrier to transformative climate action is precisely the fact that present policies do not take advantage of cross-sectoral synergies. [J. David Tabara, Spain]	Accept. Cross-sectoral is added to the text.
1114	7	30			The last sentence of this paragraph is important and may deserve more elaboration to avoid a framing of the summary that governments have the main role in meeting low-emissions targets. [Rob Swart, Netherlands]	Accept. It is elevated to the start of the paragraph and further elaborated.
7882	7	30	7	32	…also be realized, including cost-effective and tailored strategies for implementable and enforceable mechanisms that forge international agreements and targets. {4.4.1; 4.4.3} Non-state actors, including industry, civil society and scientific institutes play a key role in the governance mechanisms, a role that should be recognized in the conception of those mechanisms to increase ownership of and engagement with their implementation and enforcement post-factum, [Yana POPKOSTOVA, France]	Accept (partially). Text added: "including industry, civil society and scientific institutions' to the multi-level governance part.
5445	7	32	7	32	It is suggested to substitute "numerous" by "some" given the small number of such examples compared to the huge task ahead of us. [Klaus Radunsky, Austria]	Accept. Text change to 'multiple'
19292	7	32	7	32	Isn't "numerous" slightly strong? [Charlotte Vailles, France]	Accept. Text change to 'multiple'
14068	7	32	7	32	Examples of societies? Or does it refer to institutional arrangements (line 36)? [Elvira Poloczanska, Germany]	Noted. It refers more to "communities". This was not modified in the text because countries are less like communities than societies.
7575	7	32	7	33	I am wondering how current examples can illustrate that achieving 1.5 degrees is possible. I have the feeling very bold assumptions regarding upscaling need to be made here. [Andries Hof, Netherlands]	Taken into account. The text does not state that examples demonstrate that 1.5C is achievable, just that 1.5C-compatible societies are possible. We have however nuanced the text in the SOD around this statement to make it less 1.5C-specific.
5734	7	32	7	35	The statement is long and the meaning is not very clear. [Hong Yang, Switzerland]	Taken into account. The text is revised, to make it clearer.
10907	7	32	7	41	This is the most important paragraph and should actually be first in the summary, instead of the « politically correct » but unreadable first paragraph of page 6 summary. [Beat Brunner, Switzerland]	Taken into account. A modified version of this paragraph is the second paragraph of the ES in the SOD.
544	7	33	7	34	At the same time, very few cities, countries, businesses or communities are truly in line with 1.5C. This is not true. Over 35 cities in North America alone have committed to 100% clean, renewable energy (http://www.sierraclub.org/ready-for-100/cities-ready-for-100) as have over 100 major businesses worldwide (there100.org) and numerous communities (thesolutionsproject.org; 100.org) [Mark Jacobson, United States of America]	Reject. The statement is about what is currently happening, not what cities aspire to deliver.
2738	7	33	7	34	Not sure why cities are singled out here - what about rural areas? Regions? Rural-urban linkages? Etc [Penny Urquhart, South Africa]	Accept - Text amended to include regions (which cover rural areas).
3695	7	34			Does not make sense for any entity smaller than the global community to be "truly in line" with 1.5 °C or any other temperature goal. Temperatue increase is a function of global cumulative emissions (at least approximately). Whether smaller entities are doing their 'fair share' depends on allocation of effort, equity, etc. Suggest rephrasing [Harald Winkler, South Africa]	Reject. Bottom-up processes and multi-level governance are emerging as mechanisms to strengthen the global response to both adaptation & mitigation. It is not about "fair shares" necessarily, but more about individual examples that can serve as role models, taking into account different contexts.
16393	7	34	7	34	I would urge changing "Increased ambition" to "Greatly increased ambition" to reflect more accurately how much greater ambition is really needed--virtually all nations and cities of the world are not even close to doing enough. [Michael MacCracken, United States of America]	Reject. Using words like "greatly" can be perceived as prescriptive. The difference between "increased" and "greatly increased" ambition is not clear.
19709	7	36	7	37	In legal frameworks make specific reference to human rights law. For an overview see the International Bar Association Achieving Justice and Human Rights in an Era of Climate Disruption. Online at https://www.ibanet.org/PresidentialTaskForceClimateChangeJustice2014Report.aspx [Tara Shine, Ireland]	Reject. Reference is not peer-reviewed and there is no basis for such a statement in the chapter.
999	7	37			Add the words "alignment of governments and business and industry," after "equity-enhancing financial institutions,". [Stephen Wiel, United States of America]	Accept - Text amended to add 'alignment of government and business institutions'.
5446	7	37	7	38	The following wording is suggested: .., and collaborative networks in all regions including all main actors and decision makers. [Klaus Radunsky, Austria]	Taken into account. The specific text suggestion is not adopted, but "alignment of government and business institutions" is added. The point about multiple actors is made elsewhere (in the para on governance). See also response to comment 5446.
18696	7	38	7	38	Should be "across scales and regions" [Wilfran Moufouma Okia, France]	Accept. Text amended.
14992	7	38	7	40	Practically everywhere around the world, particularly in developing countries… -- this appears to be an overstatement. [Farhan Akhtar, United States of America]	Reject. There is evidence that all around the world, also in developed countries, capabilities are a limiting factor. In an updated formulation, we further elaborate on this

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16394	7	39	7	39	I would urge changing "short" to "far short" [Michael MacCracken, United States of America]	Reject. See response to comment 16393.
1115	7	40			This framing ("measures") again emphasizes the role of governments and gives bottom-up change in society and the priovate sector insufficient emphasis. [Rob Swart, Netherlands]	Taken into account. This paragraph has been completely rewritten and split in two new paragraphs , though still using the word "countries", ample attention is given to other governmental and non-governmental action.
6574	7	40	7	41	Challenges related to multinational networks do not only relate to scaling up but also to public representation and legitimacy of such networks (that is, what and whom they represent). This comment applies also t the relative sections mentioned in these lines. [J. David Tabara, Spain]	Noted, but at this point the chapter does not make this point. In our understanding, literature on this is missing.
19293	7	42	7	49	Maybe education could also be referred to in the Executive Summary [Charlotte Vailles, France]	Taken into account. It is mentioned on page 7, line 27 in the ES FOD, and page 6 in the SOD.
1116	7	43			This message (as in the underlying text) rightly emphasizes changing behaviour in addition to the referendes to technological and governance changes above, but by coupling tjhis to lifestyles leaves unnoted that the required transitions also have elements related to process changes (e.g. in industries) and maybe fundamental changes in economic and financial systems. [Rob Swart, Netherlands]	Taken into account. We chose to address changes in decision-making in industry, finance etc. elsewhere in the ES (page 4-8), and specifically in the chapter in sections 4.4.1-4.4.6 (of the SOD).
7576	7	43	7	43	I agree that changing lifestyle and behaviour is important, but I am not sure it will be necessary. Is this based on hard evidence? [Andries Hof, Netherlands]	Noted. Ch 2 (modelling) outcomes emphasise the need for behaviour and lifestyle change and also call it essential. We assess the "how" of it in 4.4.3.
6575	7	43	7	43	Changing behaviors and lifestyles' of whom? Of the Western industrialized countries or the developing ones or both? Specially in the later lifestyles are changing fast but in more carbon-intensive pathways. The report tends to use a language in which 'people' and 'individuals' mostly seem to refer to the first kind of societies, hence ignoring cultural and socio-economic differences. [J. David Tabara, Spain]	Noted. Behaviour changes are needed across the world, regarding both mitigation and adaptation. The ES is not mandated to present prescriptive inferences.
1026	7	43	7	49	Here changing behavior and lifestyles is discussed only from climate change viewpoint. Sharing economy from ownership to share (ex, automobile) in combination with AI and IoT may have huge possibility to save energy, though not intending to reduce emissions. It would be better to add these new behavioral change that has no relationship with climate change, still have a huge impact on climate change. [Mitsutsune Yamaguchi, Japan]	Taken into account. See also response to comment 7522. The types of behaviour changes that contribute to 1.5C are discussed in 4.4.3. General purpose technologies and their impact on 1.5C mitigation and adaptation options in 4.4.4. However, this ES necessarily needs to make a selection of points it made and this did not make it in.
20247	7	43	7	49	A concensus exists that the public must be activated to enable our politicians to take the neccesary steps to meet the challenges of climate change. Museums are uniquely qualified to contribute to activating the public on climate change awareness, mitigation, and resilience, because, in the words of Robert Janes, they have several exceptional characteristics: They are grounded in their communities and are expressions of locality; They are a bridge between science and culture; They bear witness by assembling evidence based on knowledge and making things known; They are seed banks of sustainable living practices that have guided our species for millennia; They are some of the most free and creative work environments in the world.;They enjoy an unprecedented degree of public trust;They are skilled at making learning accessible, engaging and fun. Finally they offer an existing globl infrastructure - agora or arenas for local communites to utilise in accomodating local climate challenges while also offering the IPCC an existing infrastructure to communicate the global challenges. [Morien Rees, Norway]	Noted. It would however go too far to highlight this in the ES of this chapter. Also, literature is missing on how museums could play a role. We do mention "greater public awareness and improved education" which is an area where museums could play a role.
6198	7	43	7	49	It seems to me rather one-sided to only highlight the positive opportunities here. It is clearly the case also that a very significant part of the political problem is in resistance to such behaviour change, or the 'stickiness' of existing practices. There is a very large literature on this. This should be acknowledged as a distinct political problem that needs attention. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account (partially). Acceptability is discussed in 4.4.3. Resistance to change is not discussed explicitly in the ES; it is a part of the discussion in the context of "social feasibility" with the different mitigation options.
5447	7	43	7	49	It is suggested to screen literaure on successful examples how barriers could be overcome in order to change lifestyle and behaviour. It seems very important to use the power of young pupils (age of 10 to 14) to educate their parents and grandparents. Unfortunately, Article 6 of the Convention has not been a strong focus until now! See also the suggestions in the book `'The Ostrich Paradox; Why We Underprepare for Disasters. By Robert Meyer and Howard Kunreuther' [Klaus Radunsky, Austria]	Noted. This was not added since it is too specific to be added at the ES. Also, the evidence base for this is not strong.
7522	7	43	7	49	We think the concept of circulare economy could be mentioned here.{4.3.4.3} [Øyvind Christophersen, Norway]	Noted. Chapter 5 addresses it in the context of the SDGs. Chapter 4 only in the context of deep emission reductions in industry (4.3.5) which is mentioned only cursory in this ES. We aim for this ES to remain succinct and have a narrative that goes beyond a list of mitigation options for deep emission reductions and their possibilities and limitations. hence the limited emphasis on this concept frame
19340	7	43	7	49	Education can reduce fertility rates - but higher education generally promotes materialized happiness, increasing extraction, consumption and emission rates; [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The role of population growth particularly when combined with affluence is discussed in 4.4.3. The link between higher education and materialised happiness has limited supportive evidence globally.
19341	7	43	7	49	Education and media can de-materialize wellbeing: after basic needs, happiness is people and activities - social nonmaterial actions - not endlessly working-earning-spending-buying products resulting in destructive extractions of limited natural resources and dangerous emissions. [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. See response to comment 19339.
19339	7	43	7	49	Re behaviour and lifestyle change: Education and media are (the) principal agents of behaviour change. Nearly 100% of media - including social media - is commercial, promoting "materialized happiness", purchase and consumption of products, and thereby extraction of rapidly depleted natural resources and production of climate changing emissions. [Birgit van Munster, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Information and education, though important and mentioned elsewhere in the ES, is not always effective in changing behaviour. It also not the only agent for behavioural change. This is further discussed in 4.4.3. We also indicate that wellbeing is not based on hedonia but also eudaimonia in that section. It goes too far to include that point in the ES.
11461	7	43	7	49	Changing behaviour and lifestyles suggests over-consumption is the key issue here, treating the lifestyles of the affluent, industrialised world as a the global norm. I am not sure this is what is intended. After all, we should be supporting the aspirations of those in poverty to live more prosperous lifestyles but doing so in a way that capitalises on opportunities to decarbonise production, regenerate ecosystem processes etc. "Changing behaviour and lifestyles" also suggests: (1) that it is individual behaviours, attitudes and values that are the problem, not the social and economic structures in which they are embedded; and (2) that the social and behavioural factors that influence lifestyles and consumption are more-or-less equivalent regardless of the resources being consumed (i.e. food, water, energy, housing etc.). I would like to see this paragraph re-framed around "enabling" behaviours and lifestyles that enable sustainability transitions; that is, transitions to more equitable and more environmentally sensitive ways of life. [Stewart Lockie, Australia]	Taken into account. Behaviour change requires enabling environments, see section 4.4.3 (in the SOD) and strengthening motivation to change. We refer to wasteful consumption in the SOD ES. But it is not just (over)consumption and putting the emphasis only on individuals. We revise the text to emphasise the crucial virtuous cycle of: behavioural change, political support for more change, and more behavioural change etc.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7887	7	43	7	49	Include references / mention of the developments of a global Circular Economy and transition from a Linear to a Circular system e.g. regarding behaviour and lifestyles: (source adapted from: Siemens, Klaus Lützenkirchen - Head of Corporate Environmental Protection Munich Germany) The present dominant Linear Economy model has strong implications to the degree of Climate Changes on Earth. Earth is a closed system where matter and emissions remain in the system and the Earth functions in natural cycles with natural limits to resources. Societies need to consider those limits in order to survive. A Circular Economy model keeps products, components and materials at their highest utility and value at all times. A Circular Economy is restorative and regenerative by design and distinguishes between biological cycles and technical cycles. Sustainable Circular Economy industrial model thinking respects the cyclical nature of the Earth where products are designed and manufactured in a way that does not exceed the natural limits of resources and ecosystems. Harmful substances/emissions are phased out of manufacturing processes or prevented from entering eco-systems and purity of resources is recreated at the same rate as resources are being consumed. Worldwide population growth is spurring increased demands in consumeable goods and is causing increased residual waste streams arising from the take, make, waste Linear Economy model. A Circular Economy system of thinking is focused on eliminating potential unsustainable waste streams, including greenhouse gas emissions. Examples of resource efficiency being addressed around the world include the United Nations 2030 Agenda for Sustainable Development with responsible consumption and production targets; the German GER Resource Efficiency Program; the Chinese CN Resource and Environment Index; and the United States US Sustainable Material Management Program. In addition, many multinational companies are beginning to source 100% of their product related materials from recycled goods (Nike, Apple). In this context a Circular Economy model gains traction in policymaking to achieve economic development within environmental constraints. Examples of Circular Economy policy developments include: European Union Circular Economy action plan Closing the Loop (2015) and Eco Design Directive (2018); German Resource Efficiency Programme ProGress (2016); Chinese Circular economy development strategy and immediate plan of action (2013); and Canadian Resource Recovery and Circular Economy Act (2016). Common characteristics of the Circular Economy are material loop closing, product life extension and increasing material efficiencies. Circular business models look at new relationships and are key to overcoming the limitations of linear approaches. Circular input models, waste value models, lifespan models (Life Cycle Analysis), platform models, and products as services models are all examples of Circular Economy thinking which are disruptive andare powered by new technologies and in particular through digital connectivity via mobile devices and machine-to-machines [Geraldine Ann Cusack, Ireland]	Noted. Very relevant point. See further response to comment 7522.
920	7	44	7	49	Should population limits be considered under this heading? [David Infield, United Kingdom (of Great Britain and Northern Ireland)]	See response to comment 19340.
14069	7	45	7	45	include production [Elvira Poloczanska, Germany]	Taken into account - it is mentioned in the same line.
6724	7	46	7	49	The issue of lifestyles and behavior change as factors that could enable a virtious cycle that would accelerate a transition to stay below 1.5 oC is welcomed. However, there have been fast technological transitions in the past that have not required lifestyle and behavioral change that should also be considered i.e. nuclear energy and the jet engine (see "Apples, oranges, and consistent comparisons of the temporal dynamics of energy transitions", Grubler, Wilson and Nemet 2016). There is an implicit assumption that the only technologies that can be deployed fast enough to stay within the 1.5 oC limit are carbon secuestration technologies, not mitigation technologies. This could lead to misunderstandings and missgivings. [Jennifer Morgan, Netherlands]	Noted- technological solutions often imply behaviour change, facilitated by political and public support. Eg nuclear energy needs to be accepted by the general public, which can be challenging. The last part of this comment is not clear.
4792	7	48	7	48	may help' rather than 'help'; there's no direct causal link between my change in lifestyle and your support. In fact, the opposite often happens: visibly practicing new lifestyles often induces resistance. [Marcel Wissenburg, Netherlands]	Reject the suggested change, although the point is acknowledged. The conditionality is already expressed in the "lifestyle an result in greater participation..". That non-participating individuals or groups may not contribute is expressed by "help" - there is no guarantee, indeed. In the SOD, a sentence on factors for public and political support is in the paragraph following this one.
7883	7	49	7	50	…further action on climate change, creating a virtuous cycle upheld by a solid democratic license. [Yana POPKOSTOVA, France]	Reject. The addition "upheld by a solid democratic license" would be prescriptive in the sense that it implies that a democratic license is a condition. It needs to be acknowledged that not every region would necessarily agree.
14994	7	51	7	55	Would be helpful to mention the key role of private sector across innovation and implementing fast responses. [Farhan Akhtar, United States of America]	Accepted. Addressed elsewhere in the ES (paragraph 2, page 6). This section aims to address the policy instruments with public actors.
2739	7	51	7	55	A number of different key messages in the Exec Summary deal with policy / governance / institutional points - these could be better rationalised / distinguished from each other. [Penny Urquhart, South Africa]	Accepted. The SOD ES has been amended to group similar messages together.
5449	7	51	8	2	One of the main barriers has not been mentioned: that investments in fossil fuels and traditional technologies often offers still a higher return of investment and less risks compared to investments in low carbon technologies and in higher resilience. It is the responsibility of governments and Parliaments to design and agree rules that change that situation. [Klaus Radunsky, Austria]	Accept. Rephrased as "as long as the market continues to prefer fossil fuel-based technology for a variety of reasons".
7884	7	51	7	55	A set of policy instruments, working across governance levels and promoting innovation, are needed to implement a rapid and far-reaching response. Policy instruments, both price and non-price could accelerate the deployment of carbon-neutral technologies ahead of their prospectively achieved cost-effectiveness in respect to fossil fuels. A synergetic and structured use of a mix of regulation, grants, standards, subsidies, loads and feed-in tariffs, information and social influence strategies to trigger innovation and align a low-carbon transition with equitable access to… [Yana POPKOSTOVA, France]	Reject. Thank you for the suggestions, but after discussion we are not sure whether this is supported by evidence in the chapter. The long list \also makes the text more difficult to read.
3696	7	52			non-price defines instruments negatively, by what they are not. Suggest "regulatory" [Harald Winkler, South Africa]	Noted. Good suggestion but this is reflected the way the underlying section is written. See also response to comment 5448.
5448	7	52	7	52	Would a wording such as "market and non-market mechanism" not be easier to be understood by the policy level compared to "price and non-price"? [Klaus Radunsky, Austria]	Reject. We appreciate the suggestion, but this point is particularly made to reflect the carbon pricing point made later on. The link to the Paris Agreement Article 6, is not appropriate here, unlike where it has been used specifically as in section 4.4.7 (4.4.5 in the SOD)
14993	7	53	7	53	carbon-neutral technologies before they can be more cost-effective than fossil fuels -- but they already are in some cases. [Farhan Akhtar, United States of America]	Noted. That does not make the sentence less relevant or true. If they are not cost-effective, they would need support.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
18782	7	53	7	55	the formulation "before they can be more cost-effective than fossil fuels" implies a) that the the cost would be the single-determining factor whether the technologies disseminate fast enough, and b) that the technologies would operate on a level playing field. However, this para should also note that the main purpose of such policies and measures has to be the rapid-enough dissemination of carbon neutral technologies (where cost-effectiveness is one of course important factor, but there are additional important barriers that impede the dissemination, e.g. political economy aspects etc.). it could further note that from a macro-economic perspective, taking into account e.g. avoided adverse climate impacts, but also direct sustainable benefits of carbon neutral technologies (such as in the area of health) need to be taken into account in a perspective of "cost effectiveness" [Sven Harmeling, Germany]	Accept. Language revised to "as long as the market continues to prefer fossil fuel-based technology for a variety of reasons".
7987	8				There are clear contradictions throughout the document between "non_state actors playing a key role", "bottom-up initiatives" and the necessary "fast active intervention" and "serious community engagement for efficient and clear actions " of states and international organisations. No clear answer to the question is given in the document of how the bottom-up and top-down decisions can meet for taking efficient short term decisions (also taking into account the large and serious technical uncertainties...). [Jean Marie Seiler, France]	Noted but cannot resolve this issue due to lack of underlying evidence on streamlining bottom-up and top down decision-making. It is included in the section on gaps in knowledge.
10910	8				No words about a tax on carbon ? A carbon tax, which proceeds are used to finance renewables is a very powerful too. [Beat Brunner, Switzerland]	Taken into account. We discuss carbon pricing in the section on policy instruments.
10903	8	3	8	3	Add sentence "market mechanisms for mitigation play an important role in reducing mitigation cost, thus leading to higer ambition and an increased likelihood to reach the 1.5°C target of the Paris Agreement (4.4.7)" [Axel Michaelowa, Switzerland]	Taken into account. We have included a more specific sentence on "carbon pricing is a necessary but insufficient part of the [policy]mix".
10908	8	4	8	4	"1.5°C -compatible worlds" should be singular, we have a single Planet Earth and is not understandable like is imho. Suggesting : "To be able to limit warming to 1.5°C, ..." [Beat Brunner, Switzerland]	Reject. We have multiple possible outcomes of a 1.5C warmer world. This is the only comment on the understandability.
14995	8	4	8	9	Include private sector here more explicitly as well; not just public financial institutions, e.g., "including central and multilateral banks, financial institutions, and other investors" [Farhan Akhtar, United States of America]	Taken into account in the text under the bold headline.
19710	8	4	8	9	This review of ESG and climate justice can help to direct climate compatible investment. Pursuing Climate Justice within Environmental, Social and Governance Frameworks. 2017. Online at http://www.mrfcj.org/wp-content/uploads/2017/03/Policy-Brief-Pursuing-Climate-Justice-within-ESG-Investment-Frameworks-Mary-Robinson-Foundation-Climate-Justice-Jan-2017.pdf [Tara Shine, Ireland]	Noted. The ESG literature is reviewed in section 4.4.1 (in the SOD). However, this reference is not peer-reviewed and cannot be included.
1117	8	5	8	6	The financial sector (here and in the underlying texts) gets relatively little attention but seems of key importance. Here, at least other actors should be included such as asset managers, pension funds and other institutional investors. [Rob Swart, Netherlands]	Noted. We acknowledge the point, but also have to choose what to include in the ES specifically. Finance actually gets considerable attention in section 4.4.6 (of the SOD).
7899	8	5	8	6	1.5°C -compatible worlds will require active intervention to reduce investment risks in low carbon technologies and to redirect world savings. This implies the involvement of the financial sector including central and multilateral banks. In general, the chapter focuses on the role of the financial sector, including banks, and has an international finance bias. There needs to be more discussion about domestic resource mobilization, and the role of cities in finance, including land value capture. [Westphal Michael, United States of America]	Accept. Though we don't mention cities, we have included language related to domestic finance in the SOD ES.
3691	8	6			Also development banks - at national and regional level [Harald Winkler, South Africa]	Taken into account. We don't aim to be exhaustive in this section on the financial sector but do mention it in the SOD section on finance. The point on the mainstream finance sector in countries is made. It's indeed not only about international banks.
7885	8	8	8	10	Public guarantees, development assistance and support of non-state actors could facilitate enhanced adaptation investment and to a certain extent accelerate the divestment from high to low-carbon assets which is already happening. [Yana POPKOSTOVA, France]	Taken into account. Mitigation is mentioned in this sentence now, which has been significantly revised.
3690	8	11	8	16	I miss in this concluding para of the ES a reference to develoment and climate. Seems to me that better alignment of devleopment goals (whether SDG, national or local) with climate goals neesd a lot more attention. [Harald Winkler, South Africa]	Accepted. The ES has been rewritten to link aspects of climate and development throughout. A reference to CBDR is also added.
971	8	11	8	16	given the huge transformation implied in goverannce systems it is surprising to have such a thin summary of knowledge gaps. [Victor Davd, United States of America]	Accepted. The paragraph on gaps has been expanded to make more comprehensive on governance.
14996	8	14	8	14	practical principles of climate resilient governance is ill-defined. Suggest the authors refrain from referring to principles that are not well established and commonly agreed. [Farhan Akhtar, United States of America]	Accept. Revised to make it conditional
7886	8	15	8	16	…systems can be bolstered in a direction which promotes and sustains climate action. It is feasible to attempt identifying holistic principles of Carbon Reduction governance which can be applied across policy systems and national policy methodologies. Sub-national and cross-national synergies and coalitions need to be recognized and empowered because the pathway to 1.5C cannot be effective without the urban/city engagement with and ownership of the process. [Yana POPKOSTOVA, France]	Reject. This introduces prescriptive language and is not supported by the chapter.
7200	8	16			Gaps in knowledge on the effect disruptive emerging technologies on the energy use and CO2 emissions need to be resolved. They include questions how these disruptive technologies, such as additive manufacturing, robotics, drones and the Internet of Things increase or decrease energy consumption and if policies can be developed to maximise the beneficial effects of these technologies and/or the cost effectiveness of interventions concerning these technologies. {4.3.4.2, 4.4.6} [Leendert Verhoef, Netherlands]	Noted. It is a fair point but chose to emphasise key options in this paragraph of the ES, which is broadly covered in the phrase "what can realistically expected from innovation". Section 4.4.4 discusses such technologies.
19318	9	1	10	33	Extremely important and well written chapter. [Marco Mazzotti, Switzerland]	Noted - thank you.
2229	9	1	10	33	Suggest to delete. The section only summarises key messages from AR5 and the parts on 1,5 C are not substantiated by references. [Kenneth Möllersten, Sweden]	Rejected - we don't find this sentence.
1208	9	1	10	33	4.1: start with the narrative arc (storyline) of the chapter and introduce the various sections of the remaining chapter at the end. [Petra Tschakert, Australia]	Accepted - we have modified this section to include accordingly
19711	9	1	9	2	Note that the opportunities posed by the transition to a 1.5 world includes opportunities for justice, rights and greater equality if climate actions ares designed with human rights and gender equality in mind. Without integration of these issues (as indicated in the Preamble of the Paris Agreement) the challenges associated with 1.5 pathways will be greater, as will the risks. [Tara Shine, Ireland]	Taken into account - these considerations are well treated in many other places in chapter 4 and it cannot be put in this very brief introduction. The expression 'opportunities and challenges' are all the human dimension at stake
1207	9	3			Stick to the term '1.5C warmer world' throughout the chapter (consistent with Box 3.12). [Petra Tschakert, Australia]	Editorial
16395	9	5	9	5	There needs to be a qualification here--not all types of serious impacts "can be alleviated by adaptation and development responses", including the commitment to sea level rise that is being initiated and the loss of biodiversity that is occurring due to climate and ocean acidification--at least they cannot be meaningfully alleviated. [Michael MacCracken, United States of America]	Accepted - text has been modified
2740	9	8	9	10	Suggest adding "and their co-benefits" after "adaptation and mitigation responses" [Penny Urquhart, South Africa]	Accepted - Have amended text to take this into account.
4299	9	8	9	10	I do not understand why adaptation and mitigation responses have to be discussed together. Why not separately as in previous AR ?. Why is it that a discussion on mitigation has to deal with issues such as equity and justice ? (very important for society but rather out of scope of a discussion on how to achieve the 1.5 ° target...). [Abanades Carlos, Spain]	Rejected - Coupling responses is the mandate of this chapter and important for an accelerated response. Literature on mitigation equity issues, for example to tackle the others distributional impacts of energy cost
1118	9	10			Isn't this the focus of chapter 5?? [Rob Swart, Netherlands]	Taken into account - we rephrase the sentence to stress the importance of the alignment with SDG to accelerate action and hands its political support
2484	9	12	9	22	Need to add the importance of individual/personal responsibility; the same goes for entire section [Lisa Lucero, United States of America]	Accepted - Have added text on behavioural change in checklist of preconditions.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
13050	9	14	9	14	it is not clear what "social cost" means, if it considers only economic costs (few lines before is written "maximizing economic efficiency" [Caserini Stefano, Italy]	Rejected - we are forced to refer to the glossary and the box on economics on 1.5 because of the space restrictions.
16396	9	17	9	19	I am not clear what is meant here. With recent technology advances it is becoming less expensive to be deriving energy from renewable resources--what needs to be overcome is the inertia created by large business interests. I just do not think "mediating" is the right word here, in addition to not being very clear as to meaning. [Michael MacCracken, United States of America]	Accepted - changed to "managing the economic impact" with the assumption that impact can be positive.
16397	9	19	9	22	Does this statement not assume that the least cost development path in the future will be fossil fuel-derived energy with its necessary energy investments and harmful emissions to health, air quality, water quality, and more? With renewable energy costs declining rapidly (and much greater improvements are in the pipeline, including that will avoid the need for petroleum powered individual transporation), it would seem that the cost of development with distributed renewables is going to be less than the costs and indirect impacts from going a fossil-fuel path. If this is the case, then the pressure to cut fossil fuel emissions to zero has actually stimulated technology development that will make development less expensive than it has been. [Michael MacCracken, United States of America]	Rejected in this section because we simply sum up the AR5 conclusions that state that there is always a marginal cost, that the deployment of low carbon energy systems implies higher energy costs, even in the most optimistic assumptions. The rest of the chapter will discuss how to overcome this difficulty
2230	9	24	9	24	All these claims need references. [Kenneth Möllersten, Sweden]	Rejected - we simply note that what has to be accelerated to reach 1.5. Accelerated change requires additional sets of efforts and policies.
6725	9	25	9	27	Despite acknowledging the power of 'behaviour and systemic politcal and econimic changes in improving resilience and reducing emissios' the report is quick to signal that the only way we could reach 1.5 oC is with "massive penetration of cheap carbon dioxide removal technologies". Openining the door to behavior and systemic political and economic changes as needed to reach 1.5 they should be assessed at least at the the same level of detail as crabon removal technoligies are. Rather than yielding quickly to report what is known or withing the areas of comfort of the IPCC. [Jennifer Morgan, Netherlands]	Taken into account - This chapter attempts to consider ALL options. moreover the chapter 4 does not devote long developments to CDR and rather insists on all the other action variables
4300	9	26	9	33	The rethoric of section 4.1 is overwhelming. Example: I have read 5 times the last paragraph of the section, and still do not know what is the message (other than the obvious need of a coherent governance...). May be it is just my problem. [Abanades Carlos, Spain]	Taken into account - Thank you for pointing out your difficulty
2231	9	27	9	29	The implicit claim here is that achieving 2 Cdoes not require structural changes from the global to local level in development pathways and governance and in economic, financial, instidutional, social and technical systems. This needs to be substantiated with references to adequate reports and articles. [Kenneth Möllersten, Sweden]	Accepted and amended.
11141	9	28	9	29	The second significant difference is that a 1.5°C transition requires structural changes from the global- to the local-level in development pathways and governance, and in economic, financial, institutional, social and technical systems. - this is a blanket statement without links to the rest of the report or references. What evidence is there that this is needed for 1.5 and not 2? [Michiel Schaeffer, Netherlands]	Accepted and amended.
1119	9	29			Should the importance of land management be mentioned here? The lower the temperature target, the greater the importance of land-based solutions. [Rob Swart, Netherlands]	Accepted
2485	9	29	9	29	Need to add importance of education; the same goes for entire section [Lisa Lucero, United States of America]	Taken into account - a reference into education will be later presented as a key parameter of the enabling environment
18697	9	30	9	30	unclear what is meant by "varying temporal and spatial distribution of various….". [Wilfran Moufouma Okia, France]	Taken into account - we will modify to simpler language.
3069	9	31	9	33	Instead of focussing on "no regrets" and "negative cost" options, which some will dispute, especially the latter, can you instead say the same thing but focus on the mitigation cobenefits of alternative development and adaptation actions? E.g. the benefits of transit orientated city development. [Christopher Bataille, Canada]	Accepted - and reframed more positively.
19712	9	31	9	39	Need to add a reference to the Paris Agreements commitments to respect human rights and gender equality in climate action (see the preamble to the Paris Agreement). [Tara Shine, Ireland]	Taken into account, we talk about environment with more detail in chapter 5
17679	9	31	9	39	The chapter is right to draw attention to these 6 objectives. It is also important to add that the global response should be in line with principles of equity - such as the doctrine of common but differentiated responsibilities and respective capacities. This is also in line with later statements in the chapter (page 12, line 28). [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - Added that reference.
19319	9	31	9	39	Crucial paragraph, to be phrased as precisely as possible. There is room for improvement, I believe. [Marco Mazzotti, Switzerland]	Accepted and rephrased.
10215	9	31	9	39	I like the intro but this paragraph seems too much unreferenced author opinion - where do these 6 things come from? [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - We have addressed this with cross references to Chapter 2 (on divest and invest trends required) and "enabling environment" in Chapter 4. On re-reading this section we have now rewritten point 4.
16398	9	31	9	39	It seems to me that this enumeration needs to more clearly emphasize the need for ongoing research and development, including facilitating new technologies that seem to get stuck in the transition from research accomplishment to being marketed. The first point talks about facilitating "options" but a number of the emerging technological advances have yet to be recognized as options in any of the analyses done by integrated assessment models (e.g., ocean turbines that actually work by going to magnetic bearings instead of ball bearings; fast charge batteries that are possible by focusing on use of ultra-capacitors instead of chemical, rare element batteries; etc.). [COI note--I'm personally trying to encourage both, including by minor investment in the former.] [Michael MacCracken, United States of America]	Rejected - We have referenced new technologies and innovation, but cannot go into this level of detail in an introductory section.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
4805	9	31	9	39	The author forgot to mention "actual action" in deep decarbonisation. It's fine to have an enabling environment but if economic agents do not take the opportunity to act, nothing happens and the goal goes out of reach. The emphasis on "no regret" is from the old age where there were "uncertainty" about the existance of climate change or whether is a hoax, thus only no-regrets actions, defensible even in absence of climate change, were prominently supported. Since 2007, anthropogenic climate change is "unequivocal" and its large scale damage do justify even high costs of mitigation action. Note that costs to polluters do not count in this, because of the "polluters pay principle". Since the Paris Agreement is the frame of the paragraph, it's important to report all its main keywords (mitigation and adaptation but also resilience and "loss and damage", to which one separate article has been agreed and should not be re-litigated). Accordingly, the text should be integrated in a way like this: "In the context of the Paris Agreement, the global response therefore implies the need to focus on: (1) accelerating the realization of 'no-regret' and 'negative costs' options to deliver short-term development, mitigation and adaptation co-benefits; (2) embracing deep decarbonisation strategies and measures, also in synergy across countries and sectors, by leveraging all venues and tools indicated by the Agreement; (3) accelerating the implementation of policy packages apt to deliver mitigation and adaptation as co-benefit of long-term development benefits and universal improvements in quality of life, including response measures for countries and sectors particularly hit by mitigation actions, and more in general pursuing the Sustainable Development Goals; (4) enabling environments that help address institutional. market and behavioural barriers to these perspectives; (5) actual action in deep decarbonization; (6) increasing the profitability of production of (and investment in) clean technologies and behaviours; (7) diverting investments from past and current trends that can lead to a lock-in into climate-vulnerable and carbon-intensive development pathways; (8) reinforcing innovation processes, changes in lifestyles and spatial dynamics that will allow for further deep reductions in GHG emissions; (9) enhancing the adaptive capacity of key systems at risk (e.g.. water. energy. food, cities and coastal resources) to climate change impacts; (10) anticipating, minimising and managing risks arising from actual climate change losses and damages; (11) increasing resilience and capability of recover from losses and damages, also thanks to international and domestic solidarity networks". [Valentino Piana, Italy]	Accepted and rephrased.
12469	9	35			How authors finds that Paris Agreement is indicating diverting investments from current trends, that can lead to a lock-in into climate-vulnerable and carbon-intensive development pathways. Are we considering 17 SDGs or only energy and climate releted ones. [Dr Noim UDDIN, Australia]	Taken into account - We have changed that sentence
7331	9	36	9	36	Delete the text "a lock-in into". [Eleni Kaditi, Austria]	Rejected - the term exists in literature
2232	9	45	9	46	This is a sweeping statement that needs to be revised. "Consideration" per se will not lead to any change at all. [Kenneth Möllersten, Sweden]	Accepted - Good point. Addressed.
16399	9	46	9	48	That the transition to a green energy system will result in more jobs, greater efficiency, greater energy security, reduced environmental pollution and health problems, and more needs to be emphasized. Yes, fossil fuel infrastructure investment may be lost, but for most people the benefits will far exceed the loss of economic value of fossil fuel infrastructure, particularly if developing nations avoid taking the same fossil fuel path as developed nations--and this is technologically possible without sacrificing energy services if done thoughtfully. [Michael MacCracken, United States of America]	Accepted - We have rephrased to emphasise balance between opportunity and loss.
6199	9	46	9	50	There are two rather different statements here both about the political feasibility question. It is not clear if they are intended to be linked and similar points. If so, this is mistaken, they refer to rathrer different political points. In the former, it is popular backlash against climate policy because of unemployment which is the risk. in the latter it is the power of large companies - those holding fossil fuel assets and their investors - who could pose the risk. Minimising the risk of the former is intrinsic to the challenge of 1.5C in that popular backlash can derail the political process. But I do not see how it is possible to achieve 1.5C without hurting the assets of those holding extensive FF assets. Minimising the losses to those interests stands in a direct contradiction to 1.5C. The political challenge is thus to create sufficient political support to overcome the opposition of those interests and/or to directly compensate them for their losses. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - We have cross referenced to "enabling environment" section on sunset industries.
2629	9	46	9	50	surely protecting carbon-intensive assets is incompatible with climate action? [Zoha Shawoo, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - It is a politically pragmatic point, but we have reworded it.
6726	9	46	9	50	In line with the comment above, the report states that "It may be hard to accelerate climate action in the loss of economic value of carbon-intensive assets, which appears unavoidalbe, cannot be minimized". Combined with the report's extensvie discussion of carbon removal technologies, there appears to be a bias. Carbon removal technologies have a central role in the report whereas loss of economic value of carbon-intensive assets does not. In other words, there seems to be an implicit preference to undergo risks associated with unproven and expensive carbon removal technologies rather than exploring the possibilities of a managed decline of a carbon economy like the loss of economic value of carbon intesnvie assets now. [Jennifer Morgan, Netherlands]	Accepted - Reworded.
11142	9	46	9	50	This paragraph highlights the risks for acceptance for low carbon transformation resulting from the "loss of economic value of carbon-intensive assets", but it doesn't mention the opportunities to increase acceptance resulting from the development of new industries and job creation. [Michiel Schaeffer, Netherlands]	accepted - new phrasing
18698	9	48	9	48	Suggests it might be possible to minimize the loss of economic value of fossil fuels and still achieve climate action. Further explanation needed. [Wilfran Moufouma Okia, France]	Accepted - new phrasing.
6727	9	48	9	50	"It may be hard to accelerate climate action if the loss of economic value of carbon-intensive assets, which appears unavoidable, cannot be minimized." Why need to be minimised? Was the economic losses also minimized from accelerated technology changes following Montreal (and Kigali) Protocol on the substances that deplete the ozone layer? Minimising economic losses of carbon intensive assets seem to be in contradiction with the 1.5-consistent transition where there is an "absence of temporal flexibility". [Jennifer Morgan, Netherlands]	Accepted - new phrasing.
4806	9	48	9	50	We should not care only about polluters being subsidised once more. We need to positively incentivise clean technologies providers and users. Accordingly, the sentence ending with "cannot be minimized." should be changed into "cannot be somehow compensated, provided this reduces resistances to change and actually leads to faster divestment. High profits should accrue to innovators, producers, installers and users of zero-emission and low-emission technologies in all sectors, so as to boost self-funded and externally-funded expansion at fast pace, leading to employment, exports, and tax revenues". [Valentino Piana, Italy]	Accepted - new phrasing.
1120	9	50			or compensated? [Rob Swart, Netherlands]	Accepted - Agreed and added.
3070	9	54	9	55	Can you be more descriptive when you discuss a "shift in the production frontier of the economy". Do you mean an expansion, contraction, or shift between inputs? [Christopher Bataille, Canada]	Accepted - we have been more specific.
18699	9	55	9	55	Wording sounds like you mean development reduction, adaptation reduction, mitigation reduction [Wilfran Moufouma Okia, France]	Accepted - we have amended to avoid this confusion.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9892	10	1	10	2	The authors have cited 2015 data but they may use the latest publication by the UN on World Population Statistics, refer to - United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248. [Shipra Shah, Fiji]	Taken into account - Noted thank you.
14119	10	2	10	2	Ensure consisteny with chapters 1 and 5, eg chapter 2 fig 2.5, range 8.5-9.5 billion [Elvira Poloczanska, Germany]	Taken into account
4834	10	5	10	5	The author should mention the SDGs, e.g. in this updated version: "These are trends that could continue for the next few decades (Burt et al. 2014), in interaction with the efforts and achievements in the Sustainable Development Goals, as well as...". This avoids the cherrypicking of few variables, made in the whole paragraph, whereas the international respons to climate change has been incardinated as part of the SDG agenda, which should be considered as a whole. [Valentino Piana, Italy]	Rejected - Good remark, but we think that it is inappropriate in this section
4807	10	5	10	6	Add to this list of disruptive technologies: 3D-printing (sometimes called "additive manufacturing"). [Valentino Piana, Italy]	Taken into account - but too much detail for this introduction, so we have removed reference to nano and bio-technologies in favour of "new technologies"
19294	10	8	10	8	I am not sure the understand the transition "Nevertheless…" [Charlotte Vailles, France]	Taken into account - we have changed the text.
2741	10	20	10	22	Climate policies are by definition and of necessity framework policies, requiring mainstreaming into all other sectors for their functioning. Therefore this 'area of potential' could more accurately be termed a failure to achieve the necessary mainstreaming to date - even in countries where climate policy is relatively well developed. [Penny Urquhart, South Africa]	Accepted - we have added a reference to mainstreaming.
3983	10	21			suggest: is aligning (and integrating) climate policy with other public policies (fiscal, industrial, urban planning, infrastructure, innovation) [Barbara Norman, Australia]	Accepted - we have added a reference to mainstreaming.
17740	10	26	10	28	See reference to publication on the essence of global governancwe and an international governance structure for climate governace http://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/24_thinkpiece_global_governance.pdf https://www.iisd.org/pdf/2008/geg_climate_gov.pdf [Afua Adu-Boateng, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - Paragraph has ben substantially rewritten
14070	10	26	10	33	Does this paragraph also need to mention the NDC ambtion gap – see Exec Summary p6 line 6-8 [Elvira Poloczanska, Germany]	Accepted - we have added, and how co-operation can bridge the gap.
1705	10	26	10	34	While outlining climate policy implementation strategies (under heading Accelerating the global response to climate change: on page 9 of the document), it is essential to focus on "global environmental governance" (GEG). The GEG is the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection. The efficacy of global environmental governance will ultimately depend on implementation at global and domestic levels. [Mishra Santosh Kumar, India]	Accepted - we have rephrased accordingly
1715	10	26	10	34	While outlining climate policy implementation strategies (under heading Accelerating the global response to climate change: on page 9 of the document), it is essential to focus on "global environmental governance" (GEG). The GEG is the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection. The efficacy of global environmental governance will ultimately depend on implementation at global and domestic levels. [Mishra Santosh Kumar, India]	Accepted - we have rephrased accordingly
1720	10	26	10	34	While outlining climate policy implementation strategies (under heading Accelerating the global response to climate change: on page 9 of the document), it is essential to focus on "global environmental governance" (GEG). The GEG is the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection. The efficacy of global environmental governance will ultimately depend on implementation at global and domestic levels. [Mishra Santosh Kumar, India]	Accepted - we have rephrased accordingly
1725	10	26	10	34	While outlining climate policy implementation strategies (under heading Accelerating the global response to climate change: on page 9 of the document), it is essential to focus on "global environmental governance" (GEG). The GEG is the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection. The efficacy of global environmental governance will ultimately depend on implementation at global and domestic levels. [Mishra Santosh Kumar, India]	Accepted - we have rephrased accordingly
19713	10	28	10	29	A useful reference that makes this point about the risk of uneven adoption of zero carbon pathways by countries is the Mary Robinson Foundation's report on Zero Carbon, Zero poverty. Zero Carbon Zero Poverty: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Mary Robinson Foundation, 2015. Online at http://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Rejected - Only peer reviewed articles can be accepted
1910	10	28	10	29	does not allow for free-ring: The formulation is a bit measleading. You want to say, that the target of 1.5 degress can not be reached with free riding. Ofcourse, actors can still free-ride on the mitigation efforts of others. Moreover, the sentence seems to contradict p.11 l.44 which stays that there is room for same actors to mitigate less than others. [Jasper Meya, Germany]	Taken into account - we will try to avoid this possible misunderstanding
5216	10	28	10	33	As the 1.5°C transition requires accelerated action, in multiple forms, across all world regions almost simultaneously, it does not allow for free-riding. Hence, a key governance challenge is how the gain from converging climate and sustainable development policies can contribute to the emergence of a world governance based on reciprocity (Ostrom and Walker 2005) and partnership (United Nations 2016a) and how different actors and processes in climate governance can reinforce each other to enable this (Gupta 2014; Andonova et al. 2017). This statement whle just barely steering clear of becoming policy prescriptive, does come dangerously close to words that promote some form of world governance. The critical few words that are missing here should be words that reinforce the voluntary nature of each nationally determined contribtuion in the context of the Paris Agreement. [Arthur Lee, United States of America]	Taken into account - we will pay attention not to this impression
14120	10	29	10	29	free-riding, suggest avoid jargon [Elvira Poloczanska, Germany]	Rejected - because this is a very common expression in economic literature. I do agree with you that it's just a bit obscure
19295	10	30	10	35	It may be useful to remind what are SS1 and SS2, for the chapter to stand alone. [Charlotte Vailles, France]	Accepted - we will do
7072	10	36	11	31	These are very general descriptions (new literature reaching the same old conclusions?), I was hoping for sectorial or regional evaluations, but maybe these are presented later? [Érika Mata, Sweden]	Accept. Table 4.1 already aims to give some information at the sectoral level, and as our insights in the final version of chapter 2 is improving, we aim to make this more concrete.
10548	10	36	13	49	Do not discuss the system. The same socio-econoic system that created the problems are being proposed to changed it, with some soco-technical changes. However this is not possibe in the long-term. You should discuss more more and challenge the current economic system. [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account. The new section 4.2.2.2 includes a brief discussion on this, although we note that peer-reviewed literature is sparse and the reviewer does not provide sources, unfortunately.
5736	10	36	16	43	The text in Section 4.2 is all too general and the pathways can be for adaptation of any level of warming, not just 1.5C. The text may be condensed in a Table which gives a summary of individual adaptation measures. [Hong Yang, Switzerland]	Accept. The text on adaptation is made more specific, and on mitigation more sectorally specific.
20662	10	36	16	43	For section 4.2, align discussion with each of the four pathways presented in chapter 1 to again keep reader focused on the holistic characteristics of each pathway and the implications of them. Without associated the implications with the four types of pathways, they are vague and lose some of their meaning for the reader. [Koko Warner, Germany]	Reject. In chapter 4, we only take the temperature stabilisation and overshoots into account as we are focussing on what needs to be the global response for 1.5C. In essence, the difference is not fundamental, both will require fast and accelerated action in all possible sectors.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
2788	10	40	11	31	There are also studies that estimate the maximum reductions that can be achieved through implementation of known mitigation technologies in one or more countries over a specified period. A recent example is Mark Z. Jacobson et al., 2017, 100% clean and renewable wind, water and sunlight all-sector energy roadmaps for 139 countries of the world, Joule. [Erik Haites, Canada]	Taken into account. Jacobson's work is cited in section 4.3.2. The specific focus of 4.2.1 (in SOD: 4.2.2) is the rate of change, which Jacobson does not explicitly address.
4808	10	43	10	44	The author should also look to a third strand of literature, covering historical and recent examples of diffusion of clean technologies in specific countries and sectors in a pace that, if generalised to more countries and sectors, would lead to fall in aggregate emissions in the range required by the commitment to limit warming to 1.5ºC. In first approximation, papers covering local examples of increase in the stock of clean technologies by 10% or higher in a year. [Valentino Piana, Italy]	Partly accept. A recent reference on upscaling policy targets is included (Roelfsema et al). The reviewer does not give any references for the suggestion he makes.
7070	10	49			Fouquet (2016) analyzes data until year 2000, with corresponding limited implications for regions with high technological and sustainable development. [Érika Mata, Sweden]	Noted. No action needed.
4929	10	53	10	55	With respect to adaptation pathways, models developed in the field of archaeology that describe pathway "pitfalls" such as rigidity traps are also relevant here. Recommend that the concepts of rigidity and path dependence and that such information is derived from and can be tested in archaeology be incorporated here (if only briefly). Relevant references include: 1.) Schoon, M., Fabricius, C., Anderies, J. M., & Nelson, M. (2011). Synthesis: Vulnerability, traps, and transformations-long-term perspectives from archaeology. Ecology and Society, 16(2). and 2.) Hegmon, M., Peeples, M., Kinzig, A., Kulow, S., Meegan, C., & Nelson, M. (2008). Social Transformation and Its Human Costs in the Prehispanic U.S. Southwest. American Anthropologist, 110(3), new series, 313-324. Retrieved from http://www.jstor.org/stable/27564014. [Marcy Rockman, United States of America]	Accepted - we have noted that examining historical pathways can help judge how past pitfalls can be avoided when undertaking adaptation pathways (which are forward looking).
18389	10	54	10	54	Can't find Gajjar reference in Mendeley [Wilfran Moufouma Okia, France]	Noted. It's been fixed.
6542	10	54	10	55	The year of publication for Gajjar et al. is not given. The same applies to Line 2 of page 11. [Victor Ongoma, Kenya]	Noted. It's a submitted paper, still under review, so a year of publication is not available.
9893	11	1	11	4	Forestry and agriculture are other sectors where multi-level stakeholder involvement in climate adaptation is of critical importance, refer to - Brown, H.C.P., Smit, B., Somorin, O.A., Sonwa, D.J. and Nkem, J.N. 2014. Climate change and forest communities: prospects for building institutional adaptive capacity in the Congo basin forests. Ambio 43(6): 759-769. Sova, C.A., Helfgott, A., Chaudhury, A.S., Matthews, D., Thornton, T.F. and Vermeulen, S. 2015. Multilevel stakeholder influence mapping: visualizing power relations across actor levels in Nepal's agricultural climate change adaptation regime. Systemic Practice and Action Research 28(4): 383–409. [Shipra Shah, Fiji]	Reject. Outside the scope of this section, but will forward the references to other sections in the chapter
14997	11	4	11	4	While the SDGs may be relevant to conceptualizing 'sustainable development' within the discussion of global warming of 1.5 degrees, the SDGs are not the focus of this exercise. Authors should stick closely to the mandate given to them from the Panel and not incorporate other goals which broaden the analysis of this report beyond the mandate of the IPCC and issues specifically relevant to global warming of 1.5 degrees. [Farhan Akhtar, United States of America]	Partly accepted. The discussion of the sustainable development implications of the pathways consistent with 1.5 warming is now moved to chapter 5 of the report.
6728	11	6	11	20	Under the second approach "how technologies have developed over time and contrasts those patterns against quantitative models to understand how contemporary technologies may develop in the future" it may be worth mentioning that nearly all models substantially underestimated the developments of renewables. See for example in Nature Energy 2, 17140 (2017): The underestimated potential of solar energy to mitigate climate change by F Creutzig et al : https://www.nature.com/articles/nenergy2017140.epdf [Jennifer Morgan, Netherlands]	Accept, text changed to: "Most recently, Creutzig et al. (2017) confirmed this for solar energy. "
17691	11	7	11	9	There will be a massive increase in electricity for transport, though this does not necessarily exceed 2°C by much: the pace electrification in transport in a 1.5 degree scenario is signifcantly fatser than in a 2 degree scenario. Similarly, the extent (across modes and regions) is signifcantly different (wider in terms of geographical scope, and also involving deeply road freight in terms of modeal coverage). This sentence seems to be very dismissive of these changes. I think this could be due to the limited increetal demand for electricity in a 1.5 degree scenario if compared with a 2 degree one, but this limited difference is likely to be imputable to greater modal shifts/behavioral changes, rather than a similar rate of adoption of electric vehicles. I think you should be careful not to give misleading indications. [Pierpaolo Cazzola, France]	Accepted. The sentences are revised to avoid the suggested misleading indications.
4659	11	8			Add explanation to IAMS and change abbreviation to "IAMs" format (see line 46 on the same page) [Radim Tolasz, Czech Republic]	Accept. Written in full.
14121	11	8	11	8	spell out acronym as first use [Elvira Poloczanska, Germany]	Accept. Written in full.
14244	11	8	11	8	The acronym IAMS (or IAM) doesn't appear to be defined anywhere. [Jason Donev, Canada]	Accept. Written in full.
1121	11	9		10	Over which temporal and spatial scales is this finding true? Implicitrly it suggest global, and foer time scales sufficient for a 1.5 degree scenario... [Rob Swart, Netherlands]	Accept. "over the course of the century" added.
17692	11	9	11	11	Incremental mitigation in transport compared to 2°C mainly comes from demand reductions (e.g. modal shift) and an increased use of biofuels in liquid energy carriers: I would be careful to dismiss modal shift as "incremental" to electrification. Modal shift is today the one of cheapest solutions available (provided that you account for the savings in road building to cover the cost of new public transpirt infrastructure), in conjunction with incremental energy efficiency improvements . Given its cost profile, modal shift should be portrayed as a major pillar for decarbonization to 1.5 degrees, not just a complement to electrification. I would also be careful to refer exclusively to "modal shift". Emissions can be saved also through solutions (such as urban densification and transot oriented developments) that enabe shorter trips, especially in cities. I think this should be reflected in the narrative. [Pierpaolo Cazzola, France]	Accepted. Sentence revised and a reference is made to scenarios results on the separate contributions of modal shift, biofuels, and electrifications to transport decarbonization
20320	11	9	11	11	Looking at Van Sluisveld et al. (2015), the decarbonisation rate indicator seems to be only consistent with historic rates when normalised by GDP, but not when taking other normalisation metrics, such as total primary energy. [Marine Gorner, France]	Accept, text revised to "van Sluisveld et al. (2015), based on five Integrated Assessment Models (IAMs), tentatively conclude that when metrics are normalized to GDP (as opposed to other normalization metrics such as primary energy), modelled rates of change of emissions over the course of the century are broadly consistent with past trends."
11057	11	11	8	11	Please clarify that Van Sluisveld 2015 only address energy supply in detail but not demad-side mitigation options. [Jakob Wachsmuth, Germany]	Accept. Text added.
7794	11	11	11	17	Missing here and in 4.3.3.1, where it may fit better with reference to this section, is the considerable evidence that modern efficiency, like modern renewables, exhibits expanding returns (Lovins 2017). That reference provides context: "Models based on scarcity and depletion cannot generate or tolerate expanding returns—e.g., when we buy more photovoltaics (PV) and wind-power, they get cheaper, so we buy more, so they get cheaper. IEA's wind and PV forecasts thus respectively rose 5× and 19× since 2000 without catching up with reality. Fundamental physical and commercial phenomena have made PV costs drop steeply for decades, not rising in a single year. Modern energy efficiency too can get bigger but cheaper, not just through mass-produced widgets like LEDs but also because integrative design spreads rapidly, substitutes brains and information for hardware, and depletes nothing but stupidity. / In short, today's energy transition exhibits not the Ricardian economics of scarcity, like diminishing returns to farmland and minerals, but the complementary modern economics of abundance, with expanding returns (Arthur 1999, 2004; Nagy et al. 2013). These flow from mass manufacturing of fast granular technologies with rapid learning, network effects, and mutually reinforcing innovations. More broadly, today's emergent paradigm for profitable climate stabilization envisions an energy-and-land-use transformation not slowed by incumbents' inertias but sped by insurgents' ambitions (Rockström et al. 2017; Abramczyk et al. 2017) " [Amory Lovins, United States of America]	Taken into account for the consistency with solar/wind estimates (see comment 6728). The other comments are references are outside the scope of this section.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7649	11	11	11	17	Missing here and in 4.3.3.1, where it may fit better with reference to this section, is the considerable evidence that modern efficiency, like modern renewables, exhibits expanding returns (Lovins 2017). That reference provides context: “Models based on scarcity and depletion cannot generate or tolerate expanding returns—e.g., when we buy more photovoltaics (PV) and wind-power, they get cheaper, so we buy more, so they get cheaper. IEA’s wind and PV forecasts thus respectively rose 5× and 19× since 2000 without catching up with reality. Fundamental physical and commercial phenomena have made PV costs drop steeply for decades, not rising in a single year. Modern energy efficiency too can get bigger but cheaper, not just through mass-produced widgets like LEDs but also because integrative design spreads rapidly, substitutes brains and information for hardware, and depletes nothing but stupidity. / In short, today’s energy transition exhibits not the Ricardian economics of scarcity, like diminishing returns to farmland and minerals, but the complementary modern economics of abundance, with expanding returns (Arthur 1999, 2004; Nagy et al. 2013). These flow from mass manufacturing of fast granular technologies with rapid learning, network effects, and mutually reinforcing innovations. More broadly, today’s emergent paradigm for profitable climate stabilization envisions an energy-and-land-use transformation not slowed by incumbents’ inertias but sped by insurgents’ ambitions (Rockström et al. 2017; Abramczyk et al. 2017) “ [Amory Lovins, United States of America]	Taken into account for the consistency with solar/wind estimates (see comment 6728). The other comments are references are outside the scope of this section.
7071	11	15			Geels et al. 2016a eller 2016b? [Érika Mata, Sweden]	Editorial
753	11	15	11	15	Geels et al. (2016) there are two in the reference list so is this 2016a or b? [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
13051	11	15	11	15	Gees et al 2016 has two references. It is Gees et al 2016a? [Caserini Stefano, Italy]	Editorial
4930	11	22	11	31	Re-stating comment from above regarding adaptation pathways and the effects of the past on the present, as these concepts and references should also be incorporated in this paragraph. With respect to adaptation pathways, models developed in the field of archaeology that describe pathway "pitfalls" such as rigidity traps are also relevant here. Recommend that the concepts of rigidity and path dependence and that such information is derived from and can be tested in archaeology be incorporated here (if only briefly). Relevant references include: 1.) Schoon, M., Fabricius, C., Anderies, J. M., & Nelson, M. (2011). Synthesis: Vulnerability, traps, and transformations-long-term perspectives from archaeology. Ecology and Society, 16(2). and 2.) Hegmon, M., Peeples, M., Kinzig, A., Kulow, S., Meegan, C., & Nelson, M. (2008). Social Transformation and Its Human Costs in the Prehispanic U.S. Southwest. American Anthropologist, 110(3), new series, 313-324. Retrieved from http://www.jstor.org/stable/27564014. [Marcy Rockman, United States of America]	Accepted - we have noted that examining historical pathways can help judge how past pitfalls can be avoided when undertaking adaptation pathways (which are forward looking).
18700	11	23	11	23	Strange wording - "we assume that time progreses forward" [Wilfran Moufouma Okia, France]	Accept. Changed to "trends proceed as in the past"
6729	11	23	11	24	The problem with these approaches is that they 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-4cniQbS0AdTeI2Un9QaTUWC--vl83PIlZ3AEtF9FW88bMEh_XBb6tzo9dR5YRBeUsYzzEY%3D&tracking_referrer=www.vox.com. [Jennifer Morgan, Netherlands]	Taken into account in the text. Creutzig et al included as a reference.
2233	11	25	11	25	Who are "we"? [Kenneth Möllersten, Sweden]	Accept, changed to "it" (twice)
2234	11	25	11	26	The implcations of the assumption here, that time is not linear, need to be elaborated in a clear way. [Kenneth Möllersten, Sweden]	Accept. Word "linear" added.
10248	11	25	11	27	Historical analysis is based on studying the events and long periods (e.g. see Fernand Braudel book Civilization and Capitalism, 15th–18th Centuries, vol. 3: The Perspective of the World) [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Noted. It goes beyond the scope of this section to take into account broader historical perspectives that are not directly applicable to global warming of 1.5C
5217	11	27	11	31	Assessments of the rate of change will vary accordingly, with extrapolating Studies emphasizing the slow, difficult process of change (Fouquet 2016) and fitting studies pointing towards the possible fast speed of (Wilson et al. 2013). Both approaches indicate that the rapidity of changes in the past have not necessarily been slower than the ones that pathways, including those assessed in Chapter 2, indicate. The assessment of both types of literature needs to incorporate an understanding of the technologies themselves. Technologies that had changed with "software" and little environmental and social footprint cannot be assessed as being directly comparable to energy technologies that require wholesale, massive scale-up with equipment and processes that need to obey the laws of thermodynamics, chemistry, and physics. In other words, processes that require large social and environmental footprint cannot be compared to technological changes that required only the miniaturization of things. For example, there is no "Moore's Law" for thermodynamics, which is not a law anyway but was a simple empirical observation made by Gordon Moore about integrated circuits, and has often been erroneously cited by some as an optimistic projection for future changes. [Arthur Lee, United States of America]	Taken into account. The observation that Moore's Law may not apply to mitigation technologies, with public perception and scaling challenges, for instance, is valid. The point on such technologies is made in Van Sluisveld et al, as referenced.
18701	11	29	11	29	End of sentence seems to be missing words - "the possible fast speed of" [Wilfran Moufouma Okia, France]	Accept. "the changes" added.
16400	11	29	11	29	the possible fast speed of what. Giving a reference here without explaining what is meant just does not help the reader not very familiar with the literature. [Michael MacCracken, United States of America]	Accept. "the changes" added.
17230	11	29	11	29	the possible speed of … : Hanging sentence [Himangana Gupta, India]	Accept. "the changes" added.
7796	11	29	11	31	Syntax incorrect, meaning unclear. [Amory Lovins, United States of America]	Accept. "the changes" added.
7801	11	29	11	31	Syntax incorrect, meaning unclear. (Sorry, I must reenter this here, and the next four comments, because I must not have clicked in the right place before copying from Word.) [Amory Lovins, United States of America]	Accept. "the changes" added.
7650	11	29	11	31	Syntax incorrect, meaning unclear. [Amory Lovins, United States of America]	Accept. "the changes" added.
7655	11	29	11	31	Syntax incorrect, meaning unclear. (Sorry, I must reenter this here, and the next four comments, because I must not have clicked in the right place before copying from Word.) [Amory Lovins, United States of America]	Accept. "the changes" added.
14071	11	29	11	31	Provide examples and be concrete about the rapidity that is implied here. [Elvira Poloczanska, Germany]	Accept. Text changed to "technological transitions in mobility, fuel switch or energy supply".
10996	11	34	11	34	Lot of overlap with Chapter 2 [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Section revised to address overlaps
1209	11	34	13	49	I still don't understand what this sub-section 4.2.2 tries to achieve. The text is mainly about emission reduction pathways and some smaller parts on impacts, with very little to nothing on vulnerabilities and adaptation; yet, this sub-section claims to be in line with the AR5 definition of climate-resilient pathways. As discussed previously, Ch5 deals in detail with climate-resilient development pathways, bringing adaptation, mitigation, development, poverty reduction, and equity and justice together, in a way that we think is more useful to the reader than this section. Why muddy the waters? [Petra Tschakert, Australia]	Accepted. Section revised and the current version better addresses your concerns
14072	11	34	13	49	The environmental implications of non-fossil fuel technologies needs to be included - impacts on natural habitats & local communities of huge increase in extraction of rare earth minerals e.g. nickel, lithium, cobalt for electric cars, need for closed loop/circular economy innovations [Elvira Poloczanska, Germany]	Accepted. That is true but the plan for this section is stocktaking so the focus will be on the broader synthesis while leaving the details to other sections of chp 4 and other chapters. Section revised to further reflect this.
5735	11	36	11	39	Not sure if this part is a note for later expansion. [Hong Yang, Switzerland]	Accepted. The section now revised and better addresses your concerns
18390	11	37	11	37	Rogelj et al (2015) not linked to Mendeley [Wilfran Moufouma Okia, France]	Done

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10995	11	41	11	42	We need to address non-overshoot and anor sweep them away because they're not in the scenario database [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Yes, Currently we have only Rogelj et al (2015) for 1.5c. We expect the new ensemble of scenarios to be available soon will have non-overshoot IAM scenarios. We are also looking for non-IAM scenario literature from chapters 3 and 5 to fill this gap.
6732	11	41	11	49	Similar to comments above, despite recognizing that social preference may accelerate the transition, the report takes IAMs at face value pointing out that all1.5 oC pathways show an overshoot and that it will not be reached without secuestration technologies, more promienently BECCS. [Jennifer Morgan, Netherlands]	Rejected. Not true. We are looking at all the scenarios and literature consistent with 1.5c whether IAM or non-IAM, overshoot or without overshoot. The current assessment is based on the current vintage of IAM reviewed in Rogelj et al (2015), BUT as noted in the first paragraph we waiting to incorporate the new ensemble from IAM scenarios that may include ones without overshoot as well as we are looking into the non-IAM literature from chapters 2, 3 and 5.
16401	11	41	11	42	I think it quite misleading to use the name "1.5 C pathways" for pathways that overshoo 1.5 C but then come back to that value; the names of pathways should be based on the maximum value they reach rather than some eventual lower number, which is where we should be aiming for all pathways in order to minimize impacts. In particular, there is also really no good scientific reason to accept stabilization at 1.5 C as acceptable given the severe impacts that will be occurring at the value, especially after having overshot 1.5 C; this is especially the case as reaching back to 1.5 C after overshooting will be causing very severe consequences for the leaders of the nations that have suggested this value (i.e., sea level rise that will be on course to be undating low lying island nations quite possibly before one gets back to 1.5 C). In my view, the notion of 1.5 C is that that should be the ceiling and effort should be made to get back to 0.5 C or so. Thus, what we would want is a pathway that peaks at 1.5 C and returns to less than 0.5 C, and if the pathway is going to take conditions up to 2 or 3 C, this has to be noted in the name of the pathway--if we can overshoot and come down to 1.5 C, we can overshoot and come back down to 0.5 C, it would just take more effort on Carbon Dioxide Removal. And the near-term maximum temperature can be moderated by Solar Radiation Management, an important option to be discussing. So, there are lots of pathways--and let's name them by the maximum increase that they reach as that will be a key determinant of the damage done, even if the temperature later cools down. [Michael MacCracken, United States of America]	Rejected. The naming and framing convention adopted in the whole report are defined and discussed in chapter 1. Here our interest is on assessing scenarios and literature that achieve 1.5 whether with or without overshoot. It is true that the implications for impacts and adaptation will be different whether there is overshoot or not and we are looking into literature to reflect those implications.
6730	11	41	11	43	"The main characteristics of 1.5°C pathways can be summarized as follows: they are below the emissions pathways of RCP2.6 in AR5, and all feature temperature overshoot. Global GHG emissions will need to change from the current ca. 50 GtCO2eq yr-1 to become net zero by mid-century and net negative thereafter." Why we assume only scenarios that global GHG emissions become net zero by mid-century (or by 2060-80 as later stated) and then the need for significant net negative emissions? Are scenarios becoming net zero much earlier than mid-century seriously considered (and much less need for negative emissions)? [Jennifer Morgan, Netherlands]	Accepted. These are the characteristics from the IAM scenarios consistent with 1.5c as reviewed in the Rogelj et al (2015). This neither exhaustive nor conclusive and we are waiting for new modeling literature from IAM as well as from non-IAM to incorporate any additional features
7073	11	44		45	Why should regions with high emissions achieve zero emissions and not all regions reduce their emissions? Is this conclusion based in a particular modelling result? It looks like a typical methodogical issue, e.g. that a IAM takes one-big solution in instead of several smaller solutions just because the model cannot do otherwise. [Érika Mata, Sweden]	Accepted. Sentence deleted.
4809	11	44	11	45	These statements, in particular the words "this implies that large emitters, and regions and cities with high emissions, will need to achieve net-zero emissions by the 2030s", are key to the whole report and should be in bold, passed up to the summaries. [Valentino Piana, Italy]	Noted.
2235	11	45	11	46	Why do these particular emitters need to achieve net-zero by 2030? Really, the determining factor is how the global emissions develop and to what extent one or several individual emitters need to reach net-zero by a certain time must depend on how the sum of all global emissions develop. [Kenneth Möllersten, Sweden]	Accepted. Sentence deleted.
5116	11	45	11	49	Given the scale of concern about the efficacy, feasibility, and appropriateness (and potential harm) of BECCS (and the initial discussion of concerns and potential harm in Chapter 3.7.2.1), it is important to flag that here, even if discussed in greater detail later in the chapter. [Tonya Rawe, United States of America]	Rejected. Our assessment is based on the literature and models assessed by chapter 2. Indeed there are more options to remove carbon beside BECCs and that we are not preferring one over the other and fairly assess them all in section 4.3.6
7074	11	46		48	Are IAMs needed to arrive to such an evident conclusion (a)? [Érika Mata, Sweden]	Accepted. Not necessary, but the available literature is mostly IAM
16404	11	46	11	49	It really does seem to me that additional CDR approaches merit consideration, especially as the costs of further mitigation and of impacts increase so higher CDR costs, including direct air capture become cost effective. I also think that SRM needs to be listed here as an option for peak shaving--so not full blown cancellation of warming and substitute for mitigation, but a relatively small supplement to mitigation. Ignoring discussion of these options seems like a censoring of information that decision makers might well want to have. [Michael MacCracken, United States of America]	Accepted. Subsection 4.3.6 deals specifically with the different CDR technology options including their potentials and costs while subsection 4.3.7 deals with SRM in details
6731	11	51	11	52	"Almost the entire assumed abatement potential for non-CO2 GHGs is already exhausted in 2°C scenarios, so few additional reductions are possible in the 1.5°C pathways." Is this also true for e.g. methane emissions from agriculture - livestock; oil/gas extraction/transportation; wastewater management? [Jennifer Morgan, Netherlands]	Accepted. Statement revised
6788	11	51	12	12	The statement that there is no room for enrgy demand increase is inccorect. This holds only true if the increase coms from fossil sources and should be spelled out. If the increased energy demand is supplied by carbon neutral energy sources, the demand can increase. [Arnulf Jaeger-Waldau, Italy]	Accepted. Statement revised
6789	11	51	12	12	No energy source is "carbon-free", but low carbon or can be made carbon neutral. [Arnulf Jaeger-Waldau, Italy]	Accepted. Will consider use the term "low carbon" than "carbon free"
6790	11	51	12	12	Why is there no mentioning of synthetic fuels made out of CO2 from the atmosphere and renewable energies? [Arnulf Jaeger-Waldau, Italy]	Accepted. The CCSU applications as fuel and other uses are discussed in other subsections of the chapter (see section 4.3)
6791	11	51	12	12	Energy related GHG emissions are only 65% of total emissions. Another 20% are industry and 15% agriculture. If the industry should be decarbonised, biomass will be necessary as raw material and will not be available for energy use. [Arnulf Jaeger-Waldau, Italy]	Accepted. Section revised. The competition for land for feedstock and food and for energy are addressed in section 4.3.
4810	11	52	11	54	The statement "There is almost no room for growth in energy demand" should be rather qualified as "There is almost no room for growth in energy demand covered by emission-emitting sources:" If a certain source of energy does not emit GHG why shouldn't cover demand? Indeed, with the energy-intensive production of panels and turbines drawing on already-installed renewables, thus with emissions in Life Cycle Analysis falling to zero, their current and NDC-induced boom is a key condition for limiting warming to 1.5ºC, the more so as they are becoming the cheapest ones to provide electricity to the grid. See e.g. https://www.theguardian.com/environment/2017/may/10/indian-solar-power-prices-hit-record-low-undercutting-fossil-fuels, ttps://www.bloomberg.com/news/articles/2017-06-01/cheaper-solar-in-india-prompts-rethink-for-more-coal-projects, with relation to 1.5ºC highlighted by https://www.carbonbrief.org/india-planned-coal-plants-could-single-handedly-jeopordise-one-point-five-target quoting http://onlinelibrary.wiley.com/doi/10.1002/2017EF000542/full and, for a world-wide perspective, https://data.bloomberglp.com/bnef/sites/14/2017/04/2017-04-25-Michael-Liebreich-BNEFSummit-Keynote.pdf [Valentino Piana, Italy]	Accepted. Statement revised
18702	11	53	11	53	350 to 450 represents a 30% increase, which seems large enough to not refer to this as "almost no room for growth" [Wilfran Moufouma Okia, France]	Accepted. Sentence revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7332	11	54	11	55	Delete the text "If left unmanaged, this could have significant implications for the achievement of SDG7 on universal affordable access to clean energy by 2030, with potential limits to the reduction in poverty in fossil". [Eleni Kaditi, Austria]	Accepted. Sentence deleted
20621	12	1		12	Synthetic fuels from recycled CO2 need to be considered [Hans Poertner, Germany]	Accepted. The CCSU applications as fuel and other uses are discussed in other subsections of the chapter (see section 4.3)
17231	12	1	12	1	Fuel intensive' instead of fuel intense [Himangana Gupta, India]	Accepted. Sentence removed
7333	12	1	12	1	Delete the text "fuel intense economies and regions." [Eleni Kaditi, Austria]	Accepted. Sentence removed
14998	12	4	12	4	this paragraph -- this chapter? [Farhan Akhtar, United States of America]	Accepted. Fixed
16402	12	5	12	5	this paragraph or this section? [Michael MacCracken, United States of America]	Accepted. Fixed
10914	12	7			This statement is imho clearly wrong : There won't be a "massive increase in electricity for transport". Studies in Switzerland and UK have given results of 10-15 % increase in electricity consumption for electric cars. However electricity use from well-to-car must be substracted. DOE (Department Of Energy) estimated in 2009 "6 kWh pro Gallon" for refining. A number confirmed by various industry sources, which gives around 1.5 kWh per liter. Add transport, pumping, electricity for distribution in gas stations instead of at home or work for approx 0.5 kWh per liter. Total 2.0 kWh/liter of electricity to bring gas to car (not counting wells). As ICE cars efficiency is less than 20 %, typically 15-20 % in real-world mixed trafic situations, and a liter gas has 10 kWh primary energy, mechanical end energy of a liter is 1.5-2 kWh, which is the same than the electricity used to produce the gas. Thus if we convert whole terrestrial and air transportation to battery-powered electricity, and shut down the corresponding fuel production, we will not consume any more electricity. For shipping industry, heavy fuel might not use as much electricity, but shipping industry can convert to wind+PV-electricity, not consuming more electricity from the grid than what gets saved. See Jacobson's study too. The above remark should imho be added to the report, as it is fundamental to debunk the general belief that Evs will increase electricity use. [Beat Brunner, Switzerland]	Accepted. Sentence revised
16403	12	7	12	8	This sentence does not really make sense, at least to me. [Michael MacCracken, United States of America]	Accepted. Sentence revised
4811	12	7	12	8	As for the electrification of transport, given the widely different carbon budget and the total decarbonisation of electricity already been necessary for "well below" 2ºC, it is very unlikely that electrification of trasport "not necessarily exceed[ing] 2ºC by much". The sentence could be transformed into: "With the rapid decarbonisation of electricity production, electrification of trasport becomes more effective in decreasing indirect emissions". [Valentino Piana, Italy]	Accepted. Sentence revised
3071	12	7	12	8	I do not see the connection between the first and latter halves of the sentence starting with "Furthermore …" [Christopher Bataille, Canada]	Accepted. The sentence is deleted
4812	12	9	12	10	The author should be more clear in underlining second-generation biofuels and biomethane, which have significant less conflicts with food production. Accordingly, the sentence "... in general below)" could be integrated with "... in general below), including bio-methane and second-generation biofuels". [Valentino Piana, Italy]	Accepted. Emphasis removed
7075	12	10		12	Lower emissions mean HIGHER reduction rates, right? [Érika Mata, Sweden]	Accepted. Sentence revised
11143	12	10	12	12	1.5°C scenarios feature reduction rates of 25% and 50% lower than for 2°C respectively - this implies that the rates of emission reductions are lower for 1.5 (i.e. slower reductions). Consider rewording. [Michiel Schaeffer, Netherlands]	Accepted. Sentence revised.
7076	12	14		15	Great if the figure could show regions and sectors. [Érika Mata, Sweden]	Accepted. The revised version included a table on sectoral targets. Regional details are not there yet and will depend on availability and consistency of results from the forthcoming IAM and non-IAM scenarios literature from chapter 2
12945	12	18	12	39	Climate resilient pathway. Ch5 has climate resilient develipment pathway . There is need for coordination. Also mentions of SSPs as in ch 2 . Ch 5 and ch2 discusses respective concepts and pathways in details so here can it be dropped with appropriate references? [Joyashree Roy, India]	Accepted. Subsection removed and discussion deferred to chapter 5
17680	12	28	12	28	The chapter refers to "equity, fairness and justice" but does not define them. For relevant literature on what this means in the context of mitigating climate change to avoid dangerous climate change see Simon Caney 'Two Kinds of Climate Justice: Avoiding Harm and Sharing Burdens', Journal of Political Philosophy, vol.22 no.2 (2014), 125-149 Simon Caney 'Just Emissions', Philosophy & Public Affairs, vol.40 no.4 (2012), 255-300; Simon Caney '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 'Cosmopolitan Justice, Responsibility, and Global Climate Change', Leiden Journal of International Law, vol.18 no.4 (2005), 747-775. [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Subsection removed and discussion deferred to chapter 5
20622	12	30		35	uncler how mitigation success is achieved in the SSPs [Hans Poertner, Germany]	Accepted. Section revised to remove ambiguity.
545	12	30	12	30	The emission pathways form the IAM literature… This section would benefit from discussing the prior as well as more comprehensive literature on solution pathways to global warming, including the 100% clean, renewable wind, water, solar (WWS) pathways of Jacobson, Delucchi et al. published in the documents below, which call for 80% conversion to WWS in all energy sectors by 2030 and 100% by 2050. This transition is shown in http://web.stanford.edu/group/efmh/jacobson/Articles/I/CountryGraphs/TimelineWorld.png, which is found in Figure 2 of Jacobson et al. (Joule, 1, doi:10.1016/j.joule.2017.07.005, 2017), cited below. Such a transition is found to reduce CO2 levels in the atmosphere to almost 350 ppmv by 2100 (http://web.stanford.edu/group/efmh/jacobson/Articles/I/CountryGraphs/CO2ChangesWithWWS.pdf) [Mark Jacobson, United States of America]	Accepted. Results from the suggested references are reflected.
546	12	30	12	30	(1) Jacobson, M.Z., and M.A. Delucchi, A path to sustainable energy by 2030, Scientific American, November 2009; [Mark Jacobson, United States of America]	Accepted. The references are added to Mendeley and will be considered for citation
547	12	30	12	30	(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; [Mark Jacobson, United States of America]	Accepted. The references are added to Mendeley and will be considered for citation
548	12	30	12	30	(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; [Mark Jacobson, United States of America]	Accepted. The references are added to Mendeley and will be considered for citation
549	12	30	12	30	(4) Jacobson, M.Z., R.W. Howarth, M.A. Delucchi, S.R. Scobies, J.M. Barth, M.J. Dvorak, M. Klevze, H. Katkhuda, B. Miranda, N.A. Chowdhury, R. Jones, L. Plano, and A.R. Ingraffea, Examining the feasibility of converting New York State's all-purpose energy infrastructure to one using wind, water, and sunlight, Energy Policy, 57, 585-601, 2013; [Mark Jacobson, United States of America]	Accepted. The references are added to Mendeley and will be considered for citation
550	12	30	12	30	(5) Jacobson, M.Z., M.A. Delucchi, A.R. Ingraffea, R.W. Howarth, G. Bazouin, B. Bridgeland, K. Burkhart, M. Chang, N. Chowdhury, R. Cook, G. Escher, M. Galka, L. Han, C. Heavey, A. Hernandez, D.F. Jacobson, D.S. Jacobson, B. Miranda, G. Novotny, M. Pellat, P. Quach, A. Romano, D. Stewart, L. Vogel, S. Wang, H. Wang, L. Willman, T. Yeskoo, A roadmap for repowering California for all purposes with wind, water, and sunlight, Energy, 73, 875-889, doi:10.1016/j.energy.2014.06.099; [Mark Jacobson, United States of America]	Accepted. The references are added and considered for citation

Comment No	From Page	From Line	To Page	To Line	Comment	Response
551	12	30	12	30	(6) Jacobson, M.Z., M.A. Delucchi, G. Bazouin, Z.A.F. Bauer, C.C. Heavey, E. Fisher, S. B. Morris, D.J.Y. Piekutowski, T.A. Vencill, T.W. Yeskoo, 100% clean and renewable wind, water, sunlight (WWS) all-sector energy roadmaps for the 50 United States, Energy and Environmental Sciences, 8, 2093-2117, doi:10.1039/C5EE01283J, 2015a [Mark Jacobson, United States of America]	Accepted. The references are added to Mendeley and will be considered for citation
552	12	30	12	30	(7) Jacobson, M.Z., M.A. Delucchi, G. Bazouin, M.J. Dvorak, R. Arghandeh, Z. A.F. Bauer, A. Cotte, G.M.T.H. de Moor, E.G. Goldner, C. Heier, R.T. Holmes, S.A. Hughes, L. Jin, M. Kapadia, C. Menon, S.A. Mullendore, E.M. Paris, G.A. Provost, A.R. Romano, C. Srivastava, T.A. Vencill, N.S. Whitney, and T.W. Yeskoo, A 100% wind, water, sunlight (WWS) all-sector energy plan for Washington State, Renewable Energy, 86, 75-88 2016; [Mark Jacobson, United States of America]	Accepted. The references are added to Mendeley and will be considered for citation
553	12	30	12	30	(8) Jacobson, M.Z., M.A. Delucchi, Z.A.F. Bauer, S.C. Goodman, W.E. Chapman, M.A. Cameron, Alphabetical: C. Bozonnat, L. Chobadi, H.A. Clonts, P. Enevoldsen, J.R. Erwin, S.N. Fobi, O.K. Goldstrom, E.M. Hennessy, J. Liu, J. Lo, C.B. Meyer, S.B. Morris, K.R. Moy, P.L. O'Neill, I. Petkov, S. Redfern, R. Schucker, M.A. Sontag, J. Wang, E. Weiner, A.S. Yachanin, 100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for 139 countries of the world, Joule, 1, doi:10.1016/j.joule.2017.07.005, 2017 [Mark Jacobson, United States of America]	Accepted. The references are added to Mendeley and will be considered for citation
554	12	30	12	30	(9) 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, 2015b [Mark Jacobson, United States of America]	Accepted. The references are added to Mendeley and will be considered for citation
10997	12	30	12	35	Treatment of the SSPs is opaque for the non-afficionados! [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. SSPs are introduced and defined in chapter 2. The objective here is to take stock of their implications for mitigation, adaptation, and impacts. More referencing to that extent is now reflected.
3072	12	37	12	39	Is this section still to be written? If so I refer you to the Deep Decarbonization Pathways Project (DDPP). "Bataille, C., H. Waisman, M. Colombier, L. Segafredo, and J. Williams (2016) The need for national deep decarbonization pathways for effective climate policy, Climate Policy, 16:sup1, S1-S6. DOI: 10.1080/14693062.2016.1179620" [Christopher Bataille, Canada]	Accepted. The reference provided is added to Mendeley and will be considered for citation. The DDPP project has already been referred to in the box in section 4.4 as well on policy cases.
4813	12	37	12	39	For an example of non-IAM relevant literature, see Jacobson et al. 100% Clean and Renewable Wind, Water, and Sunlight (WWS) All-Sector Energy Roadmaps for 139 Countries of the World. Joule, 2017 DOI: 10.1016/j.joule.2017.07.005 See also REN21 Renewable Global Futures Reports, 2017. [Valentino Piana, Italy]	Accepted. Reference added and results are cited
5117	12	37	12	39	In discussion of non-IAM literature, it could be helpful to include in the contrast with IAM the factors that prompt inclusion of particular approaches (like BECCS). (e.g. cost of land assumed to be available for BECCS to be at a scale) Why is BECCS so prominent in IAMs as a "feasible" technology? What factors were not considered? These are important questions to include discussion of, given how much promise is now being put into BECCS, when others are raising significant questions about the feasibility -- socially as well as technologically -- of BECCS. [Tonya Rawe, United States of America]	Accepted. The scope, potential and feasibility of BECCS are discussed in section 4.3.
19715	12	42	12	45	Need to explore the implications of 1.5 pathways on human rights. This issue is unpacked in the publicaton listed in the line above. [Tara Shine, Ireland]	Accepted. Based on availability of 1.5c relevant literature, the human rights dimension is treated under governance and SD in other sections of the chapter as well as in chapter 5
3615	12	43	12	45	feasibility is missing – yes scale, implications for adaptation and implications for policy-making but where is feasibility? [Stewart Fast, Canada]	Accepted. Feasibility is treated in section 4.3, particularly see 4.3.1.
7077	12	51		52	Is there other literature really- specific for the 1.5C to 2C comparison - than the IAMs in such a short timeframe? [Érika Mata, Sweden]	Noted. Some Non-IAM relevant literature cited. Further, Chapter 2 is looking into non-IAM literature and we waiting to take stock of that assessment for this section
1122	12	52			Not only energy and lifestyles, also in other areas (industry, agriculture and forestry, finance) transformations may be required. [Rob Swart, Netherlands]	Accepted.
7078	12	52		53	I do not remember this specific investment requirement from Chapter 3, but anyway, is relative investment useful? I investment useful at all, given all uncertainties related to costs (see comment in row 39 above)? May it be more useful to set reduction targets an investigate with other - non IAMs - tools how to achieve them? [Érika Mata, Sweden]	Accepted. Cited investment number from chapter 2 are correct. It is true that both investment costs and mitigation outcomes are relevant when comparing IAM with non-IAM pathways. Nonetheless, we are constrained to assess what the literature says
7797	12	52	12	54	This statement is almost certainly incorrect. (I assume Chapter 2 draws it from the same outdated reference as 4.2.3.4 does.) [Amory Lovins, United States of America]	Noted.
7798	12	52	12	54	Please see my comment on p 4-15, lines 9–14. [Amory Lovins, United States of America]	Noted
7802	12	52	12	54	This statement is almost certainly incorrect. (I assume Chapter 2 draws it from the same outdated reference as 4.2.3.4 does.) Please see my comment on p 4-15, lines 9–14. [Amory Lovins, United States of America]	noted.
7651	12	52	12	54	This statement is almost certainly incorrect. (I assume Chapter 2 draws it from the same outdated reference as 4.2.3.4 does.) [Amory Lovins, United States of America]	Noted.
7652	12	52	12	54	Please see my comment on p 4-15, lines 9–14. [Amory Lovins, United States of America]	Noted
7656	12	52	12	54	This statement is almost certainly incorrect. (I assume Chapter 2 draws it from the same outdated reference as 4.2.3.4 does.) Please see my comment on p 4-15, lines 9–14. [Amory Lovins, United States of America]	noted.
1123	12	53			More investments, or "different" investments? 40% more than without temterature target, which seems to refer to some unknown BaU, but a BaU is undefined and can be anything...Change or in any case add reference. [Rob Swart, Netherlands]	Accepted. References to chapter 2 added.
4814	13	2	13	11	The comparison between 1.5ºC and 2ºC scenario is not the most appropriate for a Special report that has been requested by UNFCCC in order to frame and inform the NDC update following the Facilitative Dialogue in COP24. What is crucial is the difference between 1.5ºC and the temperature expected as result of the implementation of current NDCs ("3.2°C by 2100 and 3.0°C, if conditional Intended Nationally Determined Contributions are included", p. xvii, UNEP, Emission Gap Report 2016). This comparison provides much more evidence of avoided climate impacts in stabilizing temperature at 1.5ºC. Accordingly, the author should add, after the current l. 11, a sentence about this other comparison. [Valentino Piana, Italy]	Accepted. The framing question is addressed in chapter 1. The relevance to NDCs is dealt with in a different section of chapter 4 and in the x-chapter box on NDCs.
9841	13	3	13	4	A forecasting projection should be developed to evaluate the investment necessary to handle the outcomes of these significant increases in temperature and precipitation (infrastructure destruction, health hazards, etc) and compare and contrast this projected crisis management investment to the investment necessary to prevent such from happening. Such a comparative perspective might induce higher approval for preventive investment. [Yana POPKOSTOVA, France]	Accepted. Unfortunately there is no peer-reviewed literature on investment scale and magnitudes for adaptation yet and we are working with chapter 3 on these fronts.
18391	13	5	13	5	Wang et al. 2017b not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9890	13	6	13	12	The paragraph is disappointing and it alone provides for a very good campaign against the need of acceleration of efforts to remain below 1.5 C. If, as stated "the avoided climate impacts of moving from 2 to 1.5 C warming are difficult to define" then why bother to push for accelerating change and allocating higher investment to such an effort? I do not see the need of this paragraph - it does not add any knowledge, facts or arguments and is a patch to a report which is holistically persuasive on the pertinency and feasibility of moving to a 1.5 ambition. This paragraph should be deleted. [Yana POPKOSTOVA, France]	Rejected. The objective here is not to persuade for the urgency or feasibility of 1.5c but rather to provide a balanced assessment of its implications. Section revised and emphasis is made more clear
1124	13	7	13	27	These paragraphs seem to fit better in Chapter 3. [Rob Swart, Netherlands]	Accepted. The section takes a high level assessment of what is considered in more details in chapters 3 and 2, so some of the statements that may seem to better fit in chapter 2 or 3, do also fit here for that purpose.
20623	13	17		27	study, schleussner et al. elaborates on impact on a RCP8.5 trajectory. This shortcoming should be mentioned as it excludes stablization and asscociated long-term impacts. Sea level rise is likely strongly underestimated. [Hans Poertner, Germany]	Noted.
18703	13	17	13	17	A little unclear what is meant by the % reductions here [Wilfran Moufouma Okia, France]	Accepted. The reductions are in relation to the risk level of 2c. Sentences are revised.
19320	13	17	13	17	why SRM is emphasized here and later, beside the classical adaptation and mitigation options? Isn't SRM a (climate change) mitigation strategy? [Marco Mazzotti, Switzerland]	Rejected. 4.2.2.2 has not mentioned SRM at all, the SRM is discussed in 4.3.7.
18382	13	17	13	17	The bibliographic entry for IPCC, 2014 should have the title as just "Climate Change 2014: Impacts, Adaptation, and Vulnerability" if intending to refer to both Parts A and B of the AR5 WGII report. Right now if just refers to Part B. [Wilfran Moufouma Okia, France]	Accepted.
14245	13	19	13	19	'90 %' should be 90% [Jason Donev, Canada]	Accepted. Fixed and sentence revised
19296	13	21	13	27	Wouldn't it be possible to present the changes from a 2°C to a 1,5°C? (and not the other way around). It would seem as more positive [Charlotte Vailles, France]	Noted.
9891	13	21	13	28	This paragraph directly negates the statement made in the paragraph c/o on line 7. Here, we can certainly observe that median water availability changes dramatically between a 1.5 and 2 C scenario. [Yana POPKOSTOVA, France]	Rejected. There is no contradiction. The earlier statement relates to the broader IAM literature(typically based on model inter-comparisons) while the later is specific to a single study. The forthcoming literature is expected to provide more insights into this issue.
10915	13	25			"about 10 cm" should be "minimum 10 cm", and "estimated 50 cm" should be "estimated minimum 50 cm" [Beat Brunner, Switzerland]	Accepted. Sentence fixed
4815	13	25	13	28	A crucial piece of literature to be quoted here is Drijfhout, S. et al. Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models. Proc. Natl. Acad. Sci. 201511451 (2015). doi:10.1073/pnas.1511451112 which demonstrates that "20% of thresholds of abrupt shifts crossed for 1.5°C compared to 50% at 2°C". The importance of such paper has been stressed also by Schneussner presentation to August 2016 Scoping meeting for this Special Report (https://www.ipcc.ch/report/sr15/pdf/presentations/sr15_scop_Impacts_on_Ecosystems_Schleussner.pdf). [Valentino Piana, Italy]	Noted.
10916	13	27			To be noted that 50 cm rise by 2100 for a 2°C scenario is an conservative (optimistic) estimate, not taking in account unverified hypothesises (like speed of Groenland melting). Thus the difference with 1.5°C could be significantly more than 10 cm (which represents a 20% increase in projected rising for a 33 % increase in global temperature rise). [Beat Brunner, Switzerland]	Noted.
11042	13	30	13	49	Decision-making is strongly affected by "politics", in every governance dimension, on any level. See, among others, Brunsson 2009 (The consequences of decision-making); Geden 2016 (The Paris Agreement and the inherent inconsistency of climate policymaking); Cairney 2016 (The politics of evidence-based policymaking); Victor 2013 (Global Warming Gridlock), Vogler 2015 (Climate Change in World Politics). [Oliver Geden, Germany]	Rejected. The provided references are added to the database. The politics, governance and institutions behind decision making are dealt with in other sections of the chapter (e.g. section 4.4)
11041	13	33	13	33	Why "some literature"? Is there any literature suggesting otherwise? [Oliver Geden, Germany]	Accepted. Sentence revised
5118	13	33	13	36	And does other literature offer a different take on the level of resources, costs, and efforts required, to present a balanced picture of the literature? And to avoid what may appear to be an alarmist statement? [Tonya Rawe, United States of America]	Accepted. Sentence revised
19297	13	34	13	36	Over which period would occur the doubling of the mitigation costs and the tripling of the carbon price? [Charlotte Vailles, France]	Accepted. By mid 2050 [2030-2080]. Sentence revised.
19298	13	34	13	36	The avoided impacts of a lower warming seem difficult to neglect [Charlotte Vailles, France]	Noted.
555	13	34	13	36	Su et al. showed that achieving 1.5 C would…double the mitigation cost. This claim is contradicted entirely by Jacobson, M.Z., M.A. Delucchi, Z.A.F. Bauer, S.C. Goodman, W.E. Chapman, M.A. Cameron, Alphabetical: C. Bozonnat, L. Chobadi, H.A. Clonts, P. Enevoldsen, J.R. Erwin, S.N. Fobi, O.K. Goldstrom, E.M. Hennessy, J. Liu, J. Lo, C.B. Meyer, S.B. Morris, K.R. Moy, P.L. O'Neill, I. Petkov, S. Redfern, R. Schucker, M.A. Sontag, J. Wang, E. Weiner, A.S. Yachanin, 100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for 139 countries of the world, Joule, 1, doi:10.1016/j.joule.2017.07.005, 2017 who show that a 100% wind-water-solar (WWS) has 1/4th the social cost as a fossil fuel world, and the energy cost in both cases is virtually the same. [Mark Jacobson, United States of America]	Accepted. References are added to the database. Referencing to relevant sections of chapter 2 is added
7079	13	35			what is "the mitigation cost"? [Érika Mata, Sweden]	Accepted. Mitigation costs are measured as GDP (Gross Domestic Product) loss. Sentence revised.
14073	13	38			Where are policy implications for adaptation discussed? They should relate to the findings from 4.2.2.2.2, i.e. coral bleaching, water availability, and sea-level rise. [Elvira Poloczanska, Germany]	Accepted. Policy options for adaptation are addressed in sections 4.3 and 4.4
7080	13	41		42	Annual building renovation rates of 3% to NZEB by 2020 may be also worth be reminded of. (Actually all key point by sectors could be mentioned and not just a couple of examples?) [Érika Mata, Sweden]	Rejected. All examples are now removed from the section due to space
556	13	41	13	43	Examples consistent with 1.5 C include… Please include as examples U.S.Senate Resolution 632, House Resolution 540, Senate Bill 987, and the U.S. House "100 by '50 Act.", all of which call for the U.S. to go to 100% clean, renewable energy by 2050. Similarly, California and Hawaii have laws or proposed laws to go to 100% clean, renewable energy by 2045 in the electriciy sectors. [Mark Jacobson, United States of America]	Rejected. All examples are now removed from the section due to space
6200	13	41	13	43	I know these two examples are only meant to be indicative, but neither on their own could be actually regarded as consistent with 1.5C unless they went along with other changes. i.e. the 100% renewable electricity system only really is consistent with 1.5C if it also involves the electrificiation of transport, home heating, and cooking. Logically, that electricity decarrbonisation could occur in part by de-electrifying some activities, i.e. shifting electric cooking to natural gas, which would be unlikeley to be consistent with 1.5C. The value of these examples could be more precise. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. All examples are now removed from the section due to space
6733	13	41	13	43	"Examples consistent with 1.5°C include a fully renewable electricity system by 2035 (a policy target by Denmark) or a low-carbon steel industry by 2050." Fully renewable electricity system by 2035 even if at global seems too late for 1.5C and net zero emissions (especially as non-electricity energy sectors will follow only later) and again assumes very significant role for negative emission technologies [Jennifer Morgan, Netherlands]	Rejected. All examples are now removed from the section due to space
7081	13	48		49	could one specify who "a range of people" is? [Érika Mata, Sweden]	Accepted. All examples are now removed from the section due to space

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12470	14				Not sure whether in this assessment section 4.2.3 is entirely necessary. This is not assessing the literature in the context of the objective of the chapter. [Dr Noim UDDIN, Australia]	Rejected, discussion of framing systematic issues was an IPCC request, and thus part of our mandate
14074	14	1			This section deals mainly with mitigation and only occasionally with adaptation. In fact, some of the sections do not mention adaptation at all. This should be more balanced, or at least made clear in the introduction of this subchapter. [Elvira Poloczanska, Germany]	Taken into account - we deleted 4.2.3 so no longer relevant
14999	14	1	14	44	I would consider three buckets here, social, technological, and financial innovation. Disruptive and socio-technical innovation is fine, but financial innovation is missing -- i.e., new financial instruments/mechanisms/models to provide climate finance. In the innovation discussion, it could also be helpful to reference the cross cutting concept of National Systems of Innovation (TEC brief #7 -- unfccc.int/ttclear/misc_/...static/TEC.../60d1580f741a4bc783da5a00cf64a879.pdf) [Farhan Akhtar, United States of America]	Taken into account, financial systems are discussed in 4.4.6
19071	14	1	16	43	Writing about "radical transition", "disruptive innovation"and "Socio-technical innovation" under "4.2.3 Framing systemic issues: resilient economic systems, social systems, innovation systems [...]" would require a mention to Giovanni Dosi's concept of "technological paradigm", which is fully comprenhensive and suitable concept to this section. It will be suggested to incluide a reference, e.g.: Dosi, G. (1982). 'Technological Paradigms and Technological Trajectories. A Suggested Interpretation of the Determinants and Directions of Technical Change'. Research Policy 11, 147-162, reference also available as Dosi, G., & Nelson, R. R. (2016). Technological paradigms and technological trajectories. The Palgrave Encyclopedia of Strategic Management, 1-12 [Miriam Solera Ureña, Germany]	Taken into account, we included more recent references on socio technical innovation that covers Dosi's work
19073	14	1	16	43	When framing systemic issues, it would be recommended to include a reference to developed-developing countries solidarity, such as technology and know-how transfer to developing countries in order to improve their resilience [Miriam Solera Ureña, Germany]	Taken into account, solidarity issues are discussed in Chapter 5, see Box 5.4 'Alternative Development Pathways and Transnational Movements'
20624	14	1	16	43	While the discussion of principles in transformaton and effort is much appreciated, policy makes would appreciate a quantitative assessment of effort for 1.5 vs. 2°C if at all possible. [Hans Poertner, Germany]	Taken into account, included where possible
16405	14	4	14	10	Given the reporesentation of the goal of the Paris Agreement is to stay "well below 2 C temperature rise, or below 1.5 C"--how is it that so much of this report is focused around an end goal of stabilization at one of these two levels? Pretty clearly, the goal is to not be having severe impacts and there will be very significant impacts at these levels and commitments to much greater impacts over time as sea level continues to rise, etc. I just do not see how focusing on 1.5 C equilibrium pathways after overshoots is consistent with the goal the negotiators are talking about--they quite clearly want any overshoot to come back to at least below 1.5 C (and if informed of the consequences at this level, would prefer to be back below 0.5 C). So, again, why focusing on stabilization at 1.5 C (and naming pathways to get only to this level)? [Michael MacCracken, United States of America]	Taken into account, this report aims to impact of global warming of 1.5C and related GhG emission pathways, which is the mandate of this report - see section 1.2
4816	14	4	14	18	Before the paragraph on Disruptive innovation, the author should insert a paragraph on "Fast diffusion of existing state-of-art clean technologies". Indeed many zero emission technologies exist, several countries are already at - or near - 100% renewables and zero emissions (land cover included), thus copying best-in-class examples would be highly impacting total emissions. In the timeframe of the exhaustion of the carbon budget of 1.5ºC, there may be not enough time for totally new technologies to ramp up market penetration in a way that makes the difference. The two classes of tehcnologies should not be opposed to each other but both included in the chapter. [Valentino Piana, Italy]	Accepted and noted (eg. We refer to roof top solar, energy storage in section 4.2.3.1)
19716	14	6	14	10	Human rights law is a useful framework when considering social issues. [Tara Shine, Ireland]	Taken into account, Chapter 5 makes reference to human rights as part of climate-resilient development pathways (section 5.7.3.2)
557	14	6	14	7	1.5C cannot be achieved using climate mitigation alone. This claimi is contradicted directly by the 100% WWS roadmaps referenced above plus the resulting CO2 levels shown in http://web.stanford.edu/group/efmh/jacobson/Articles/I/CountryGraphs/CO2ChangesWithWWS.pdf [Mark Jacobson, United States of America]	Accepted, we removed the text 'cannot be achieved using climate mitigation policy alone, and'
6734	14	13	14	30	These 3 short paras seem to miss the scale of disruptive mpact of existing technologies (e.g. established renewable technologies, existing storage solutions and grid solutions etc); the significance of technologies emerging (e.g. new renewable technologies; new storage solutions); such large cross-cutting technologies like blockchains etc and - what is perhaps the most important - the combination interplay of all of these above in helping to reduce emissions. [Jennifer Morgan, Netherlands]	Accepted and noted (eg. We refer to roof top solar, energy storage in section 4.2.3.1)
10549	14	13	14	44	The discussions of the idea of disruptive innovation need sto be more socially and politically embedded. Firms have no interest in disruptive sustainble innovation, excepot if they will profit from that, which many times comes with losses for the rest of the society. You should move beyond the mainstream neoclassical economics to challenge the discussions on innovation beyond the Scumpeterian views. [Jose Antonio Puppim de Oliveira, Brazil]	Accepted, governance and institutional capacities are discussed in 4.4

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7888	14	13	14	30	Include references / mention of the developments of a global Circular Economy and transition from a Linear to a Circular system e.g: Siemens and the Industry 4.0 movement. Valuable examples of solutions to combating GHG emissions is evident in the industry sector. Companies need to be approached by governing bodies in an effort to develop more dynamic interaction and consultation with them on the whole issue of eco-design and design for recovery and recyclability at the beginning lifecycle of a product or piece of infrastructure Increasingly, companies from all sectors are having to confront and adapt to a range of disruptive forces including globalisation, increased urbanisation, intense competition for raw materials and natural resources and the revolution in technology is challenging the business models of many sectors while forcing all companies to be more accountable to, and transparent with, all their stakeholders. A Circular Economy model provides for embedded goals of the SDGs (including combating climate change - Mitigation and Adaptation) to be addressed from the beginning of the value loop. Technology enhances the flexibility and efficiency of production processes. Companies like Siemens are working toward the complete integration and digital representation of the physical manufacturing environments. This means working on and in virtual copies of manufacturing sites (a little like a computer gaming environment) – prior to the actual installation of any hardware or devices on the factory floor. Digitalization for the future means living in a world that's increasingly interconnected by complex and heterogeneous technology systems; & by the yr 2020, around 50 billion technology devices will be linked online. The Digitalisation of businesses will help to support this regenerative, optimizing and exchange environment for a CE. Developments in technologies and services help companies to reduce the consumption of energy and natural resources by optimizing the processes of manufacturing, leaning the processes, and reducing wasted energy, materials and efforts. And all these aspects are accomplished through the digitalization, electrification and automation of industrial systems - it's the systematic enabling of technology, IoT, using Artificial Intelligence to think and predict the processing stages in an effort to operate business more efficiently and thus reduce negative environmental impacts. Business environments operate through and with mountains of data which informs all that they do in the various divisions of business operations. The data indicates trends and movements for own goals, aspirations and project work. Digital Factories solutions / virtual design mechanisms / IoT/ Industry 4.0 / Energy Performance contracting services business are all endeavours that are helping to inform the development of a more sustainable circular economy. Other examples in businesses already experimenting and developing within the Sharing Economy space include what is now commonplace real-time carpooling/ taxi services(Uber) renting of spare rooms (airb&b) activities etc and insight and lessons learned (the good and the bad) from new and digitalized businesses facilitated through the use of apps on smartphones, and their approaches, can be used to help to guide the more traditional businesses to transform to the CE approach. A major consideration in looking at the CE is the Pace of Change in technology and specific indicators like a return on development or r&d per ¼ metric, or annual application software systems uptake by new products. These are able to inform a company (and government / research institutes etc through collaboration) of the trending changes in working habits. The ability to interpret information, and the closer integration of data systems across connected devices and across multiple sources is crucial to streamlining the digitalisation evolution. Recently there have been technological developments in software platforms (Clouds for the Industry sector) and allows connectivity among devises and pieces of hardware across varied data sources to harness key information for better industrial operations – and the value to a company is in the ability of a company to change and optimise their operational flows and reduce its emissions. A factory that is able to maximize cost advantages by adjusting its production output to current resource prices without human intervention is offered by	Taken into account, industrial systems are now discussed in 4.3.5
10550	14	13	14	44	Socio-technical transitions discussions have several gaps in practice. First the political-economy gap. It will noty happen if there is no political support, which many times does not exists, as the powerfull economic actors, like oil and construction companies, have much more power than those that want the transition. Second, the socio-technical transitions assume that the capabilities for the transitions already exists, what is not true in many countries, particularly developing countries. [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account, this in 4.4. Socio technical innovation happens all across the world
6201	14	13	14	44	It seems to me the logical sequence is to reverse these two subsections. I.e. the principal point here is that to think about 1.5C entails thinking about a major socio-technical transition. The transitions literature tells us various things about this. One of these is that innovation that shifts systems from one state to another is disruptive, and often leads to existing assets being stranded. In deed it seems to me then that the other subsections in this section follow logically as different elements are important to shaping transitiosn (finance, policy, etc). [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, disruptive and socio technical innovations are not necessarily related, so their is no hierarchy
6735	14	14	14	30	It'sgood to have included a section (albeit brief) on disruption. However, far more discussion is needed on this topic to flesh out the true potential of disruption to accelerate the pace of change beyond historical trends and beyond what traditional modeling approaches have predicted. This is especially critical in light of the rapid need to transform the energy system and the risks and costs associated with relying on CDR approaches. The RMI report, Positive Disruption, outlines the ways in which solar, batteries and other renwable energy solutions are disruptive solutions that can result in non-linear changes in the energy system thus making it possible to limit warming below 2 degrees without using CDR approaches. What's more, this section states that "rooftop solar may be disruptive" when in fact PV in general IS disruptive (no caveat needed). See Creutzig et al 2017 (lined to in cell above). The uptake of LED lightbulbs is another example of the potential rapid change that is possible and the disruption happening in the electricity system. https://thinkprogress.org/5-charts-that-illustrate-the-remarkable-led-lighting-revolution-83ecb6c1f472/ [Jennifer Morgan, Netherlands]	Taken into account, reference is a news article
19388	14	14	14	30	Disruptive innovation is mentioned as a potental source of systems change, towards climate mitigation. Particular innovations in the energy sector have been mentioned. is there a desirable rate of adoption of disruptive technologies? [Sumetee Pahwa Gajjar, India]	Taken into account, a key characteristic of disruptive change is that it is not predictable. There is no literature linking this literature to modelling reported in chapter 2
18392	14	15	14	15	Christensen (1997) not linked to Mendeley [Wilfran Moufouma Okia, France]	Editorial
7901	14	16	14	20	It is not just the gross climate finance that the the MDBs and national development banks are delivering, but net climate finance, which includes 'brown' investments. As long as 'brown' flows dominate, staying beloe 1.5 deg will be impossible. [Westphal Michael, United States of America]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
20827	14	18	14	21	I think it is important to explicitly include health as a category of co-benefit in this section. In fact, the Shaw et al reference cited here deals mainly with the health co-benefit of increased physical activity associated with walking and cycling (rather than livelihoods). This benefit is not explicitly mentioned in the report and yet (especially in developed countries where sedentary lifestyles prevail) it has the potential to far outweigh the more obvious co-benefits of reduced air pollution (Smith, A.C., Holland, M., Korkeala, O., Warmington, J., Forster, D., Apsimon, H., Oxley, T., Dickens, R. & Smith, S.M. (2015), Health and environmental co-benefits and conflicts of actions to meet UK carbon targets. Climate Policy. DOI:10.1080/14693062.2014.980212) [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, these are indeed significant co-benefits. Synergies and trade-offs between Adaptation and Health, as well as Mitigation and health, are discussed in sections 5.3 and 5.4 respectively (see also 4.4.3 that climate action may have other benefits)

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1383	14	18	72	7	I like a lot the research from Newman, and agree with the arguments supported by references to it, however it would be beneficial for the robustness of the arguments in the draft to provide a larger diversity of authors and works supporting the arguments currently referred to the large number of citations to Newman's work. [Roger Cremades, Germany]	Taken into account, other references are included
16406	14	20	14	24	I would just add that in the energy field there has not until recently been the incentive or captial to bring alternatives to fossil fuels to the market. With the increasing pressure to do so, there are all sorts of potential approaches that could contribute that just need to be fostered. For example, battery technology is developing rapidy--and once there is a shift to ultra-capacitor batteries that do not rely on chemical reactions, the obstacles of unacceptably long recharge times and of lmiting them to 1000 cycles or so will be overcome, and so the transportation needs of those now coming of age in developing nations of south Asia and Africa will be able to be met in much easier and less costly and impactful ways that building up the infrastructure for long-term continuation of use of petroleum (for an example of emerging progress, see http://www.microtrontec.com). And, of course, solar and wind technologies are becoming far less costly and their use has many indirect benefits as well (and next paragraph makes this point on one type of solar). What is needed is an opportunity for the new technologies to emerge and some reasonable incentive for their use. [Michael MacCracken, United States of America]	Taken into account, this is discussed in 4.3
9336	14	23	14	23	The phrase "economic feasible" may read "economically feasible" [Siir KILKIS, Turkey]	Editorial
9899	14	23	14	25	Absolutely. Therefore notions of historic trends on technological path dependencies are futile and should not be relied upon in designing scenarios and methodologies for 1.5 C transition. [Yana POPKOSTOVA, France]	Noted and taken into account
1291	14	29	14	30	The implications (principally economic and societal) of stranded assets should be mentioned in at least one additional sentence. [Colin Raymond, United States of America]	Accepted, included now
7799	14	29	14	30	Stranded assets can be technical assets (like power plants, oilfields and wells, or refineries) and fuels. Carbon Tracker has published extensive analyses of stranded assets across the range of hydrocarbons, lately including coal. [Amory Lovins, United States of America]	Accepted and noted
7804	14	29	14	30	: Stranded assets can be technical assets (like power plants, oilfields and wells, or refineries) and fuels. Carbon Tracker has published extensive analyses of stranded assets across the range of hydrocarbons, lately including coal. [Amory Lovins, United States of America]	Taken into account
7653	14	29	14	30	Stranded assets can be technical assets (like power plants, oilfields and wells, or refineries) and fuels. Carbon Tracker has published extensive analyses of stranded assets across the range of hydrocarbons, lately including coal. [Amory Lovins, United States of America]	Accepted and noted
7658	14	29	14	30	: Stranded assets can be technical assets (like power plants, oilfields and wells, or refineries) and fuels. Carbon Tracker has published extensive analyses of stranded assets across the range of hydrocarbons, lately including coal. [Amory Lovins, United States of America]	Taken into account
7803	14	29	14	31	Syntax incorrect, meaning unclear. [Amory Lovins, United States of America]	Editorial
7657	14	29	14	31	Syntax incorrect, meaning unclear. [Amory Lovins, United States of America]	Editorial
16407	14	29	14	30	Given that the climate change issue has been getting extensive discussion since the 1992 Earth Summit and Kyoto Agreement, it is time to stop calling much of the fossil fuel infrastructure "stranded assets" and start calling it what it is, namely "bad investments" or even, given that the fossil fuel companies mischaracterized the science and opposed policy changes that would have allowed a slower pace of change, "fraudulently derived investments"--those who have such investments should well have (and likely did) know better but did it any way, and for that they deserve no sympathy. So, I would urge use of another phrase for such investments--it is not as if such investments are guaranteed as is provided for bank deposits, etc. (at least in some countries). [Michael MacCracken, United States of America]	Rejected, this would be a normative intervention that is not backed up in the scientific literature
3697	14	30			Consider adding literature on stranded assets in a developing country - coal rather than oil: Burton, J, Caetano, T, Hughes, A, Merven, B, Ahjum, F & McCall, B 2016. The impact of stranding power sector assets in South Africa. Cape Town, Mitigation Action Plans and Scenarios (MAPS). http://www.erc.uct.ac.za/sites/default/files/image_tool/images/119/Papers-2016/2016-Burtonetal-Impact_stranding_power_sector_assets.pdf [Harald Winkler, South Africa]	Taken into account
4817	14	30	14	31	It is important to mention also that new investment in assets that will soon become stranded should be avoided. Accordingly, after the end of current paragraph ".... Breyer 2017). New investment in further assets that would soon become stranded is economically damaging to the investor and expensive to be compensated by policymakers, so before such investment a full study of future remuneration and amortization should be carried out leading, in many cases, to cancellation". [Valentino Piana, Italy]	Taken into account, but not necessary to add
3616	14	33	14	44	some reference to separate “social innovation” literature would be helpful here [Stewart Fast, Canada]	Accepted, added
14246	14	34	14	35	“The idea of technological transitions has been advanced by economists since Schumpeter and Kondratief who talked about industrial change coming in waves (Šmihula 2009; Adams and Mouatt 2010).” Are these historical economists? It’s strange to not be citing their work but someone else talking about them? When did they talk about this? [Jason Donev, Canada]	Taken into account, Smihula and Adams and Mouatt and other build on Schumpeter and Kondratief. So original citation not needed
4818	14	42	14	42	The quoted Kemp et al. 1998, a seminal paper, is pretty old and does not relate to climate change (it does not even mention it). A more recent piece of literature, directly relating to mitigation of climate change is Caniëls, M.C.J. and H.A. Romijn (2009), ‘Strategic Niche Management as a Policy Instrument for Climate Change Mitigation’, in: V. Piana (Ed.), Innovative Economic Policies for Climate Change Mitigation. Economics Web Institute: Rome, Italy, 67-82. It would be appropriate to quote both. [Valentino Piana, Italy]	Accepted, added
9337	14	43	14	44	The statement "functional approaches through technological innovation systems (Hekkert et al. 2007; Bergek et al. 2008) are applied in practice to develop policy responses to innovation challenges" may be supported by additional references from the literature. These include the integration of the functional approaches literature and sustainability-oriented innovation systems. An example may be given as K?lk??, ?., (2016) Sustainability-oriented innovation system analyses of Brazil, Russia, India, China, South Africa, Turkey and Singapore, Journal of Cleaner Production Volume 130, 1 September 2016, Pages 235-247" <https://doi.org/10.1016/j.jclepro.2016.03.138>. [Siir KILKIS, Turkey]	Accepted, added
10551	14	47	15	5	The idea of decoupling does not work in the long term (see Daly, 1998; Jackson, 2009; Dale et al. 2016, etc.) both in theory and practice with the economic system we have. The rebound effect is one limiyttation, but also the dependency of the market economy on grow to keep it viable. In the long term we will have an increase of the emissions or a collapse into the system. The OECD and UNEP examples of decoupling are change from carbon intensive fossil fuels to other fossil fuels, such as gas, which in the case of the USA comes from fraking that leads to many negative environmental consequences, [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account, our assessment of the scientific literature reveals decoupling is happening
1292	14	48	14	49	The term 'a range of people' is unnecessarily vague. [Colin Raymond, United States of America]	Taken into account, the sentence has been removed

Comment No	From Page	From Line	To Page	To Line	Comment	Response
925	14	48	15	5	the concept of decoupling economic growth from use of fossil fuels could be better explained. An example of how the economy can grow without increased use of fossil fuels should be given. For example, with increased service-oriented industries, the economy can grow without an increase in fossil fuels. Perhaps a similar argument can be made about the tech sector, if references are available. Also, rebound effects are mentioned but not described. The author should define what a rebound effect is and how it historically has affected this decoupling of fossil fuels and economic growth. I have only heard of the rebound effect being used in the context of energy efficiency as energy used is cut as devices are more efficient and then users tend to use more energy because their overall bills are down. [Elizabeth Aldrich, United States of America]	Taken into account, our assessment of the scientific literature reveals decoupling is happening, also in China and India. The references included do explain the rebound effect
14247	14	48	15	5	The idea of decoupling needs to be treated more carefully. It seems that the access to energy rather than fossil fuels is what drives wealth. The evidence of decoupling needs to include ideas like improvements in energy intensity (how much economic good can be achieved for a given amount of primary energy) or, in this context, carbon intensity (how much economic good can be achieved for a given amount of released carbon in an economy). Jurisdictions like Ontario were historically able to decouple their wealth from fossil fuels by changing their electricity portfolio to include significantly more nuclear power. Presumably, other jurisdictions will be able to drive decoupling through other primary energy substitutions whether it be solar, wind, biofuels or what have you. In general, energy intensity has been improving with time for most countries, and this point should be underscored as a more general point than what is taken from (von Weizsäcker et al. 2014; Newman 2017). A number of countries have long gotten a significant fraction of their electricity from hydropower (Canada, Brazil, Norway, to name a few) or geothermal (Iceland). The great difficulty on this decoupling arises from the transportation sector with its historic lack of petroleum alternatives for primary motive power. [Jason Donev, Canada]	Taken into account, we added a line on fossil fuels but not land use
4819	14	49	14	49	The word "people" is a little bit diminutive; perhaps it would be better to substitute it with "scholars". [Valentino Piana, Italy]	Taken into account, the sentence has been removed
9901	14	51	14	52	Vigilance is needed. The paragraph uses wealth and economic growth interchangeably and there is difference between the two notions. "decoupling of economic growth and prosperity accumulation from fossil fuel consumption" is a more accurate phrase. [Yana POPKOSTOVA, France]	Accepted, changed into economic growth
7082	14	53			On rebound effects in the Swedish building sector: J Nässén, J Holmberg -Quantifying the rebound effects of energy efficiency improvements and energy conserving behaviour in Sweden, Energy Efficiency, 2009 [Érika Mata, Sweden]	Taken into account, newer and broader references that focus on decoupling are included
18704	14	54	14	54	Global emissions have decoupled over the past two years? [Wilfran Moufouma Okia, France]	Taken into account, revised
1542	14	54	14	55	IEA speaks about decoupling between world GDP and GHG emissions in a strange way : GHG emissions considered are not the total anthropogenic emissions but only a subset (i.e. fossil and industry emissions, but not land use and forestry emissions). If one looks at all anthropogenic emissions (including land use and forestry), there has been continuous growth these last years, up to 2016 at least (see fig 3 of Global Carbon Budget 2016 : https://www.earth-syst-sci-data.net/8/605/2016/). It does not seem very scientific to talk about decoupling when considering only part of man-made emissions, especially at a time when there are policies in place to increase substitution of fossil fuels by biomass (solid or liquid). The extent to which the increase in land use and forestry emission is linked to this substitution of fossil fuels is not clear, but could need some attention. Anyway, the text should be clear that no decoupling is observed when considering the whole of man-made GHG emissions. [Noé Lecocq, Belgium]	Taken into account, we changed text into fossil fuels but not land use
6736	14	54	15	2	This framing entirely ignores the (acknolwedged) role that RE and EE has played in decoupling. Even the IEA states that decoupling is largely the result of increased deployment of RE and EE and reduced coal use in China. It's utterly inaccurate to omit this. [Jennifer Morgan, Netherlands]	Taken into account, due to EE and RE
17232	14	55	14	55	This would be a wrong statement. Though the growth of world economy has decoupled from growth in emissions, we still cannot say the decoupling is absolute. This may be true for some developed economies, but major emitters have still not reached a stage where economic growth has decoupled from emission growth. [Himangana Gupta, India]	Rejected, scientific literature shows decoupling is happening and IEA suggests it is now absolute
4751	14	55	14	55	Insert semicolon before "Newman (2017)" [Valentino Piana, Italy]	editorial - not needed, this is start of new sentence
12946	15	2	15	2	Dcouping in Indian context also is in AR5 WGIII chapter 10 , also in recent literature. • Dasgupta Shyamasree and Joyashree Roy (2016), Analysing energy intensity trends and decoupling of growth from energy use in Indian manufacturing industries during 1973-74 to 2011-12, Energy Efficiency, pp 1-19, doi:10.1007/s12053-016-9497-9.ISSN: 1570-646X (Print) 1570-6478 (Online), For china -An analysis of the driving factors of energy-related CO2 emission reduction in China from 2005 to 2013 , Tianyu Qi , Yuyan Weng, Xiliang Zhang, Jiankun He , Energy Economics 60 (2016) 15–22 [Joyashree Roy, India]	Taken into account, the text on decoupling has been shortened
19389	15	3	15	4	Decoupling of wealth from environmental harm is dependent upon social innovation and disruptive technologies. To achieve 1.5 the rate of disruptive innovation must increase. At the same time, the rate of such innovations is unpredictable. There is thus a logical contradiction wrt what is cited from Newman 2017 - a normative outcome is desired from an unpredictable process . [Sumetee Pahwa Gajjar, India]	Taken into account, please note that it is emphasised here that the rate is unpredictable, we do not refer to the extent
19390	15	4	15	5	The relevance of disruptive innovation at city level is mentioned but not explained / expanded (Swilling et al, 2013) [Sumetee Pahwa Gajjar, India]	Accepted, explanation added
10917	15	5			Decoupling of economic growth and energy use is also due to the competitive advantage of efficiency, which has become the driving force, while the economy of scarcity has become an economy of plethora where efficiency (and thus energy efficiency too) has become a key competitive advantage. This reinforces decreases in energy consumption. [Beat Brunner, Switzerland]	Taken into account, we needed to shorten the text on decoupling
9902	15	5	15	7	For the decoupling process to be accelerated and sustained, and the energy transformation bolstered, an accelerated knowledge transfer needs to be achieved. The development and dissemination of tailored information campaigns, case studies and learning materials at local level has proven to achieve considerable results in terms of popular demand for action, bottom-up mandate for strong policy mechanisms and accelerated investment into low-carbon assets spurred by repetitional and business benefits. [Yana POPKOSTOVA, France]	Accepted, accelerating response is discussed in 4.4.5 (now 4.4.3) including tailored information campaigns
10552	15	8	15	25	The financial system is a reflection of the economic system. No surprise it is not sensitive to long term needs, which require many radical changes in the short term. [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account; this is explicitly discussed in section 4.4.6
17386	15	8	15	25	The decoupling of finance could be emphasised here, with standard currency being used which is both a means of exchange and a store of value. Where the requirement for the uptake of specific technologies and low carbon pathways being the key focus, this becomes increasingly important. The multiplier effect can be substantially enhanced with this decoupling. Bernard Lietaer & Jacqui Dunne, 2013 Rethinking Money: How New Currencies Turn Scarcity into Prosperity, Berrett-Koehler Publishers, NY [Gavin Allwright, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, this is discussed in 4.4.6
6737	15	8	15	30	There have been major examples proving the financial value of fossil free portfolios. E.g. FTSE has ex-fossil global and regional indices to pair its global indices of thousands of companies. These “ex-fossil” indices are not perfect but exclude 100-150 major fossil companies. Their returns have been higher and their volatility have been lower in every timeframe (3M, 6M, 12M, 3YR, 5YR) that than the underlying full indices. http://www.ftse.com/Analytics/FactSheets/temp/87ca7a99-f9a6-4760-97e4-b4098a1c4331.pdf [Jennifer Morgan, Netherlands]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6738	15	8	15	30	The section could also mention the significant divestment developments (https://gofossilfree.org/) including by some of the largest asset holds and asset managers of the world and the Task Force on Climate-related Financial Disclosures (https://www.fsb-tcfd.org/) [Jennifer Morgan, Netherlands]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
19391	15	8	15	52	It will be useful to link section 4.2.3.5 institutional change and political leadership, and section 4.2.3.4 Financial systems to boxes which contain some examples from practice, in addition to citations. [Sumetee Pahwa Gajjar, India]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
1125	15	8	15	25	The relatively short length of this section in my view underestimates the importance of the financial sector, with mutiple players. Arguably, much of the information is not (yet) in the peer reviewed literature. The Tassk-Force of Climate-Related Disclosures may be noted as an incentive to move the privater sectoer including the financial sector in more sustaineble directions. The EU has made climate risk assessment for pension funds mandatory http://www.reuters.com/article/us-eu-finance-climatechange-idUSKBN13J1SV . Companies increasingly take into account Environmental, Social and Governance (ESG) criteria to enhance the sustainability and ethical impact of their investments (from a Social Corporate Responsdibikluity point of view). The risks (of climate impacts but also of - 1.5 degree - climate policy) for the stability of financial sector should also be noted, e.g., http://www.nature.com/nclimate/journal/v7/n4/full/nclimate3255.html?WT.feed_name=subjects_business&foxtrotcallback=true . Also reference to the role of complementary currencies aiming at redirecting societies into more sustaonable directions could be noted (even if not specifically refering to 1.5 degrees). There is an emerging literatire on this, even a journal https://ijccr.net/ , or F. Verhagen: "Resolving Climate Change Through Monetary Transformation " [Rob Swart, Netherlands]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
7800	15	9	15	14	How can a 2008 reference be reliable in 2017? In 2008 nearly everyone assumed renewables would cost much more than fueled resources? n\Now we know they cost less. (NREL's REFs study indicated slightly higher costs in 2010, but when rerun a few years later, showed same-or-lower costs vs business-a-usual (BAU), and since then costs have fallen dramatically.) Lovins & RMI (2011), summarized by Lovins (2015, 2015a), showed in great detail that with 2x US GDP growth 2010–50, practical and proven means deployed at historically reasonable rates could profitably achieve 3x energy efficiency, including 4x electric efficiency by 2050, plus 5x renewables and 82–86% lower fossil CO2 emissions with 2.6x GDP, would save $5 trillion NPV in private internal cost. (So far, this trajectory is on track in the marketplace 2010–16.) Similarly, the Chinese government's top energy agency (ERI 2017, Price et al. 2017, Zhou et al. 2016) showed that 2010–50 Chinese 7x energy productivity, 13x carbon productivity, 67% shift off fossil fuels (83% in the power sector), 80% off coal, and 42% CO2 reduction (despite 7x GDP growth) would save $3.1 trillion NPV in private internal cost. (This uniquely detailed and rigorous study, reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior authors of the 13th Five Year Plan, which it strongly informed.) To be sure, the cashflow profile differs between these strong-efficiency-and-renewables trajectories and BAU, but not only to efficiency and most renewables now have not only reduced capital intensity but also much shorter lead times and faster paybacks than marginal fossil-fueled systems, so their intensity-times-velocity capital requirements are generally even lower. And as I'll note in TK, modern energy efficiency using integrative design (in all sectors, Lovins 2010) typically exhibits not diminishing returns but expanding returns and declining capital intensity with scale (Lovins 2017). [Amory Lovins, United States of America]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
7805	15	9	15	14	How can a 2008 reference be reliable in 2017? In 2008 nearly everyone assumed renewables would cost much more than fueled resources? n\Now we know they cost less. (NREL's REFs study indicated slightly higher costs in 2010, but when rerun a few years later, showed same-or-lower costs vs business-a-usual (BAU), and since then costs have fallen dramatically.) Lovins & RMI (2011), summarized by Lovins (2015, 2015a), showed in great detail that with 2x US GDP growth 2010–50, practical and proven means deployed at historically reasonable rates could profitably achieve 3x energy efficiency, including 4x electric efficiency by 2050, plus 5x renewables and 82–86% lower fossil CO2 emissions with 2.6x GDP, would save $5 trillion NPV in private internal cost. (So far, this trajectory is on track in the marketplace 2010–16.) Similarly, the Chinese government's top energy agency (ERI 2017, Price et al. 2017, Zhou et al. 2016) showed that 2010–50 Chinese 7x energy productivity, 13x carbon productivity, 67% shift off fossil fuels (83% in the power sector), 80% off coal, and 42% CO2 reduction (despite 7x GDP growth) would save $3.1 trillion NPV in private internal cost. (This uniquely detailed and rigorous study, reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior authors of the 13th Five Year Plan, which it strongly informed.) To be sure, the cashflow profile differs between these strong-efficiency-and-renewables trajectories and BAU, but not only to efficiency and most renewables now have not only reduced capital intensity but also much shorter lead times and faster paybacks than marginal fossil-fueled systems, so their intensity-times-velocity capital requirements are generally even lower. And modern energy efficiency using integrative design (in all sectors, Lovins 2010) typically exhibits not diminishing returns but expanding returns and declining capital intensity with scale (Lovins 2017). [Amory Lovins, United States of America]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
6739	15	9	15	25	No mention of the divestment movement as a recognition of the risk of continued fossil fuel invesment. http://www.tandfonline.com/doi/abs/10.1080/14693062.2015.1094729 [Jennifer Morgan, Netherlands]	Taken into account, this is discussed in 4.4.6
13052	15	9	15	25	I believe that this part is relevant ad should be expanded; the risk of stranded assets should be mentioned; i.e. Fuss et al 2016 Substantial risk for financial assets. Nature [Caserini Stefano, Italy]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
7654	15	9	15	14	How can a 2008 reference be reliable in 2017? In 2008 nearly everyone assumed renewables would cost much more than fueled resources? n\Now we know they cost less. (NREL's REFs study indicated slightly higher costs in 2010, but when rerun a few years later, showed same-or-lower costs vs business-a-usual (BAU), and since then costs have fallen dramatically.) Lovins & RMI (2011), summarized by Lovins (2015, 2015a), showed in great detail that with 2x US GDP growth 2010–50, practical and proven means deployed at historically reasonable rates could profitably achieve 3x energy efficiency, including 4x electric efficiency by 2050, plus 5x renewables and 82–86% lower fossil CO2 emissions with 2.6x GDP, would save $5 trillion NPV in private internal cost. (So far, this trajectory is on track in the marketplace 2010–16.) Similarly, the Chinese government's top energy agency (ERI 2017, Price et al. 2017, Zhou et al. 2016) showed that 2010–50 Chinese 7x energy productivity, 13x carbon productivity, 67% shift off fossil fuels (83% in the power sector), 80% off coal, and 42% CO2 reduction (despite 7x GDP growth) would save $3.1 trillion NPV in private internal cost. (This uniquely detailed and rigorous study, reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior authors of the 13th Five Year Plan, which it strongly informed.) To be sure, the cashflow profile differs between these strong-efficiency-and-renewables trajectories and BAU, but not only to efficiency and most renewables now have not only reduced capital intensity but also much shorter lead times and faster paybacks than marginal fossil-fueled systems, so their intensity-times-velocity capital requirements are generally even lower. And as I'll note in TK, modern energy efficiency using integrative design (in all sectors, Lovins 2010) typically exhibits not diminishing returns but expanding returns and declining capital intensity with scale (Lovins 2017). [Amory Lovins, United States of America]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7659	15	9	15	14	How can a 2008 reference be reliable in 2017? In 2008 nearly everyone assumed renewables would cost much more than fueled resources? n\Now we know they cost less. (NREL's REFs study indicated slightly higher costs in 2010, but when rerun a few years later, showed same-or-lower costs vs business-a-usual (BAU), and since then costs have fallen dramatically.) Lovins & RMI (2011), summarized by Lovins (2015, 2015a), showed in great detail that with 2x US GDP growth 2010–50, practical and proven means deployed at historically reasonable rates could profitably achieve 3x energy efficiency, including 4x electric efficiency by 2050, plus 5x renewables and 82–86% lower fossil CO2 emissions with 2.6x GDP, would save $5 trillion NPV in private internal cost. (So far, this trajectory is on track in the marketplace 2010–16.) Similarly, the Chinese government's top energy agency (ERI 2017, Price et al. 2017, Zhou et al. 2016) showed that 2010–50 Chinese 7x energy productivity, 13x carbon productivity, 67% shift off fossil fuels (83% in the power sector), 80% off coal, and 42% CO2 reduction (despite 7x GDP growth) would save $3.1 trillion NPV in private internal cost. (This uniquely detailed and rigorous study, reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior authors of the 13th Five Year Plan, which it strongly informed.) To be sure, the cashflow profile differs between these strong-efficiency-and-renewables trajectories and BAU, but not only to efficiency and most renewables now have not only reduced capital intensity but also much shorter lead times and faster paybacks than marginal fossil-fueled systems, so their intensity-times-velocity capital requirements are generally even lower. And modern energy efficiency using integrative design (in all sectors, Lovins 2010) typically exhibits not diminishing returns but expanding returns and declining capital intensity with scale (Lovins 2017). [Amory Lovins, United States of America]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
4821	15	9	15	9	Action in decarbonisation of transport is very important for limiting warming to 1.5C, especially because other sectors may have exhausted their potential mitigation already in 2C scenarios. Accordingly, the author should add transport to the list of investments. "As investment profiles of projects in energy, transport, land and urban system"... Please note that stock-echange investors are already very positive on cutting-edge firms engaged in the transition to a low-carbon sector. For instance Tesla is currently blessed with a market capitalization similar or higher than GM and Ford exactly because the market believes, to some extent, that the Paris Agreement and global decarbonisation will lead the mainstream scenario of the evolution of the automotive sector. [Valentino Piana, Italy]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
14248	15	12	15	12	"For renewable energy options such as wind and solar, investments are frontloaded and operational costs are relatively small, and also for energy efficiency, large investments need to be made early on, and the revenues are generated later." This focus on solar and wind is inappropriate. The same statement can be made for hydro, geothermal, tidal and even nuclear power. In general, one of the biggest driving factors in fossil fuel use is that they're quite cheap to set up, and even fairly cheap to run, but the external costs of their pollution (CO2 and otherwise) is what always causes problems for fossil fuels. This paragraph would support the following paragraph more strongly if the general nature of this problem where explored in more depth. [Jason Donev, Canada]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
4820	15	12	15	14	It is very common in all investments that large expenditures are at the beginning and revenues are generated later. This is not a suprise for the financial system. Renewable have a considerable advantage in time-to-build with respect to coal and nuclear plants. Accordingly, the author should integrate the sentence "... and also for energy efficiency, large investments need to be made early on, and the revenues are generated later." into something like "... and also for energy efficiency, large investments need to be made early on, and the revenues are generated later. This is easier in an environment of low interest rates and long-term perspective by investors, possibly in conjunction with policy tools such as feed-in tariffs, auctions, and ESCOs support". [Valentino Piana, Italy]	Taken into account, this is a point which is explicitly treated in section 4.4.6 we will point out the key importance of upfront costs
10249	15	16	15	25	This paragraph could have been expanded to include e.g. ethnical investing that has been around for the last decade. [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
18705	15	17	15	17	starting to warm up to climate change mitigation - strange wording [Wilfran Moufouma Okia, France]	Text is no longer included
2742	15	17	15	18	Suggest re-phrasing to clarify meaning - is there some assessment here of the actual financial flows, relative to what is needed? [Penny Urquhart, South Africa]	Taken into account; we give such orders of magnitude in section 4.4.6. we will likely give them there in the SOD
4882	15	18	15	18	It is pretty amazing that no literature is quoted in reference to the pivotal Green Climate Fund, whose central role in the international response to climate change has been enshired in the UNFCCC negotiations and outcomes. A separate sentence, at least, should be devoted to the GCF, shortly describing it and possibly indicating venues for "strengthening" this crucial piece of the international response (focus of this chapter). As very partial literature the author might want to quote is the following: Climate Focus, Green Climate Fund and the Paris Agreement, http://www.climatefocus.com/sites/default/files/GCF and Paris Brief 2016.new_.pdf, Status of Pledges and Contributions made to the Green Climate Fund, Status Date: 18 August 2017, https://www.greenclimate.fund/documents/20182/24868/Status_of_Pledges.pdf, ! GCF Request for proposals for mobilizing funds at scale, http://www.greenclimate.fund/documents/20182/730867/GCF_Request_for_proposals_to_Mobilize_Funds_at_Scale.pdf/2de47aea-8cde-477f-ad1e-1507b49ef901 [Valentino Piana, Italy]	Accepted, a reference to the role of the GCF should indeed be added here however, note that we can only quote peer-reviewed literature
4886	15	20	15	20	It would be necessary to mention the commitment of mobilizing at least 100 billion dollars a year taken by the developed countries with the Copenhagen Accord and subsequent Cancun and Paris pledges. In response to the request of the developing countries, the developed countries produced this Roadmap to US$100 Billion: http://dfat.gov.au/international-relations/themes/climate-change/Documents/climate-finance-roadmap-to-us100-billion.pdf The following countries were involved in producing this Roadmap: Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, European Commission, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and United States. The Roadmap was made publicly available in October 2016. The author might want to quote it and surrounding comments and papers. [Valentino Piana, Italy]	Taken into account. This discussion has to be referred to because there in a large controversy between developed and developing countries about the additionality of the items of the roadmap. There is however the difficulty that this discussion is not conducted in peer-reviewed literature
11144	15	22	15	24	The sentence refers to pension funds facing challenges when electing to invest in climate-friendly activities. The authors refer to "Sievänen 2013", and "Haigh 2011". Is it still the case? A lot has changed in this area and the sources are relatively old keeping in mind the rate of change in this area [Michiel Schaeffer, Netherlands]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6

Comment No	From Page	From Line	To Page	To Line	Comment	Response
5218	15	23	15	25	The literature suggests that potential could still be materialised by engagement of the financial sector, but that this depends on political signals that affect the bankability of climate-friendly investments. In fact, there is no literature at all to support this. The reason is straight, from the perspective of at least one company, because in direct conversations with large institutional investors, this company has had responses and actions from the investors that showed the portfolio managers of these funds took no action based on any long term climate change risks. While it is true that there are analysts, even in-house analysts, whose expertise is in providing advice about the climate change activities and policies of governments and industry, the fact remains at this point that the portfolio managers when asked do not yet make any holding or investment decisions based on the potential long term effects from climae change. [Arthur Lee, United States of America]	Accepted, but text is no longer included - financial systems are discussed in Section 4.4.6
4822	15	23	15	25	Examples of large-scale engagement of the financial sector can be found in the NAZCA portal at UNFCCC (http://climateaction.unfccc.int/investors) and in many news releases and initiatives. The sentence might then become: "The literature suggests that potential could still be materialised by engagement of the financial system (e.g. by initiatives such as those highlighted at UNFCCC Climate action portal), but that this...". [Valentino Piana, Italy]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
7083	15	24			Indeed, the interest rates used when calculated the profitability of the investments, which can be determined e.g. in a cooperation between the finance and public sectors, are key determinants of the profitability of the investments. See some references for the building sector: Richard G. Newell and Juha Siikamäki, Nudging Energy Efficiency Behavior: The Role of Information Labels, Journal of the Association of Environmental and Resource Economists 2014 1:4, 555-598; Copiello S, Gabrielli L, Bonifaci P, Evaluation of energy retrofit in buildings under conditions of uncertainty: The prominence of the discount rate, Energy (2017) 137: 104-117). For EU: Mata, É. Assessment of energy efficiency and carbon dioxide mitigation strategies in the European building stock. PhD Thesis, Chalmers University of Technology, Gothenburg, Sweden, 2013; BRISKEE EU-project http://cordis.europa.eu/project/rcn/194630_en.html. For Sweden: Mata É, Sasic Kalagasidis A, Johnsson F. Cost-effective retrofitting of Swedish residential buildings – Effects of energy price developments and discount rates. Energy Efficiency (2015) 8: 223-237; É. Mata and F. Johnsson, Cost-Effectiveness of Retrofitting Swedish Buildings, Chapter 12 in: Cost-Effective Energy Efficient Building Retrofitting, Ed. F. Pacheco Torgal et al., Elsevier, 2017, pp: 343-362. Additionally EU-Banks have recently claimed that "no shortage of funds for energy renovation", but EPBD must address latent demand (https://www.eceee.org/all-news/news/news-2017/bank-says-no-shortage-of-funds-for-energy-renovation-but-epbd-must-address-latent-demand/) [Érika Mata, Sweden]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
10918	15	25			and also depends on clear governmental policies, as well as clear commitments from large customers, as well as general public opinions. Clear communication on fossil fuels bans and phase-out schedules could help immensly in redirecting large energy-related investments from fossil-fuels to clean renewable energy. Due to the highly emotional nature of the investment sector, disruptions like climate catastrophes could potentially quickly change the investment mood, and make clear that fossil fuels-related investments (in fuels and ICE engines in particular) are very risky investments, while renewable-energy ones are much safer. [Beat Brunner, Switzerland]	taken into account, we will consider it Section 4.4.6 section
9950	15	25	15	27	This is not factually true. There are myriad of initiatives by public financial institutions, pension funds and insurance groups which disprove such a claim. Private groups are increasingly willing too divest from high-carbon assets and build coalitions around the commitment to provide financial armor to the transition movement. As such coalitions manifest themselves, this makes both commercial sense, avoids stranded assets and brings important reputation and branding benefits. One such action is the recently formed grouping 'Finance for tomorrow' at www.financefortomorrow.com which can provide important arguments for the authors to examine and see that recently the political signal seems not to influence qualitatively the financial engagement with the energy transformation. [Yana POPKOSTOVA, France]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
11043	15	28	16	2	Unclear why "organisations" are excluded from the analysis here, since they matter very much in climate governance. See, for example, Munck af Rösenschold 2014 (Institutional inertia and climate change: a review of the new institutionalist literature). Furthermore, "political leadership" is also requested on a national level, see Willis 2017 (How Members of Parliament understand and respond to climate change) [Oliver Geden, Germany]	Taken into account, text is no longer included - financial systems are discussed in Section 4.4.6
6203	15	28	16	2	The institutional and political dynamics here are crucial to understanding both the challenge of 1.5C and the dynamics of the transition. But there is little in this passage that is really connected specifically to the institutional aspects of 1.5C specifically - it is rather more generic about specific institutions (cities) involved or some very specific findings (and not enormously insightful, as in the one that electing environmentally committed legislators produces better environmental legisltion). [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
4931	15	28	15	37	Concepts of overall social governance and institutional flexibility and rigidity developed from archaeological case studies should be incorporated into the analysis presented here. Relevant references include: 1.) Schoon, M., Fabricius, C., Anderies, J. M., & Nelson, M. (2011). Synthesis: Vulnerability, traps, and transformations-long-term perspectives from archaeology. Ecology and Society, 16(2). and 2.) Hegmon, M., Peeples, M., Kinzig, A., Kulow, S., Meegan, C., & Nelson, M. (2008). Social Transformation and Its Human Costs in the Prehispanic U.S. Southwest. American Anthropologist, 110(3), new series, 313-324. Retrieved from http://www.jstor.org/stable/27564014. [Marcy Rockman, United States of America]	Rejected, not relevant to this section, it shall be transferred to Ch.5 where the archaeological dimension may be considered
10553	15	28	16	2	This section is important but brief and not well developed. Institutions are not just the 'rules of the game' of the NIE defintion of North. Also, The urbanization has been a factor of increasing emissions and not reducing it. Urbanization rates are more correlated to CO2 emissions than GDP per capita (see Sethi, M. and Puppim de Oliveira, Jose A. (2015). From global 'North-South' to local 'Urban-Rural': A shifting paradigm in climate governance? Urban Climate (Elsevier). 14 (4) 529–543.). Finally the changes need to be a collective effort and not one country or one person alone. The effects of China efforts are still to be see in the long term, as the country continues to rely on coal and cars for its development. [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
20212	15	28	16	2	Some of the strongest experience, research and literature on deliberate institutional change and leadership is from management studies, although not necessarily applied directly to climate change. Key texts include Argyris, C. and E. Schon. 1996. Organizational Learning II: Theory, Method and Practice, Addison Wesley, Reading, MA. Then from sociology, another classic text is Beck, U. 1988, Risk Society: Towards a New Modernity, English translation by M. Ritter 1992, Sage, London. He addresses the growing role of dialogue within institutions as they explicitly develop their goals and practices, rather than relying on tradition and convention. Similarly Anthony Giddens in Giddens, A. (1994) Reflexive institutions in U. Beck, A. Giddens and S. Lash, Reflexive Modernisation, Oxford, England, Blackwell. [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Rejected, what he suggest is not relevant to this section and the books he suggest are old references and not linked to climate change
18706	15	29	15	33	Wording gramatically incoherent [Wilfran Moufouma Okia, France]	Editorial
19072	15	31	14	33	[…] and behaviours emerge from socio-technical contexts made of specific material arrangements, competences and associated meanings (Shove 2010). This can be an oversimplified assumption. Behaviours emerge as result of a complex relationship dealing with specific material, political, economic, historic, geographic and cultural factors. [Miriam Solera Ureña, Germany]	Accepted - this is discussed in 4.4.3
14075	15	31	15	31	Missing a comma after 'norms'? [Elvira Poloczanska, Germany]	Editorial
14122	15	39	15	39	off the back, avoid jargon [Elvira Poloczanska, Germany]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14249	15	39	15	41	"Off the back of growing urban populations and the recognition that cities account for a majority portion of greenhouse gas emissions, cities have emerged as the locus of institutional and infrastructural climate innovation." This statement isn't cited, and needs to be (I think it's almost certainly true), and more context needs to be given. A systems-based approach looking at a population with large rural vs. the same population with both urban and rural should be evaluated. Circling urban populations in isolation is not clarifying the situation. [Jason Donev, Canada]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
4900	15	39	15	39	Before talking about the sub-national level, a paragraph devoted to national level policymaking and leadership is necessary. The Paris Agreement relies on Nationally Determined Contributions, so this level is the foundation of the international response to climate change. A sentence partially reflecting this might sound like "National level policymaking is crucial to the success of the Paris Agreement, which relies on Nationally Determined Contributions, making this level the foundation of the international response to climate change. Many countries have not only produced, in a consultative and responsive process, ambitious NDCs but have institutionalised the response to climate change at cross-ministerial and ministerial levels. An indicator of strengthened engagement of the political leadership is the number and quality of new laws, strategies, and measures taken for mitigation and adaptation after the Paris Agreement entry into force". [Valentino Piana, Italy]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
2630	15	39	15	48	mention something regarding the compatibility of institution-led, technological and government-level mitigation efforts? [Zoha Shawoo, United Kingdom (of Great Britain and Northern Ireland)]	noted
9338	15	39	15	48	The leadership that is placed on cities to "bend the curve" by the year 2020 may be provided based on a recent report "Deadline 2020: How cities will get the job done" by the C40 Cities. The report analyses the contribution C40 cities can make to delivering the Paris Agreement objective of limiting global temperature rise to 1.5 degrees. Scenarios for peaking based on high/low GDP and high/low CO2 emissions per capita were also considered for such climate mitigation targets. [Siir KILKIS, Turkey]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
11462	15	39	15	48	I think there is a confusion here between cities and sub-national governance, the latter being treated as though it exists only in the context of the former. The vast majority of jurisdictions participating in initiatives like the covenant of mayors are not large cities but smaller and, in many cases, rural local governments. Is there evidence rural jurisdictions are less progressive on climate that urban jurisdictions? I think the answer is no, there is no such evidence and, in fact, many examples of rural jurisdictions innovating in both mitigation and adaptation. Missing altogether in this paragraph are state and provincial governments. The key points here would thus be clearer if the terminology used by the cited references and later chapters was used; i.e. state and local government. [Stewart Lockie, Australia]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
17741	15	40		43	The degree of autonomy of city governments from national government plays a key role in building its institutional and financial capacity to follow a climate resilient development pathway. Metropoltan governments which, due to a top-down, centralised government structure, rely heavily on national framework and finances to manage their cities would continue to adhere to national development frameworks. It stands to reason that if climate change resilient development is a key priority for nation state, there is the likelihood that subnational governments would consider this in the metropolitan developement plan. [Afua Adu-Boateng, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
6202	15	47	15	48	This last sentence is unconnected from the rest of the paragraph, which is on cities in low carbon transitions. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
7641	15	49			In the EU, political leadership from parties and their representatives in governments has influenced climate policy outputs and outcomes (Jensen and Spoon 2011, Carter and Jacobs 2014). 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. 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, Denmark]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
12	15	50	15	52	Why is one particular country singled out for mention (and praise) under the general heading of "institutitional change and political leadership"? It is difficult to see the scientific justification for this as numerous other examples could have been given. Also, the reference for this is a comment piece (not an article or letter) in Nature. [Steffen Kallbekken, Norway]	Accepted, paragraph is deleted
7806	15	50	15	52	Updating Bai et al. (2014) and repeating from lines 9–14 on this page: The Chinese government's top energy agency (ERI 2017, Price et al. 2017, Zhou et al. 2016) showed that 2010–50 Chinese 7x energy productivity, 13x carbon productivity, 67% shift off fossil fuels (83% in the power sector), 80% off coal, and 42% CO2 reduction (despite 7x GDP growth) could save $3.1 trillion NPV in private internal cost. (This uniquely detailed and rigorous study, reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior authors of the 13th Five Year Plan, which it strongly informed.) [Amory Lovins, United States of America]	Rejected, we deleted the short paragraph on China
7807	15	50	15	52	Updating Bai et al. (2014) and repeating from lines 9–14 on this page: The Chinese government's top energy agency (ERI 2017, Price et al. 2017, Zhou et al. 2016) showed that 2010–50 Chinese 7x energy productivity, 13x carbon productivity, 67% shift off fossil fuels (83% in the power sector), 80% off coal, and 42% CO2 reduction (despite 7x GDP growth) could save $3.1 trillion NPV in private internal cost. (This uniquely detailed and rigorous study, reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior authors of the 13th Five Year Plan, which it strongly informed.) [Amory Lovins, United States of America]	Rejected, we deleted the short paragraph on China
7660	15	50	15	52	Updating Bai et al. (2014) and repeating from lines 9–14 on this page: The Chinese government's top energy agency (ERI 2017, Price et al. 2017, Zhou et al. 2016) showed that 2010–50 Chinese 7x energy productivity, 13x carbon productivity, 67% shift off fossil fuels (83% in the power sector), 80% off coal, and 42% CO2 reduction (despite 7x GDP growth) could save $3.1 trillion NPV in private internal cost. (This uniquely detailed and rigorous study, reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior authors of the 13th Five Year Plan, which it strongly informed.) [Amory Lovins, United States of America]	Rejected, we deleted the short paragraph on China
7661	15	50	15	52	Updating Bai et al. (2014) and repeating from lines 9–14 on this page: The Chinese government's top energy agency (ERI 2017, Price et al. 2017, Zhou et al. 2016) showed that 2010–50 Chinese 7x energy productivity, 13x carbon productivity, 67% shift off fossil fuels (83% in the power sector), 80% off coal, and 42% CO2 reduction (despite 7x GDP growth) could save $3.1 trillion NPV in private internal cost. (This uniquely detailed and rigorous study, reflecting >150 analyst-years' effort by four leading organizations, was steered by the senior authors of the 13th Five Year Plan, which it strongly informed.) [Amory Lovins, United States of America]	Rejected, we deleted the short paragraph on China
9952	15	50	15	53	This is factually untrue. The current government initiatives and investment in low-carbon transition and technologies in China is spurred to a large extent by the need to address raising civic consciousness and demands for better welfare. Chinese population demands to breath clean air and the party obeys. This is potentially one of the key areas of transformation seen in dominant party-population relationship in the country and is a very potent signal to the transformation of the society there. [Yana POPKOSTOVA, France]	Rejected: see reply to 7806
14250	15	51	15	52	China is also leading the way in new nuclear build, that should also be discussed. China has become quite concerned about air pollution from their coal fired plants. This is leading to actions that may ultimately allow them to hit their SDGs, including improved nuclear medicine (both treatment and diagnostic medicine, etc) and reducing their carbon intensity (and possibly their entire carbon footprint). [Jason Donev, Canada]	Rejected: see reply to 7806

Comment No	From Page	From Line	To Page	To Line	Comment	Response
5219	15	51	15	55	It remains to be seen whether decoupling of emissions and growth in China (Newman 2017) can be sustained. In African countries, the case for climate resilient growth has been slow to gain political traction, in part because it requires perceived adjustment costs in the short-term, in expectation of future gains (Resnick et al. 2012). This may be changing since the Paris Agreement where developing 1 countries view a climate resilient 2 economy as offering new competitive advantage (Cartwright 2015). This assessment is the critical asssment in this entire chapter. Without China's continued and sustained growth of renewable energy and drive to reduce emissions, there will be no decoupling of emissions from economic growth. African nations have the largest potential to growth, yet case studies of successful and long-standing institutions to spur such growth are few and far between. [Arthur Lee, United States of America]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
1210	15	54	15	54	What is 'climate-resilient growth' here? The cited paper talks about 'green growth'. Is this all the same? Clear definitions and/or x-referencing with Ch5 would help here. [Petra Tschakert, Australia]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
6740	15	54	16	2	It would be important to mention the 48 CVF Climate Liability Forum countries' Marrakesh Communique which says that these countries (with over a billion people) will 100% RE commitment "Strive to meet 100% domestic renewable energy production as rapidly as possible". They include countries from Africa, Asia, South America, Oceania etc https://unfccc.int/files/meetings/marrakech_nov_2016/application/pdf/cvf_declaration_release_en.pdf [Jennifer Morgan, Netherlands]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
2743	15	54	16	2	This needs to be updated, if necessary using grey literature - there is huge movement in African countries on developing green growth strategies etc - should at least talk about Rwanda and even Ethiopia here. Many African countries have developed climate policies and strategies which have been approved by Cabinet, and there are serious efforts to implement them, albeit with limited capacities and in the absence of the necessary financial flows. [Penny Urquhart, South Africa]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
1211	16				This section 4.2.3.6 would benefit greatly with the addition of relevant social psychological literature. See as a starting point: Clayton et al (2015) Psychological research and global climate change. Nature Climate Change, 5, 640-646 [Petra Tschakert, Australia]	Taken into account, this is discussed in 4.4.5 of FOD, The reference is included there. We now integrated this section it in the section on enabling behaviour and lifestyle change
20684	16				Section 4.3. As part of the feasibility assessments (or in addition to), each mitigation option should include the impacts (synergies and trade-offs) for adaptation and viceversa. [Debora Ley, Guatemala]	Accepted. Synergies and trade offs will be assessed
20685	16				Section 4.3. Within each of the sub-sections, there needs to be a clearer organisation between mitigation and adaptation options. [Debora Ley, Guatemala]	Accepted. We will look at the subsection titles and make sure all of them are indeed options.
20686	16				Section 4.3. Additional adaptation options need to be included (from AR5, and Ch. 3) and included in the feasiblity assessments. [Debora Ley, Guatemala]	Partly accepted. Additional options will be included in the SOD if there is literature and if chapter 3 includes them. However, we are not going to repeat the assessment in AR5.
1212	16		19		Discussion in 4.3.1 on feasibility overlaps significantly with Box 1.3. Just refer to the box. [Petra Tschakert, Australia]	Noted. Table has been retained as some people will only read Chapter 4 and the table informs the feasibility of the assessment in 4.5. Two new columns have been added to the table to provide a link to 4.5.
20574	16				4.2.3.6. Would be relevant to add a bit more on this area. Thinking of my scientific field (Psychology) and also thinking of the fact that the Paris agreement will need to be implemented, it is important to use all potential tools/knowledge available to humanity. Psychology is an area of science that targets behaviour. In this area there has been some key research conducted on behaviour change and maintenance as well as on implementation (e.g. of guidelines by health care professionals). Psychology can contribute with key knowledge on behaviour change theories (many of which rely on key interactions between the person and its context and acknowledge that humans are not rational decision making machines) in order to allow the development of behavioural goals, action plans and coping plans (Sniehotta et al 2005) that can target the actual mechanisms associated with behaviour enactment (e.g. taking the bike vs taking the car). There are currently multiple SR within the area of changing health behaviours that can be useful when thinking of changing individuals behaviours (e.g. around energy use at home, around recycling, around consumerism, around transport choice). My team has published a SR that aimed at understanding what behaviour change techniques are better placed to support change to more sustainable (and healthy in some cases) transport modes (paper tittle: Efficacy of behavioural interventions for transport behaviour change: Systematic review, meta-analysis and intervention coding. Article?in?International Journal of Behavioral Nutrition and Physical Activity 11(1):133 · November 2014. DOI: 10.1186/s12966-014-0133-9). There are also other sources of knowledge in Psychology that can support implementation of all the changes that need to occur to keep within the 1.5 C. For instance: evidence on discrimination and collaboration in groups and group work; evidence on group composition and functioning; evidence on decision making (individual and in groups); evidence on stereotyping and overcoming stereotyping; evidence on diversity; evidence on status and power; evidence on mediation and conflict resolution; evidence on debate and negotiation; evidence amassed on ownership and implementation; evidence on the importance of leadership styles and how to support leadership development; evidence on how to engage in knowledge translation; evidence on the crucial role of creating policy and develop interventions to create environmental change (see also the work of Dr. Minu Hemmati, Senior Associate at the MSP Institute eV in Berlin, Germany and the work conducted with 14.000 municipalities in Germany as a case study). [Vera Barbosa Araujo Soares Sniehotta, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, this is discussed in 4.4.5 of FO. We now integrated this section it in the section on enabling behaviour and lifestyle change
7084	16	1		2	Indeed, I would appreciate a recap on what has happends in this year after Paris agreement, with respect to the steps that the different MSs have followed to actually implement what they have agreed on. Even a list of best-practices could be motivating for the governments of the different MS claiming leadership in sustainable development. [Érika Mata, Sweden]	Rejected not relevant for this section
15000	16	1	16	2	Paris Agreement reference is not clear and implies an incorrect bifurcation with developing countries in the PA context. [Farhan Akhtar, United States of America]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
19392	16	1	16	2	the reference that climate resilient economies may be viewed as having competetive advantage (Cartright) is one-sided as the level of urbanisation and development which shall take place in Africa over the next 15 years is predicted by global think tanks to surpass previous levels, and contribute immensely to future emissions from the continent. The manner in which Africa is covered in the chapter, does not capture the scale oof attention this part of the world may require in the coming decade, through global response. [Sumetee Pahwa Gajjar, India]	Taken into account, we removed section 4.2.3, Governance is now discussed in 4.4.1
4823	16	1	16	3	These lines are the appropriate place where to add a significant sentence on SIDS / AOSIS countries, which requested this Special Report but are currently barely mentioned in this chapter. You may quote here their efforts in adaptation and financial needs, together with the fact that in such countries, climate change is a major political priority, often with a climate ministry or unit directly referring to the Prime minister. [Valentino Piana, Italy]	Taken into account - covered in section 4.4 and Box 4.8, through the addition of case studies on SIDS and the Pacific Islands.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9953	16	2	16	4	Firstly, African states cannot be homogenized. The climate change-related issues and dynamics vary widely across the continent. This being said, it is important to acknowledge that African states were 'slow to awake' to the case for climate-resilient growth and invesement because of the myriad of other issues affecting the continent - famine, migration, frozen conflicts, roque states- to mention a few alongside lack of energy access and underdeveloped energy infrastructure. In instances where communities were given incentives and knowledge to invest in decentralized renewable energy generation, this has been widely adopted, which proves that the population demands and is ready to make smart climate-resilient choices and direct scarse investment when given a clear, transparent and informed choice to make. [Yana POPKOSTOVA, France]	Accepted, factors influencing changes in sustainable lifestyles and behaviour are discussed in 4.4.3
5600	16	4			Disproportionate use of pages in section 4.3 leads to adaptation having less pages than CO2 Capture, utilisation and storage and SRM. The latter are duplicative of similar parts in ch. 2 and, even more, in AR5. By contrast, the world, already around 1 degree, will first need to adapt to 1.2, then 1.5 and, if stabilisation fails, to "well below" 2, 2, 3, 4, etc. Accordingly, adaptation is a urgent task for this Special Report. Much more space should be devoted to adaptation, its qualities (including as enshrined by the Art. 7 of the Paris Agreement), and to assess ways to strengthen the current responses in the field. [Valentino Piana, Italy]	Taken into account - text has been revised , with additional adaptation options included in the SOD, together with trade-offs and synergies with other options
19717	16	5			Section on behavioural change - needs to reference the importance of rights in informing behavioural change - in particular the right to information, the right to education and the right to participation. Note that the gender dimensions of behavioural change shoulod also be addressed. See for examples studies from the energy sector and clean cooking re women and changing behaviour or the role fo women in changing consumption patterns (see for example One Million Women in Australia) [Tara Shine, Ireland]	Taken into account, behaviour change strategies are discussed in 4.4.3, gender issues are discussed in chapter 5
20248	16	5	16	43	Throughout the report there are numerous instances, as for example here in the paragraphs on Behavourial change, where the reader is presented with a clear and concise description of an important aspect of climate change and what appears to e a simplle answer: social transformations are key to effectively respond to climate change. However in this phrase lies a task that is enormous in scale. The scale of in the challenge is not clarified. How does one imagine this can be successfullyaccomplished? [Morien Rees, Norway]	Taken into account, how this can be accomplished is discussed in section 4.4.3
10852	16	5	16	43	the following reference would well match this section, but also broaden the view: http://dx.doi.org/10.1016/j.techfore.2016.06.029 [Christian Breyer, Finland]	Taken into account, we included a key reference (Hackmann et al 2014), and refer to chapter 2 - please not that this section is now included in 4.4.3
11463	16	5	16	43	Again, framing these actions as "behavioural change" suggests high-consumption, western lifestyles as the global norm. Separating behaviour here from poverty alleviation and equity is also concerning given it is often the relatively poor and marginalized, even in so-called developed countries, who are locked in to carbon intensive modes of transport, heating, eating etc. by unsympathetic infrastructure. If lifestyles are a systemic issue then this section could be re-framed, more constructively, around the enablement of equitable, safe and low-carbon lifestyles for all (rather than the more individualized notion of behaviour). This will make it more consistent with later chapters. There is a plethora of research about how more sustainable behaviour can be facilitated. Even in relation to consumption, we know most people have favourable attitudes towards more sustainable choices but translating these dispositions into meaningful behaviour relies on a variety of factors. For food, these include: (1) recognized and trusted standards; (2) availability and visibility of green options; (3) price; and (4) quality. For energy and transport, the infrastructure or socio-technical systems in which consumption is embedded are crucial. [Stewart Lockie, Australia]	Taken into account, the 'enablement of equitable, safe and low-carbon lifestyles' are core concerns of climate-resilient development pathways discussed in section 5.7. Sustainable behaviour change is discussed in section 4.4.3
924	16	5	16	5	Limiting world population is critical and is mentioned in Chapter 2 - it could be appropriate to include some discussion under the heading of behavioural change. [David Infield, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, included now in 4.4.3
4793	16	6	16	16	First, not all individuals suffer from climate change; many benefit and have an interest in it. Second, individual behaviour is rarely entirely and usually only to a very limited degree an independent variable. Factors influencing or even determining individual behaviour should be acknowledged here: culture, economic and social capital, economic and social structure, education, etc. Behavioral change is necessary but not sufficient. And again: climate change (or the socio-economic actions causing it) is not always disadvantageous from the individual's point of view. [Marcel Wissenburg, Netherlands]	Taken into account, discussed in section 4.4.3. Effects of climate change on sustainable development indicators are discussed in chapter 5
7085	16	7		9	There is lite literature here that will address the 1.5C challenge specifically. I suggest below some references for buildings or for Sweden. [Érika Mata, Sweden]	taken into account, effects of strategies to change behaviour are discussed in section 4.4.3, now clarified
20625	16	10			use of recycled CO2 or wind should also be mentioned, not only solar. [Hans Poertner, Germany]	Taken into account, wind power added - please note that we do not aim to provide a complete overview, just examples (therefore starting with e.g.) - Chapter 2 and section 4.3.2 provide a broader discussion
15404	16	10	16	11	The list after "buildings" should be complemented with active energy efficient measures in buildings: integration of renewable energy sources, heat pumps, electronic or led lamps [Francisco Javier Hurtado Albir, Germany]	Taken into account - we did not aim to provide a complete overview, energy system transitions are discussed in section 4.3.2
7086	16	11			what is "weatherising"? [Érika Mata, Sweden]	Accepted, changed into retrofits
7087	16	12			Beharvioral changes can also include innovative working schedules or procedures. J Nässén, J Larsson, Would shorter working time reduce greenhouse gas emissions? An analysis of time use and consumption in Swedish households - Environment and Planning C: Government and Policy, 2015 [Érika Mata, Sweden]	Taken into account, behaviour change can involve many different things, we did not aim to provide a complete overview
7090	16	12			On beharvioral changes (consumers willingness) related to the adoption of DSM measures: Y, Dahlman och ,Gerhardsson, ?Behavioural Roots and System Effects of Residential Electric Heating DSM, Chalmers University of Technology (2017) [Érika Mata, Sweden]	Taken into account, behaviour change is discussed in section 4.4.3
18707	16	12	16	12	Comparing walking to flying seems (unrealistic that people will walk to a destination rather than fly). Also car sharing as an option. [Wilfran Moufouma Okia, France]	accepted, changed into walk or cycle short distances, or use public transport rather than drive or fly - now included in 4.4.3
6204	16	12	16	15	This is true but extermely question-begging - what are the policy or governance systems that might effect widespread change towards these practices (cycling, etc)? There is a very substantial empirical literature on places that have had significant shifts from cars to bikes (Copenhagen, Amsterdam, classically), as well as many case studies of the complexity of policies aimed at behaviour change. See for example Bulkeley, Paterson and Stripple (ed.) Towards a Cultural Politics of Climate Change (Cambridge 2016) which has a number of useful case studies (and further references) that could be incorporated. Simply stating that cycling and walking will be important is insufficient, we need to survey literatures and evidence on how those parts of the transition may be pursued and what the challenges are. The other thing that surveying this literature would do would be to complicate the relatively simplistic point here one lines 36-36 that you can bypass behavioural/practice questions with technical fixes (insulation, etc) - much of this literature, following the logic of the idea that transitions are always socio-technical (as in the opening framing for this section), shows the complex interplay between technology and practice. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, discussed in section 4.4.3, now clarified at end of section. Please note that we emphasise implementation of insulation, which refers to behaviour rather than technology fix; socio-technical systems are discussed in section 4.2.3.2

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7010	16	12	16	15	By utilizing climate data and user energy consumption data, energy consumption forecast model could be developed to predict energy consumption in the coming week or so using weather forecast outputs. This allows timely energy-saving measures to be taken in response to early alerts of high energy consumption days under hot weather situations. Reference: 1. Cheung, E., S. Lam, S. Tsui, T. C. Lee, W. K. Wong, J. Lai and C. Chan, 2016 : The Meter Online Service - Application of weather information in support of CLP electricity consumption forecast for customers, presented in the CEPSI - Conference of the Electric Power Supply Industry, Bangkok, Thailand, 23-27 October 2016. [Sai Ming Lee, China]	Taken into account, energy system transitions are discussed in section 4.3.2
7088	16	13			D Andersson, J Nässén, The Gothenburg congestion charge scheme: A pre–post analysis of commuting behavior and travel satisfaction, Journal of Transport Geography 52, 82-89 [Érika Mata, Sweden]	Taken into account, effects of strategies to change behaviour are discussed in 4.4.3, including pricing policies
7012	16	13	16	13	The term "reduce room temperature" may be confusing as air conditioning in the summer is one of the major sources of power consumption in the topical and sub-tropical regions. Setting a higher room temperature is a popular approach in reducing energy consumption for cooling. [Sai Ming Lee, China]	Accepted, changed into adjust
4824	16	15	16	15	An additional, recent and highly relevant, biblographic entry here is Herrmann, A. et al., Household preferences for reducing greenhouse gas emissions in four European high-income countries: Does health information matter? A mixed-methods study protocol, BMC Public Health, (2018) 18:71, DOI 10.1186/s12889-017-4604-1. [Valentino Piana, Italy]	Taken into account, included in 4.4.3
18393	16	15	16	15	(e.g., reduce meat consumption or buy local season food; shouldn't be in grey shaded Mendeley field [Wilfran Moufouma Okia, France]	Editorial
3617	16	16	16	43	Missing from this list are behavioural changes that will be needed with distributed energy systems that turn individuals into producers and consumers – this "prosumer" role requires significant change in individual behaviour (see Grijalva et al 2014) that are not obvious or frictionless [Stewart Fast, Canada]	Taken into account, energy systems are discussed in 4.3.2
11058	16	16	6	16	This paragrapgh is rather modest in addressing necessary behavioural changes. E.g., the last sentence only mentions the possibility but not the necessity to reduce Non-CO2 gases via behavioural changes. In general, the paragraph should distinguish between changes in the habits that do no reduce the service level and sufficiency-based reductions of service level. In particular, it should be made clear that the current growth in aviation and meat consumption is very likely to be incompatible with reachinig the targets of the Paris agreement. [Jakob Wachsmuth, Germany]	Taken into account, strategies to change behaviour are discussed in 4.4.3 . We added a table listing behaviour associated with high GHG emission reduction potential
9954	16	19	16	20	Behavioural change is largely influences by knowledge. Where we have information access and clear outline of risks and opportunities, social awareness grows and people make rational choices based on clear criteria of self-interest for themselves and their progenitude but also an acute sense of links to their surrounding and desire to protect it. Ecosystem change, thus occurs baed on information access. This is why, tailored campaigns and information sessions should be accelerated at local and regional levels to provide the tools for people to understand what is at stake, own the energy transformation process and thereof, provide a strong mandate to policy-makers too strengthen ambition, and motivation to business to invest in transformational actions. [Yana POPKOSTOVA, France]	Take into account, this is discussed in section 4.4.3 - the literature suggest that the effect of knowledge and information is limited though, see section 4.4.3
18708	16	20	16	20	growing animal varities? - raising different animal varieties [Wilfran Moufouma Okia, France]	Editorial
18394	16	22	16	22	Jabeen 2014 not linked to Mendeley [Wilfran Moufouma Okia, France]	Editorial
2486	16	25	16	31	Insert a nice example, the Leopold example from above? [Lisa Lucero, United States of America]	Taken into account.
4794	16	25	16	31	There is no proof that participation (or citizenship etc.) increases or decreases support for policies; it does a lot of things but not that; cf Curato et al 2017 (https://www.amacad.org/content/publications/pubContent.aspx?d=22880) [Marcel Wissenburg, Netherlands]	Taken into account. We do not suggest that participation predicts acceptability, but rather that citizen behaviour (i.e., contributing to environmental organisations, petitioning on environmental issues) and behaviour in organisations can promote climate action. We clarified this
18709	16	29	16	29	public expression of …resistance to projects aimed to promote climate change mitigation and adaptation will increase the likelihood"?! [Wilfran Moufouma Okia, France]	Editorial
13	16	29	16	31	An additional useful reference, which empirically links the public attidues to implementation of climate policies, is Tjerström E and T Tietenberg, 2013, Do differences in attitude explain differences in national climate change policies? Ecological Economics 65, 315-324 [Steffen Kallbekken, Norway]	Taken into account, references changed, now include reference to a review paper by Drews and Van den Bergh 2016
11145	16	29	16	31	The sentence points out that "public expressions of acceptability of or resistance to projects and policies aimed to promote climate chnage mitigation and adaptation will increase the likelihood that such policies, programmes and projects will be implemented", but this will only be the case for public "expressions of acceptability", not of "resistance". Suggest rewording. [Michiel Schaeffer, Netherlands]	Editorial
7642	16	31			Political leadership on climate change also influences public attitudes on climate change (Brulle et al. 2012, Sohlberg 2016). Brulle, R.J., Carmichael, J., and Jenkins, J.C., 2012. Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010. Climatic Change, 114 (2), 169–188.Sohlberg, J., 2016. The Effect of Elite Polarization: A Comparative Perspective on How Party Elites Influence Attitudes and Behavior on Climate Change in the European Union. Sustainability, 9 (1), 39. [Conor Little, Denmark]	Accepted, reference added
5220	16	33	16	37	Given the urgency of meeting the 1.5°C target, options with a substantial potential for carbon emission reduction and adaptation and with a high behavioural plasticity could be prioritised, such as the adoption and use of sustainable technologies (i.e., fuel efficient vehicles, home heating and ventilation, appliances, and weatherization (Dietz et al. 2009)). These are associated with relatively low behavioural costs and can demonstrate to users that their efforts are effective. Missing in this assessment here about high behavioral plasticity is the issue of costs. Most rational consumers still make purchasing decisions of major appliances and major capital investments based on costs. The claim that "... these are associated with relatively low behavioural costs" need to be substantiated with evidence. [Arthur Lee, United States of America]	Taken into account, see response below, we change 'behavioural plasticity' into 'are relatively easy to change' (i.e., where people face no serious barriers to change)' . Behaviour costs include financial costs. See further section 4.4.5 of FOD (44.3 in SOD) on the role of financial costs in decision making
13053	16	34	16	35	What does it mean "behavioural plasticity"? Please clarify [Caserini Stefano, Italy]	Taken into account, change into 'are relatively easy to change (i.e., where people face no serious barriers to change)'
20626	16	35			again, here and later the listing of technological options is incomplete and conservative [Hans Poertner, Germany]	Taken into account, the list is not aimed to be complete. Additional examples were added
4795	16	37	16	39	Again, the text fails to take into account that climate change can be beneficial for (many) individuals, families, villages, regions, and sometimes enture countries. [Marcel Wissenburg, Netherlands]	taken into account, impacts of climate change are discussed in Chapter 3

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20618	16	41	16	43	We would suggest moving these lines up to the very beginning of section 4.2.3.6 Behavioural Change, in order to frame upfront behavioural change as it is: a systemic change that requires several enabling factors, including infrastructure, policies and social norms and values. The most reputable and evidence-based behavioural change models reinforce this understanding (e.g. Michie, S. et al (2014), The behavioural change wheel. A guide to designing interventions. Great Britain, 2014. Available at: http://www.behaviourchangewheel.com/online-book#1). The way section 4.2.3.6 was drafted, it treats behavioural change as something belonging to the individual sphere and boiled down to individual actions, which is a perspective that considerably limits the actual potential of behavioural change to take place and contribute to addressing climate change. The sentence currently at the end of the section is actually crucial for understanding and describing behaviour change, therefore the need of having it upfront for a proper framing of the topic. [Mariana Nicolau, Germany]	Taken into account. This section discusses which types of behaviour will help limit global climate change; factors influencing such behaviour and effects and acceptability of strategies to change behaviour are discussed in 4.4.5 of FOD. We now integrated this section it in the section on enabling behaviour and lifestyle change
13399	16	46			The Section title "Assessment of current and emerging (adaptation and mitigation) options" is a bit misleading considering CDR and SRM are also assessed. How about rephrasing it to somehting like "Assessment of current and emerging options (adaptation, mitigation, CDR and SRM)"? or "Assessment of current (adaptation, mitigation) and emerging (CDR and SRM) options"? [Helene Muri, Norway]	Partially accepted. Good suggestion to change the section title. However, the suggested revision does not work as we consider CDR as mitigation and SRM as not an option but a response. Section title will be changed instead to "Feasibility assessment" or "Feasibility assessment of mitigation and adaptation options and remedial measures".
20431	16	46	41	49	It may be useful checking Section "4.3 Assessment of current and emerging (adaptation and mitigation) options" for comprehensivess - by looking at the work done towards the book Drawdown (Hawken et al 2017). Drawdown ranks 80 options in relation to drawdown potential and overrall economics. Note: I'm not sure if the book meets the cut-off date for literature that can be included in this special report. There is also a website that includes references for each of the options addressed: http://www.drawdown.org/solutions-summary-by-rank [Jeremy Webb, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We will check our list against the list on the website given; thank you, especially at district heating, Bioplastic, Blue carbon - coastal wetlands, Methane digesters, waste to energy CCS, and many utilization in buildings with wood and bamboo. As stated in the chapeau, we don't have space in this report to be comprehensive; we are assessing options that have significant new insights in the literature since AR5. Also, Drawdown may not be comprehensive: it is missing some of the CDR options.
4301	16	47			It would be good to explain here why is there a need to discuss mitigation and adaptation options "together" and together with wider societal aspects. This leads to unnecessary added complexity, rethoric and generic messages with litte practical meaning . Stating again and again the complexity and extremely high level of interconnections and implications of anything to do with climate change mitigation and adaptation does not really progress much on the state of the art, in my view. [Abanades Carlos, Spain]	Noted. This chapter is about assessing options, and the trade-offs and synergies between mitigation and adaptation options, thus, it needs to be integrated.
6576	16	52	16	52	Is feasibility the only criteria to assess adaptation and mitigation interventions? Given the highly normative and contested nature of such intervention consider if other criteria need to be taken into account; and how (which procedures are needed) to decide on such criteria. [J. David Tabara, Spain]	Noted. The framing of feasibility is done by Chapter 1 and the important emphasises on multiple dimensions of feasibility and differences across regions and contexts. This section is obliged to draw on that framing for assessing feasibility of climate responses.
5120	16	54	16	55	This sentence appears to contradict the sentence on pg 17, lines 9-11, again reducing feasibility to technological and economic considerations in the first instance. [Tonya Rawe, United States of America]	Accepted and text revised. The lines referred to are simply saying how feasibility was dealt with in AR5. The definition developed in the SR builds on AR5 and takes feasibility beyond narrow techno-economic dimensions by introducing multiple dimensions.
4660	17				Tab 4.1 - table is very similar to Box 1.3, Tab 1 [Radim Tolasz, Czech Republic]	Noted. After discussion this Table was retained as some readers will only read Chapter 4 and the table is essential to Section 4.5. A third (mitigation) and fourth (adaptation) column has been added in Chapter 4.
4661	17				Tab 4.1 - Leave out the first column and rename second one as "Dimensions". [Radim Tolasz, Czech Republic]	Noted. This is being considered by Chapter 1. Additional columns added to the table in Chapter 4 for the benefit of the feasibility study.
10554	17	4	17	11	The economic dimensions of cost-benefit analysis is not the only assessment for the options. You should expand the discussion for the much more complex decision making process to reflect anything close to relaity (beyond the economicist view) [Jose Antonio Puppim de Oliveira, Brazil]	Noted. Outline of feasibility in Chapter 1 - which are obliged to use in the framing here - emphasises multiple dimensions of feasibility not just cost and benefit.
1911	17	4	17	11	conventional climate change cost-benefit analysis and … distribution of benefits and costs between income groups: Here, I would expect a discussion on how to account for distributional issues (e.g. income inequality) in cost-benefit analysis on climate change. This can be done for instance through (i) distributional weights (Adler 2016; Fleurbaey and Abi-Rafeh 2016), e.g. applied in UK Greenbook (Her Majesty's Treasury 2011) or climate economics (e.g. Anthoff et al. 2009) or (ii) direct WTP adjustment according to desired income inequality (Baumgärtner et al. 2017). It also relates to the literature on discounting and economic inequality (e.g. Gollier 2015; Emmerling et al. 2017). References: Adler, M.D. (2016). Benefit–cost analysis and distributional weights: An overview. Review of Environmental Economics and Policy, 10(2), 264-285. Anthoff, D., Hepburn, C., and Tol, R. S. (2009). Equity weighting and the marginal damage costs of climate change. Ecological Economics, 68(3), 836-849. Baumgärtner, S., Drupp, M.A., Munz, J.M., Meya, J.N., and Quaas, M.F. (2017a). Income inequality and willingness to pay for environmental public goods. Journal of Environmental Economics and Management, 85: 35–61. Fleurbaey, M. and Abi-Rafeh, R. (2016). The use of distributional weights in benefit–cost analysis: Insights from welfare economics. Review of Environmental Economics and Policy, 10(2), 286-307. Her Majesty's Treasury (2011). The Green Book. Appraisal and Evaluation in Central Government. London: TSO. 114 pp. [Jasper Meya, Germany]	Accepted. Text amended to reflect the importance of distributional elements to both the process and the durability of the outcomes of 1.5C pathways. Two columns, "Social & regional inclusiveness" and "Intergenerational equity" have been added as parameters of feasibility used in Section 4.5. Note "equity and justice" feature strongly in Chapter 5.
10998	17	4	17	4	Not how chapter 1 set up feasibility [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and text amended. This section has been substantially revised and two new columns have been added to the table to make the link to Section 4.5 clearer. Original framing has been discussed with Chapter 1.
2744	17	4	17	5	This does not seem consistent with the definition set out in Chapter 1 - perhaps re-phrase, as it seems to contradict Ch1, as well as lines 13 to 21 below. [Penny Urquhart, South Africa]	Accepted. Chapter 1 dimensions of feasibility are adopted but the new table 4.1 includes criteria that are used in the application of the feasibility in Section 4.5.
5119	17	4	17	5	The special report -- as detailed in lines 13-18 and table 4.1 -- does not consider feasibility to be "in its essence…the cost and speed at which options….can be introduced" but rather includes a more comprehensive set of criteria for feasibility. The sentence as it is now is misleading. Given the imperative of including social factors in feasibility, this should be avoided. [Tonya Rawe, United States of America]	Accepted. Text amended with clearer distinction between Chapter 1 and Chapter 4 with a re-emphasis of the multi-dimensional nature of feasibility. This point has been expanded with the inclusion of feasibility criteria in the two added columns. Chapter 4 to focus on feasibility of implementation options for 1.5C. Scale and pace now mentioned in this context. Thank you for highlighting inconsistency.
7091	17	7		9	On gainers and loosers of global warming: LG. Giraudet, C. Guivarch (2016). Global warming as an asymmetric public bad, FAERE Working Paper, 2016.26. [Érika Mata, Sweden]	Accepted. Additional reference has been included subject to being accepted as grey literature and their not being peer reviewed .
11033	17	9	17	11	It is safe to say that AR5 did not discuss CDR feasibility in a broad sense, notably not the political and social dimensions (above all in the area of land-use) [Oliver Geden, Germany]	Noted. AR5 had a section on "feasibility" on which this SR expands by describing the multiple dimensions and the conditionality that are mentioned in AR5.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10919	17	10	17	11	To react, people must feel concerned and empowered to fix their issue. Lowering my CO2 benefits doesn't give me immediate benefits, and additionally doesn't give me the feeling that I can alone fix the global warming issue by doing so. This leads to the actual situation of defeatism and of "We can't do anything about it" feelings. Institutions and governments should emphasize the local and immediate benefits of decarbonization. CO2 emissions (affecting global scale) are intimately linked to local pollution and lower confort, compared to their electrified counter-parts. People are much more concerned by their long-term health and immediate confort than their CO2 emissions where their immediate benefits are null. - Local pollution includes health-affecting noise, particles, and toxics emitted by combustion and ICEs. All of this affects directly medium and long-term health of people mainly locally. - Confort includes much quieter roads, fresher air, better visibilty and skyline in urban aeras, less smell and irritations, more confortable rides in vehicles, no stops at gas-stations, no disconfort in heatings and their refuelings, the feeling to contribute to sustainability and progress. Those immediate and local benefits to the persons or communitiies that participate to decarbonization are much easier to understand and to motivate people than long-term, beyond own's lifetime year 2050 or 2100 goals. [Beat Brunner, Switzerland]	Noted. The behavioural components of change are to be given more systemic attention in Section 4.4.3, but have been included in the added columns of Table 4.1 with criteria of "Public acceptance", "Socio-cultural acceptability" and "Social & regional inclusiveness".
13400	17	13			In Section 4.4, options for adaptation, mitigation and SRM … : Should this rather be: "In Section 4.4, options for adaptation, mitigation, CDR and SRM …"? [Helene Muri, Norway]	Accepted. Text revised.
6577	17	16	17	18	Although the text and and table 4.1. mentions the 'cultural' as part of the 'characteristics' -while in fact it seems that it should be part of the core 'dimensions'- the report does not capture more than 3 decades of data collection by environmental sociology on public perception and cultural change regarding public perception of environmental issues and climate change. See for instance: Dunlap, R. E. & R. Brulle 2015. Climate Change and Society: Sociological Perspectives, Oxford University Press; In this regard, the role of social movements in cultural change and in the change of public perceptions of climate change is largely ignored all along the chapter. See for instance: Marquart-Pyatt, Sandra T., Aaron M. McCright, Thomas Dietz and Riley E. Dunlap. 2014. "Politics Eclipses Climate Extremes for Climate Change Perceptions." Global Environmental Change 29:246-257.; McCright, Aaron M., Riley E. Dunlap and Chenyang Xiao. 2014. "The Impacts of Temperature Anomalies and Political Orientation on Perceived Winter Warming." Nature Climate Change 4:1077-1081; McCright, Aaron M. and Riley E. Dunlap. 2015. "Comparing Two Measures of Social Movement Identity: The Environmental Movement as an Example." Social Science Quarterly 96:400-416; McCright, Aaron M., Riley E. Dunlap, Sandy Marquart-Payatt. 2016. "Political Ideology and Views about Climate Change in the European Union." Environmental Politics 25:338-358; Dunlap, Riley E., Aaron M. McCright and Jerrod Yarosh. 2016. "The Political Divide on Climate Change: Partisan Polarization Widens in the U.S." Environment 58 (September/October):4-22; Tàbara, J. D. & Ilhan, A. 2008. 'Culture As Trigger For Sustainability Transition in the Water Domain. The case of the Spanish water policy and the Ebro river basin'. Regional Environmental Change. Vol 8(2): 59-71; Pahl-Wostl, C., J. D. Tàbara, R. Bouwen, M. Craps, A. Dewulf, E. Mostert, D. Ridder, T. Taillieu. 2007. The importance of social learning and culture for sustainable resources management. Ecological Economics, 64(3):484-495. [J. David Tabara, Spain]	Accepted. Tàbara and Ilhan 2008 ref included. Thank you for very useful references. The dimensions are adopted from Chapter 1. The refs have been considered and some included in Section 4.5.1 and in the added columns of Table 4.1.
7092	17	17		19	This list of measures is very short at the moment in the SR,but I assume it will grow in the revised version with the extended literature review [Érika Mata, Sweden]	Accepted. Table 4.1 now includes two new columns that include multiple criteria that are now used in Section 4.5 which applies the feasibility framework.
11034	17	20	17	20	net is incorrect, just "negative emissions" (including "gross") [Oliver Geden, Germany]	Accepted. Text revised.
14123	17	20	17	20	No literature examples for ecosystems given (ie no citations) [Elvira Poloczanska, Germany]	Rejected. Not clear what this refers to as no reference to ecosystems in line 20 page 17.
11188	17	20	17	21	Recognising the multiple dimensions of feasibility becomes particularly important in the context of 'net negative emissions' options, such as BECCS, that are understood to be an important part of 1.5°C pathways - negative emissions are also needed for the majority of 2°C pathways, they are not just specific to 1.5 °C pathways. [Michiel Schaeffer, Netherlands]	Accepted. Text changed to "a necessary feature"
19718	17	24			Table - the section on social / cultural is missing human rights and gender equality [Tara Shine, Ireland]	Noted. An amended version of Table 4.1 has been included. This version includes new parameters. Please see references to new literature (Pelling et al. 2018; Chu et al, 2018; Ziervogel et al, 2017) to social justice.
7093	17	24			This categorization, from Chapter 1/Box 1.3, is not really justified by the literature. Maybe it could be stated that it is a proposal by the authors? Also, Chapters 2-5 do not exactly agree with the 3 dimensions in Table 4.1, but mix e.g. in Ch 2 Geophysical and Technological, and e.g. in Ch 4 almost everything. Could these different associations be motivated? [Érika Mata, Sweden]	Noted. Parameters have been debated at length across chapters. In the feasibility assessment 4.5 we provide line of sight from the parameters to the literature.
11464	17	24			Table 4.1 needs to explicitly acknowledge intra-generational justice issues such as poverty alleviation. No amount of behavioural change among those who are already affluent will achieve the 1.5 degree goal if this is ignored. [Stewart Lockie, Australia]	Noted. Table takes its architecture from Chapter 1. Note the inclusion of distributional effects , employment and poverty in the added columns. Please also reference to content of behavioural change sub-sections in this chapter under 4.4.4.
14076	17	24			Is Table 4.1 rnecessary? Repetition of Box 1.3 Table 1 chapter 1 p33, except Box 1.3 has some extra content [Elvira Poloczanska, Germany]	Noted. An amended version of Table 4.1 has been included. After discussion, this table was retained on the grounds that some people will only read Chapter 4 and that it is essential to the feasibility assessment 4.5.
6661	17	24	17	26	Table 4.1 is redundant to Table 1 in Chapter 1 [Astrid Schulz, Germany]	Noted. An amended version of Table 4.1 has been included. After discussion, this table was retained on the grounds that some people will only read Chapter 4 and that it is essential to the feasibility assessment 4.5.
11035	17	24	17	27	The use of "institutional" here seems somewhat inconsistent with the use of "institutional" in 4.2.3.5 [Oliver Geden, Germany]	Accepted. No inconsistency intended - both examples refer to the broad definition of institutions. Reference to "rules of the game" has been taken out in this text.
5737	17	24	17	27	Table 4.1, item technological. The two examples are in question form, which is not consistent with the rest of the examples and measures. [Hong Yang, Switzerland]	Accepted. This Table has been changed and the questions removed.
10216	17	24	17	27	This table repeated in Cha p1 - itis a nice idea but entries cannot be understood out of context "eg. What does "rate of land-use change refer to?" planting trees fast enough to capture carbon - halting deforestation? I* think it would be better as concrete examples [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Table has been amended with two new columns that raise the criteria applied in Section 4.5 feasibility assessment.
18031	17	26	17	27	Table 4.1. Please, consider adding "Cross-sectoral collaborations" to the Institutional dimensions. [Annamaria Lehoczky, Spain]	Noted. The revised table includes new parameters and the new text in 4.3 and 4.4 emphasises the literature on multi-actor and multi-level interactions (and partnerships in 4.4 in particular).
1912	17	26	17	27	I would suggest to also hightlight here uncertainty about abatment cost. This is likely to rise considerably compared to the 2 degress target. [Jasper Meya, Germany]	Accepted and text amended, next to reference by Daron and Stainforth.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11146	17	26	17	27	The need to categorise empirical measures by both their "characteristic" and their "dimension" seems unnecessary from looking at Table 4.1 - perhaps this could be explained further. [Michiel Schaeffer, Netherlands]	Accepted. Empirical measures has been replaced by the parameters used in feasibility assessment Section 4.5. The first two columns of the table are adopted from Chapter 1.
11147	17	26	17	27	For technological characteristics, apart from the resources limits it would be good to mention the human resources. For some rapidly developing industries, e.g. the installation of the PV panels or maintenance of the wind turbines, there may the issue of lacking qualified workforce [Michiel Schaeffer, Netherlands]	Accepted. Empirical measures has been replaced by the parameters used in feasibility assessment Section 4.5. These include a specific parameter around human capability and institutional capacity.
11148	17	26	17	27	For the social and cultural characteristics a clear reference to managing job losses in the energy intensive industries is lacking [Michiel Schaeffer, Netherlands]	Accepted. New parameters added for adaptation and mitigation in this table include jobs, productivity and distributional impacts.
11149	17	26	17	27	For the institutional characteristics the "rate of institutional change" could be complemented by "and learning": institutions need to adapt and learn, which will lead to change but also determines the way these institutions change. [Michiel Schaeffer, Netherlands]	Accepted, but not in Box. Reference to social learning now enhanced in sub-sections of 4.4.
12490	17	26	17	27	Table 4.1 - Can we really project technological learning curve? The unprecedented progress in digitalization and RES technologies over the past 5 years has disproved all previous attempts to factor in how quickly different types of technologies can be implemented. - to subfield - economic - add - benefits of preventive proactive investment as compared to reactive investment (once a climate-related hazard has occurred, sea-levels have risen, agriculture has been destroyed, people have migrated due to climate-related push factors, etc.) [Yana POPKOSTOVA, France]	Noted. This chapter was asked by the initial plenary to include a reference to existing rates of technological change (4.2.2) but the final draft emphasises the need for and examples of systemic, non-linear change.
7988	18				Technical and economical problems are raised, never really quantified. The fact that "the financial literature is practically silent on climate change" may be a consequence of the non-economic-profitability of renewable energies in comparison to existing energy sources, in the absence of subtantial subsidies. The lesson, which is not really disussed in the document, is that the present economical system may not be compatible with the massive development of renewables, as emphasized in the document ? [Jean Marie Seiler, France]	Accepted and text revised in light of new literature e.g. 'Geels et al., 2017'. This Chapter has been limited in the extent to which it engages particular economic paradigms, but does draw attention to system dynamics.
10217	18		18		This section whould point to feasibility box [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised.
12492	18	1	18	10	While it is not the purpose of this chapter to draw a universal feasibility assessment or select projects that would allow warming to remain below 1.5 C, hereafter we identify a set of principles which would render decision-making more accountable and defensible irrespective of location and context. The ultimate feasibility of different adaptation, mitigation and SRM options would be contingent upon the access to financing, information, capacity and an overall enabling environment in respect to key stakeholder involvement and public ownership of the process. [Yana POPKOSTOVA, France]	Accepted. Additional columns in the revised table include these parameters in the context of mitigation and adaptation. See also sections 4.4 - "Enabling environment" that addresses the importance of context.
7098	18	3		4	Do the authors plan to identify these important principles on a regional and sectorial basis, if such a differenciation is required? My worry is that only rather evident guidelines are provided otherwise. [Érika Mata, Sweden]	Noted. This is a global assessment. While efforts have been made to include the importance of systems and enabling environments, and while case studies try to provide location specific examples, it has not been possible to provide regional specificity. Table 4.1 now includes two new columns of parameters that may provide some of the granularity required.
11150	18	5	18	5	This section refers to the SRM options as if these are an acceptable solution on par with mitigation and adaptation, whereas earlier, on page 7 (line 21-22) the controversies of SRM are highlighted. SRM should be treated more consistently (and not put on par with mitigation and adaptation - given the profoundly different geophysical uncertainties ans risks noted in other chapters). [Michiel Schaeffer, Netherlands]	Noted. This has been part of deliberations at LAM3. This is a feasibility assessment and SRM is one of the measures in the literature, we don't assume anything but evaluate options in terms of criteria.
4796	18	6	18	9	Since for some (individuals and countries) climate change can be beneficial with disadvantages vastly outweghed by the advantages, a classic technique to win the support of those interested in non-compliance should also be considered: compensation for losses incurred by implementing or tolerating mitigation//adaptation policies; cf. David Gauthier, Morals by Agreement, Oxford UP 1986. [Marcel Wissenburg, Netherlands]	Noted. Evaluated in Chapter 4 (not Table 4.1) and a new section on "loss and damage" is being developed in Chapter 4. We cannot "prescribe" a policy response, but have sought to give it higher profile in the text.
16409	18	10	18	11	Consistent with the need to get back to 0.5 C or lower, this should say "consistent with 1.5 C or lower and …" [Michael MacCracken, United States of America]	Noted. But not clear that this refers to Table 4.1.
19719	18	16	18	17	These non- climate benefits can also include benefits in terms of human rights and gender equality. See for example: Rights for Action Putting People at the Centre of Action on Climate Change (Nov 2015) Online at http://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-Rights-for-Action-edition-2.pdf [Tara Shine, Ireland]	Accepted. The point has now been included here and in 4.4.1. The citation has not been included but will be reviewed as grey literature.
2745	18	16	18	17	Could add "in other words, climate resilient development". [Penny Urquhart, South Africa]	Accepted. Text substantially revised and this sentence no longer stands.
4302	18	16	18	20	Example of the above: it should be plainly obvious to state (withouth the need of so many references¡) that "there are many opportunities to align climate interventions with efforts that support livelihoods and local environemnt". But the question remains quantitative: are these "high priority", "soft", free of sacrifice, interventions SUFFICIENT to achieve the 1.5º C target?. I am dismayed reading the whole 4.3.1 because so much unnecessary rethoric comes with so many unnnecessary references. HAS ANYBODY OTHER THAN THE AUTHOR REVIEWED THESE SECTIONS? [Abanades Carlos, Spain]	Section 4.3.1 revised to remove perceived rhetoric. Chapters 1 and 2 are clear that there is no single answer to the feasibility of options, but that these are conditional on enabling environments and embedded in socio-technical and socio-institutional systems. The feasibility assessment conducted in 4.5 (this is an introductory section) addresses the quantitative and qualitative feasibility of options with line of sight to the literature.
13401	18	18			What is "climate intervention" here referring to? It is a bit confusing, considering the National Academy of Science defined it as another label for climate geoengieering. I guess you are not exclusively referring to geoengineering here. I therefore suggest you reformulate or define what you mean by the term. [Helene Muri, Norway]	Accepted. Changed to "climate response" and examples of such responses provided in 4.3 and 4.5.
11059	18	18	25	27	I don't see which particular evidence Peters et al. 2017 provide for this statement. I cannot tell for the other arcticles, since I just know the paper of Peters et al. quite well. This is not meant to criticize Peters et al. in general. The article is cited several times throughout in Chapter 4. From my point of view, it makes sense in some cases, but doesn't in other cases (see below). [Jakob Wachsmuth, Germany]	Accepted. Reference will be removed here.
19393	18	29	18	55	The flow of the text from feasibility into feasibility assessments, uncertainty is sub-optimal. While it is clear that the message is important, the ramifications on policy design could be made clearer. [Sumetee Pahwa Gajjar, India]	Accepted. Text revised. A LAM 3 discussion drew distinction between feasibility of 1.5 relative to feasibility of options that lead to 1.5 and this is reflected in Chapter 1 and Chapter 4.
19720	18	37	18	40	in relation to local contexts - in order to understand these contexts the right to participitaion of local commmunities, and women, in particular has to be respected. [Tara Shine, Ireland]	Noted. Revision to text in the section and in section 4.4.1 on enabling environment.
7094	18	42		47	What about the robustness of key parameters to uncertainty? Could it be good to identify clearly, e.g. that is good to reduce emissions full stop, or to insulate buildings full stop; whereas it may not be so smart to focus on only attaining cost-efficient opportunities (as profitability is per se an uncertain parameter (cf: Mata É, Wanemark J, Nik V, Sasic Kalagasidis A, Mitigation potentials from building retrofitting – A techno-economic study of uncertainties related to climate change scenarios in Sweden (in review))? [Érika Mata, Sweden]	Accepted. Robustness to uncertainty is being considered in Chapter 4 feasibility diagram.
7334	18	42	18	42	Delete the text "preventing lock-in". [Eleni Kaditi, Austria]	Accepted and changed to "avoiding". "Lock-in" is a glossary term in AR5 and in this report.
19074	18	44	18	44	Change "difficult" --> "difficulties" [Miriam Solera Ureña, Germany]	Accepted. Have removed "difficult to predict" completely.
1913	18	45	18	47	A working paper discussing the optimal life time of infrastructure in face of irreversiblities is Eisenack and Paschen (2017): Designing long-lived investments under uncertain and ongoing change. https://www.uni-oldenburg.de/fileadmin/user_upload/wire/fachgebiete/vwl/V-398-17.pdf [Jasper Meya, Germany]	Accepted and text revised. Citation considered subject to approval of grey literature.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14077	18	49	18	50	Suggest to simplify the language of this sentence. [Elvira Poloczanska, Germany]	Accepted and text amended. "The systemic approach implicit in this characterisation of feasibility introduces analytical complexity to the need for prioritisation (Reyers et al. 2017)."
10920	18	49	19	4	Interconnected systems are a handicap to change parts into sustainable alternatives. A solution is to make systems independant while making them sustainable. This also strengthens massively the resilience of such systems to catastophic climate changes and other natural or man-made disasters. [Beat Brunner, Switzerland]	Accepted. Changed with reference to Geels et al (2017) that makes the point interconnected/ co-evolved systems can sometimes have inertia and sometimes display rapid change.
16408	18	55	19	1	The goal should not be a "transition to a 1.5 C world" but to peak at as low a value as possible (ideally less than 1.5 C, with an overshoot a bit more) and return to less than about 0.5 C--and if need be to shave off peak warming with Solar Radiation Management in order to limit impacts (especially to avoid irreversible impacts). The level of impacts at 1.5 C will be so much there is really no justification for thinking of 1.5 C as an acceptable long-term stabilization level. [Michael MacCracken, United States of America]	Noted. Chapters 1 and 2 deal with overshoot and a cross chapter box deals with the 1.5 definitions.
3836	19				Small scale renewable energy production certainly has a great potential, especially solar energy and (at least in countries like Sweden) hydropower. One obstacle for the moment in Sweden is the legal system obstructing net "overproduction" of energy, i.e. it is not allowed to produce more than your own consumption and be a net energy provider out on the national transmission grid. If you do that you have to pay extra tax for all energy you produce! These kinds of obstacle need to be reduced. [Mats Winroth, Sweden]	Accept - section has been revised
4303	19		21		In contrast with my comments above: The section 4.3.2 "Energy system transitions" is nice and informative. But it is only taking a bit over 2 pages of the chapter ¡¡. This is extraordinary in a report intended assess climate change mitigation to under 1.5 ºC. This chapter needs to expand this section. [Abanades Carlos, Spain]	Accept - section has been revised
13403	19	3			Add to sentence " … (Daron et al. 15) and there are diverse challenges for an adequate representation of CDR and SRM in integrated assessment models (Tavoni et al. 2017). " Tavoni, Massimo and Bosetti, Valentina and Shayegh, Soheil and Drouet, Laurent and Emmerling, Johannes and Fuss, Sabine and Goeschl, Timo and Guivarch, Celine and Lontzek, Thomas S. and Manoussi, Vassiliki and Moreno-Cruz, Juan and Muri, Helene and Quaas, Martin F. and Rickels, Wilfried, Challenges and Opportunities for Integrated Modeling of Climate Engineering (September 11, 2017). FEEM Working Paper No. 38.2017. Available at SSRN: https://ssrn.com/abstract=3035166. [Helene Muri, Norway]	Accepted. Text revised and reference has been included subjected to approval as grey literature.
7095	19	3		4	Do the authors plan to present exemples of such multicriteria analyses? [Érika Mata, Sweden]	Noted. An MCA is developed in 4.5 of this Chapter in SOD. The references refer to examples that have been used to compile this. See expanded Table in this section which includes the makings of criteria.
1126	19	4			Which "guidelines considerations"? [Rob Swart, Netherlands]	Accepted. Text amended to refer to elements of feasibility developed in Chapter 1. We have worked closely with Chapter 1 to provide a new table for this section, and have included new columns in this table to reflect the approach taken to feasibility in Section 4.5
1746	19	7			I was surprised by the "Energy system transitions" section based on videos I saw about the SR1.5 report. Even though this is a topic of central importance to achieving 1.5 C, the section is pretty short and seems to be written more from a "continue current trajectory" perspective rather than the perspective of what can be achieved if governments and businesses made the transition a strong focus. [Levi Golston, United States of America]	Accept - whole section revised.
17387	19	7	19	48	Hydropower and Bio-energy are very wide terms (used in other sections too), these should be referenced as large-scale hydro and micro-hydro, also any mention of bio-fuels should differentiate between the use of 1st generation (agricultural product), 2nd generation (waste derived) and 3rd generation (algae or other chemical synthesis) production - the former being in general viewed as the least sustainable option. Renewable Energy Options for Shipping – Technology Brief International Renewable Energy Agency, Jan 2015. Dr Peter Nuttall and Alison Newell (University of South Pacific), Linus Mofor (IRENA) ,Gavin Allwright, Dr Alice Bows-Larkin (Tyndall Centre for Climate Change Research, University of Manchester), Diane Gilpin (B9 Shipping), Dr Christophe Rynikiewicz (University of Sussex), Dr Tristan Smith (The Energy Institute, University College London) and Michael Traut (Tyndall Centre for Climate Change Research, University of Manchester), http://www.irena.org/DocumentDownloads/Publications/IRENA_Tech_Brief_RE_for%20Shipping_2015.pdf [Gavin Allwright, United Kingdom (of Great Britain and Northern Ireland)]	Accept - whole section revised.
4662	19	11			Change the reference to "AR5" to be consistent in whole Report. [Radim Tolasz, Czech Republic]	Accept. Changed
4221	19	12	19	13	General comment: As stated in the comments for Chapters 2 and 5, there is some concern of bias evident in the report against nuclear energy, without fair consideration of the associated hazards and expected trade-offs for renewable energy technologies. As a general comment, it is noted that none of the authors or editors listed have a background in nuclear science and yet this technology is mentioned several times in the report. The absence of a scientist in this field can therefore question the report's authority and ability to present all energy technologies in a balanced manner. Chapter 4 does not discuss the feasibility of nuclear and instead refers to AR5 (p.19, lines 12-13), which is a report that extensively discusses nuclear energy, including using a substantial number of technical references, despite not one nuclear scientist or engineer being a contributor/ reviewer to AR5. Thus, the neutrality and ability to present nuclear energy appropriately and fairly is questionable. For example, the linear no-threshold model (LNT) is included in the IPCC AR5 report in Chapter 7 Energy Systems and actually misrepresents the recommendations of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) on page 550 "such estimates are neither endorsed nor disputed by UNSCEAR (Balonov et al., 2011)" when 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). Thus, the absence of contributors/ reviewers of a nuclear science/ engineering background in this Chapter, or indeed, the substitution of this knowledge and cross-referencing to another IPCC report (AR5) that also does not have contributors/ reviewers of a nuclear science/ engineering background raises questions regarding credibility. [Jessica Callen, Austria]	Accept - section added on nuclear
15001	19	12	19	13	Why are hydro, biomass, and nuclear not discussed here in the 1.5C context? Seems strange to omit these but not other sectors given that all sectors are covered in AR5. Also, hydro is mentioned on p.19 line 52-54. [Farhan Akhtar, United States of America]	Accept - for hydro and biomass this section discusses developments since AR5. Section added on nuclear
1972	19	12	19	14	In a recent article IJGEI V40 N1/2 2017, it was shown by a panel of experts that with the use of breeding reactors it was quite possible to obtain a PWR power increase of 2000 Gwe in 20 years followed by a FBR power of 18000 Gwe increase in 70 years. If a doubt exists on the conclusion of this article (writen by some of the world experts on the matter and accepted by a pair evaluation process) we suggest to ask IAEA for an additional evaluation rather than accepting a single report of the IEA with no guarantee of the expertise of the authors on nuclear power development. [Herve Nifenecker, France]	Accept - section added on nuclear

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14251	19	12	19	13	"This means that for options like nuclear energy (the capacity additions of which continue to fluctuate (IEA 2017)), hydropower and biomass, we refer to AR5 for an assessment of their feasibility." No, this is unacceptable. Nuclear power needs to be considered. Regardless of the authors' feelings about nuclear power it needs to be investigated and its contributions discussed properly. If the authors are unfamiliar with nuclear power then they should get an author to contribute to the discussion. Nuclear power is currently contributes about half of the carbon-free energy in the world (hydro being most of the other half) and both need to be discussed in detail, but neither are. This report has found a mind-bogglingly extensive array of expertise and it may need to add an expert on nuclear power and another on hydropower. I've been very impressed with the depth of knowledge on other subjects, but these two topics have not been adequately addressed. [Jason Donev, Canada]	Accept - section added on nuclear
20627	19	13			stakeholder would expect an update from AR5 and a diversified list of options. Otherwise discussion would again be constrained to BECCS as a less desirable option from the point of view of impacts. [Hans Poertner, Germany]	Accept - section has been expanded to include more options and references since AR5
18395	19	13	19	13	Double bracket [Wilfran Moufouma Okia, France]	Accept - changed
19721	19	18			Section on renewable energy. Note this section needs to i) address the gender dimensions of access to renewable energy; ii) address the social inclusion aspects of access to renewable energy and iii) ensure that States and buinesses repect human rights when designing and implementing renewable energy projects. Resources for each of these as follows: [Tara Shine, Ireland]	Noted but these issues are in chapter 5. Box on slums covers to some degree.
19722	19	18			i) Access to energy the gender dimensions. Mary Robinson Foundation. Online at http://www.mrfcj.org/pdf/Policy-Brief-Malawi-Access-to-Sustainable-Energy-the-Gender-Dimensions.pdf. See also SEforALL resources and People-Centred Accelerator. [Tara Shine, Ireland]	Noted but these issues are in chapter 5. Box on slums covers to some degree
19723	19	18			ii) The Role of Social Protection in Ending Energy Poverty: Making Zero Carbon, Zero Poverty the Climate Justice Way a Reality. 2016. Online at http://www.mrfcj.org/wp-content/uploads/2016/09/The-Role-of-Social-Protection-in-Ending-Energy-Poverty.pdf [Tara Shine, Ireland]	Noted but these issues are in chapter 5. Box on slums covers to some degree
19724	19	18			iii) Case studies available form the Human Rights and Buiness Resource Centre: https://business-humanrights.org/en/case-studies-renewable-energy [Tara Shine, Ireland]	Noted but these issues are in chapter 5. Box on slums covers to some degree
11190	19	18			Can anything be said in this section on the assumptions used by IAMs for renewable energy costs and how they compare with reality? [Michiel Schaeffer, Netherlands]	Noted but not the right place for this.
20628	19	18		24	Again missing the option of CO2 recycling and synthetic fule as one that would also be applicable to shipping and air traffic. Power to gas technologies are being tested widely and should not be ignored. [Hans Poertner, Germany]	Accept - section has been revised
10999	19	18	19	18	This section should cover integration challenges at high levels of penetration [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accept - section has been expanded
4222	19	18	19	48	The report does not appear to consider some of the limitations/ risks associated with solar PV, for example: * The hazardous chemicals required for solar panel manufacturing combined with an absence of many PV companies addressing appropriate recycling, highlights the need for appropriate polices in place to manage this aspect of the life cycle to limit any impact it may have on health or the environment (ILO 2012; SVTC 2014a; SVTC 2014b). * The highest number of fatalities per TWh for energy sources may be from rooftop solar due to the hazards from falling during installation and the relative high frequency of fatalities from falls (US Department of Labor 2016; 2017; Wang 2008). * A recent report by the World Bank (2017) states that renewable technologies such as wind, solar, hydrogen and electricity systems are actually more material intensive in their composition than fossil-fuel based energy supply systems. It notes that a new set of challenges related to the sustainable development of minerals and resources is likely to result from the increased use of renewable technologies. The report warns that it will be necessary to develop appropriate policies and measures that help ensure that the transition to low carbon is managed so that it will not negatively impact sustainable development priorities, from environmental and other material impact issues to supporting continued economic and equitable growth, in developing countries. A lack of data and the need for further research and studies on this issue was also noted. * Following a survey of photovoltaic module manufacturers, none were able to provide documentation to verify that their supply chains do not contain conflict minerals based on the due diligence guidelines set by the OECD. Thus the companies may contribute, directly or indirectly, to armed conflict, infringements of human rights and impede economic and social development SVTC 2014a; SVTC 2014c; OECD 2016). This point and the three above regarding the hazardous chemicals, challenges of sustainable development of minerals and resources, and possible fatalities can be considerd trade-offs and possible risks in the use of this mitigation technology. References: (ILO 2012) International Labour Office, The global impact of e-waste Addressing the challenge, Geneva: ILO (2012) (OECD 2016) Organisation for Economic Co-operation and Development, OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, Third Edition, Paris: OECD (2016) (SVTC 2014a) The Silicon Valley Toxics Coalition, Solar Scorecard 2014, available from: http://www.solarscorecard.com/2014/images1/SVTC-2014-Solar-Scorecard-large.gif [accessed 08/08/2017] (SVTC 2014b) The Silicon Valley Toxics Coalition, Solar Scorecard Guidelines, available from: http://www.solarscorecard.com/2014/score-guidelines.php [accessed 08/08/2017] (SVTC 2014c) The Silicon Valley Toxics Coalition, 2014 Solar Scorecard Analysis, available from: http://www.solarscorecard.com/2014/analysis.php [accessed 08/08/2017] (US Department of Labor 2016) US Department of Labor, United States Bureau of Labor Statistics, News release, National census of fatal occupational injuries in 2015, available from: https://www.bls.gov/news.release/pdf/cfoi.pdf [accessed 10/08/2017] (US Department of Labor 2017) United States Department of Labor, Commonly Used Statistics, OSHA Data & Statistics, available from: https://www.osha.gov/oshstats/commonstats.html [accessed 10/08/2017] (Wang 2008) Wang, B. Deaths per TWh for all energy sources: Rooftop solar power is actually more dangerous than Chernobyl, Next Big Future, available from: https://www.nextbigfuture.com/2008/03/deaths-per-twh-for-all-energy-sources.html [accessed 08/08/2017] (World Bank 2017) The Growing Role of Minerals and Metals for a Low Carbon Future, Washington DC: World Bank, June 2017. [Jessica Callen, Austria]	Reject - not supported by literature on the safety of energy sources
2746	19	18	19	48	Renewable energy could be discussed both as a mitigation and an adaptation option - in most LDCs, this is how it is discussed and implemented in practice. The discussion here may wish to reflect this. [Penny Urquhart, South Africa]	Accepted - text to reflect the synergies between mitigation and adaptation potential of renewable energy has been added into the SOD.
2236	19	18	19	48	The entire section Renewable Energy lacks structure and has the character of notes from a brainstorming session. It needs to be rewritten in a more structured way. [Kenneth Möllersten, Sweden]	Accept - section has been revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1127	19	18	27	47	The structure (energy first then land and ecosystems) makes sense, but I did not find a discussion on the linkages (competition biomass for food, feed, energy, industrial processes in a bio-economy) in a 1.5 degree world (in Box?). In the land and ecosystems section, a discussion about the tension between low-tech (low-input) and high-tech (high-input) agriculture would be useful. E.g., would vertical farming decrease GHG emissions (decreasing transport distances and higher efficiency of water use) or increase them (artificial lighting and other inputs) and thus have a place in a 1.5 degree world or not? The text in 4.3.4.1.4. could be expanded to cover the latter issue. [Rob Swart, Netherlands]	Accepted. Section 4.3.3 is being revised and new assessments of adaptation options are being done to address this point.
2596	19	19	19	20	Biomass or bioenergy are not included in the renewable energy options [Maria Puig Arnavat, Denmark]	Accept - section added on biomass
11060	19	19	19	24	In Van Sluisveld et al 2015, a detailed comparison of the transformation of energy supply in decarbonisation scenarios and historic changes is provided. Citing some of their results here could enrich this paragraph significantly. [Jakob Wachsmuth, Germany]	Accept - section revised
7904	19	19	19	24	It would be useful to mention the trends in installed capacity/generation for different RE techs and show what those rates would need to be to keep warming to 1.5 deg [Westphal Michael, United States of America]	Accept - section has been revised
7808	19	19	19	24	The remarks about offshore wind are already obsolete, as it was bid without subsidy into the EU market in 2017. A paper I'm about to submit to Science notes: "The International Energy Agency expects total renewables to produce by 2021 more electricity than the US and EU use, and to add nearly 60% of global new generation by 2040 (they added 55% of 2016 new capacity without or 62% with big hydro). Yet during 2000–16, IEA fore¬casts rose 5× for windpower and 19× for PVs with¬out catching up with reality. Continuing this pattern, IEA (Renewable Energy Medium-Term Market Report 2016) ex¬pects unsubsidized onshore wind and utility-scale PV levelized power prices to drop by about 15% and 25% respec¬tively dur¬ing 2016–21, but during 2016 alone, they fell by 18% and 17% respectively, and for offshore wind, 28% (Frankfurt School FS-UNEP Collaborating Centre for Climate & Sustainable Energy Finance and BNEF, "Global Trends in Renewable Energy Investment 2017," 6 April 2017, http://www.fs-unep-centre.org), while low bids fell 37% for Mexican PV and 43% for EU off¬shore wind (T. Kåberger, Opening address, REvision 2017 symposium, Renewable Energy Institute (Tokyo), 8 Mar 2017. http://renewable-ei.org/en/images/pdf/20170308/Tomas_Kaberger_Revision2017_Welcome.pdf). The more re¬new-ables we buy, the cheaper they get, so we buy more, so they get cheaper. Counting such expanding returns, BNEF's New Energy Outlook 2017 (https://about.bnef.com/new-energy-outlook/) pre¬dicts renewables will capture 72% of global power generation investment to 2040, with levelized cost falling another 66% for PV, 47% for onshore wind, and 71% for offshore wind. Renew¬able growth is accelerat¬ing (F. Creutzig et al. The underestimated potential of solar energy to mitigate climate change. Nature Energy 2, 17140 (2017), 1–9.; M. Abramczyk et al. Positive Disruption, 3 Aug 2017, Rocky Mountain Institute, https://www.rmi.org/wp-content/uploads/2017/08/RMI_Report_Positive_Disruption_2017.pdf), and seems likely to be further sped by the even faster fall in elec¬tric¬ity-storage costs (N. Kittner, F. Lill, D. Kammen. Energy storage deployment and innovation for the clean energy transition. Nat. Energy 2, 17125 (2017), 1–6)." [Amory Lovins, United States of America]	Accept - section has been revised
7662	19	19	19	24	The remarks about offshore wind are already obsolete, as it was bid without subsidy into the EU market in 2017. A paper I'm about to submit to Science notes: "The International Energy Agency expects total renewables to produce by 2021 more electricity than the US and EU use, and to add nearly 60% of global new generation by 2040 (they added 55% of 2016 new capacity without or 62% with big hydro). Yet during 2000–16, IEA fore¬casts rose 5× for windpower and 19× for PVs with¬out catching up with reality. Continuing this pattern, IEA (Renewable Energy Medium-Term Market Report 2016) ex¬pects unsubsidized onshore wind and utility-scale PV levelized power prices to drop by about 15% and 25% respec¬tively dur¬ing 2016–21, but during 2016 alone, they fell by 18% and 17% respectively, and for offshore wind, 28% (Frankfurt School FS-UNEP Collaborating Centre for Climate & Sustainable Energy Finance and BNEF, "Global Trends in Renewable Energy Investment 2017," 6 April 2017, http://www.fs-unep-centre.org), while low bids fell 37% for Mexican PV and 43% for EU off¬shore wind (T. Kåberger, Opening address, REvision 2017 symposium, Renewable Energy Institute (Tokyo), 8 Mar 2017. http://renewable-ei.org/en/images/pdf/20170308/Tomas_Kaberger_Revision2017_Welcome.pdf). The more re¬new-ables we buy, the cheaper they get, so we buy more, so they get cheaper. Counting such expanding returns, BNEF's New Energy Outlook 2017 (https://about.bnef.com/new-energy-outlook/) pre¬dicts renewables will capture 72% of global power generation investment to 2040, with levelized cost falling another 66% for PV, 47% for onshore wind, and 71% for offshore wind. Renew¬able growth is accelerat¬ing (F. Creutzig et al. The underestimated potential of solar energy to mitigate climate change. Nature Energy 2, 17140 (2017), 1–9.; M. Abramczyk et al. Positive Disruption, 3 Aug 2017, Rocky Mountain Institute, https://www.rmi.org/wp-content/uploads/2017/08/RMI_Report_Positive_Disruption_2017.pdf), and seems likely to be further sped by the even faster fall in elec¬tric¬ity-storage costs (N. Kittner, F. Lill, D. Kammen. Energy storage deployment and innovation for the clean energy transition. Nat. Energy 2, 17125 (2017), 1–6)." [Amory Lovins, United States of America]	Accept - section has been revised
7903	19	19	19	48	There is no mention of the costs other RE besides solar. There has been a wind revolution too. From REN21 2017: The global weighted average LCOE of onshore wind power fell by 18% between 2010 and 2016 alone, to USD 0.07 per kWh for wind farms commissioned in 2016. [Westphal Michael, United States of America]	Accept - section has been revised
11061	19	19	35	39	Please add references here. [Jakob Wachsmuth, Germany]	Accept. Will be done.
6741	19	19	19	48	This section as drafted ignores the rapid uptake of wind, solar and battery technologies as well as the very recent acceleration of Evs. It also makes no mention of the dramatic cost declines of renewable energy in recent years such that it is now cost competitive with FF and nuclear power in many parts of the world. It also fails to talk about the substantial co-benefits associated with RE deployment, especially when compared to continued reliance on FF and nuclear. Also, unlike CCS, it is a proven and cost effective technology that avoids CO2 generation and thus should be a priority investment for all countries. Also, limited mention of the 100% RE commitments by nations. No mention of the fact that it has been achieved in several places. Also, no mention of the fact that cities and corporate RE purchases are also driving a more rapid uptake of RE. See, the articles I've already cited and http://www.cell.com/joule/abstract/S2542-4351(17)30012-0. [Jennifer Morgan, Netherlands]	Accept - section has been revised
19394	19	20	19	24	If only solar and wind energy have grown exponentially since AR5, why does the SR1.5 take the position that a range of other technologies (bioenergy, ocean eneergy) would need to show faster growth rates. Perhaps, more studies need to be undertaken to understand why the range of technologies which are growing slower (concentrated solar, bioenergy and ocean energy) are failing to grow fast, rather than suggesting that they should. [Sumetee Pahwa Gajjar, India]	Accept - feasibility includes this element now.
921	19	21	19	21	Care is needed when interpreting the IEA analysis of offshore wind; they report on the decline in installations in 2016. In contrast, 2015 saw an over doubling of installation. [David Infield, United Kingdom (of Great Britain and Northern Ireland)]	Noted.
558	19	21	19	22	…only solar and wind are on track to reach a 2C pathway This is misleading because according to the 100% WWS roadmaps (e.g., Jacobson et al., 2017, referenced above), there is no growth in new hydropower dams needed, geothermal growth needed is only modest, and no bioenergy is needed at all. [Mark Jacobson, United States of America]	Accept - section revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6742	19	21	19	22	According to the IEA (2017), only solar energy and onshore wind energy are on track to reach a 2°C pathway. The IEA is not a neutral and scientific source for these analyses and have been systematically and consciously underestimating the contribution of renewables. See - among many similar analysis - the freshest from Erik Sauar's on "IEA counts fossil fuels threefold versus wind and solar", 28 August, 2017 https://energiogklima.no/kommentar/iea-counts-fossil-fuels-threefold-versus-wind-and-solar/ [Jennifer Morgan, Netherlands]	Accept - section revised
11189	19	21	19	22	according to the IEA, only solar energy and onshore wind energy are on track to reach a 2°C pathway - what does "on track" mean in this context? Which 2°C pathway is used? Is there any other literature to compare this to? [Michiel Schaeffer, Netherlands]	Accept - section revised
13054	19	21	19	22	How this "track" has been evaluated? Is this track coherent with all the pathways discussed in Chapter 3? Details on this point would be useful [Caserini Stefano, Italy]	Accept - section revised
6792	19	26		27	The price given here is not for "solar PV" but for "solar modules", which are just one element of a PV system. PV system costs have decreased as well, but are not only dependent on harware costs, but on local soft costs as well. Possible references: IRENA, NREL or JRC reports. [Arnulf Jaeger-Waldau, Italy]	Accept. Removed price as not needed
6793	19	26		33	The description of world-wide PPAs, which are in the range of USD 25 to 75/MWh are missiong completely. [Arnulf Jaeger-Waldau, Italy]	Noted but not the right place for this.
6743	19	26	19	27	"The largest growth factor since AR5 has been the dramatic reduction in the cost of solar PV to 0,41 USD Wp-1 (REN21 2017)". The USD 0.41 Wp-1 data refers to end 2016. Such cost data become out of date very quickly, considering the publishing date of the IPCC 1.5C report, maybe adding annual cost reduction rates or learning rate would be useful. The learning rate (cost reduction per doubling of capacity) for PV modules was about 28%. See page 17 in Bloomberg New Energy Finance: New Energy Outlook June 2017. The analysis also ignores the average module efficiency improvements for solar, the turbine size increase for wind, the increasing capacity utilization factors for both wind and solar and other similar factors, see e.g. for average solar model efficiencies at page 18: Bloomberg New Energy Finance: New Energy Outlook June 2017. Wind cost curve fell from EUR 1.32/W in 2007 to EUR 0.85/W in 2017 see page 19. https://about.bnef.com/new-energy-outlook/ [Jennifer Morgan, Netherlands]	Accept. Removed price as not needed
10853	19	26	19	27	the solar PV cost decline, however it should be specified that here solar PV module cost are meant - the total system cost are higher. A peer-reviewed reference for that could be found here: DOI: 10.1002/pip.2885; excellent overview on the expected further development can be found here: https://www.researchgate.net/publication/316753475_The_True_Competitiveness_of_Solar_PV_-_A_European_Case_Study [Christian Breyer, Finland]	Reject - not supported by literature on the comparative cost of energy sources across the world
7809	19	26	19	27	This appears to be a module (not system) market price, so it should be updated to the current level of <$0.3/Wp (lately ~$0.25) reported frequently in PV World and other trade literature. [Amory Lovins, United States of America]	Accept. Removed price as not needed
7663	19	26	19	27	This appears to be a module (not system) market price, so it should be updated to the current level of <$0.3/Wp (lately ~$0.25) reported frequently in PV World and other trade literature. [Amory Lovins, United States of America]	Accept. Removed price as not needed
10854	19	26	19	33	see also two further articles on the excellent RE-based solutions for off-grid regions (http://dx.doi.org/10.1016/j.esd.2015.12.007) and islands (http://dx.doi.org/10.1016/j.enpol.2016.03.043) [Christian Breyer, Finland]	Noted
7902	19	26	19	33	Firstly, I would cite costs as $/KWh (LCOE). For solar, it is important to make a distiction between utility-scale and rooftop solar. I would cite the LCOE declines for utility-scale solar from REN21. Moroever, rooftop solar is now within the cost range of natural gas generation in China and India. See. Westphal et al. 2017. Powering Cities in the Global South: How Energy Access for All Benefits the Economy and the Environment. World Resources Institute. [Westphal Michael, United States of America]	Accept. Removed price as not needed
4663	19	27			Use US$ curency format [Radim Tolasz, Czech Republic]	Accept. Removed price as not needed
14252	19	27	19	27	USD or Euros? Be consistent from one chapter to the next! (I know that's hard with coordinating different authors) [Jason Donev, Canada]	Accept. Removed price as not needed
14253	19	27	19	27	This line uses 0,41 USD which is an odd mix of the European way of writing a decimal with a US currency. Please use ',' or '.' Consistently.(I know that's hard with coordinating different authors) [Jason Donev, Canada]	Accept. Removed price as not needed
754	19	27	19	27	It states 0,41 USD it should read 0.41 with a point [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Removed price as not needed
13513	19	28	19	32	Renewable energies exploitation in developing countries is often a "low-hanging fruit" ready for exploitation at a relatively low cost. See the work of Szabo et al In Nature Energy https://www.nature.com/articles/nenergy2016140 [Fabio Monforti-Ferrario, Italy]	Accept - changed
755	19	30	19	32	The statement that "and have already provided many remote communities with energy independence" is highly unlikely, and needs a few citations including a good definition of 'energy independence'. The Nature citation does not mention this. See line 42 and 43 of page 19. From my knowledge and from the over 110 case studies mentioned in these two citations off-grid renewable systems very rarly provide all the energy requirements and fossil fuels are still used (Jimenez, R. (2017). Development Effects of Rural Electrification (IDB-PB-261). Retrieved from https://publications.iadb.org/handle/11319/8157 Pueyo, A., & Hanna, R. (2015). What level of electricity access is required to enable and sustain poverty reduction? Annex 1 Literature review. Retrieved from Bourton-on-Dunsmore, UK: https://www.ids.ac.uk/files/dmfile/UtilisingElectricityAccessforPovertyReduction-LiteratureReview.pdf) [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accept - section has been revised
4874	19	33	19	33	CCS in power and industry is an enabler for BECCS and signifiant synergies exists for these three CCS application sectors, especially with joint transport and storage infrastructures. [Wilfried Maas, Netherlands]	Noted. We address this in the section on feasibility of BECCS.
3881	19	33	19	33	It would be good to include at least a sentence on the very high potential for distributed solar generation. For example "The high amount of sunlight and the great extent of existing rooftops produce a high potential for distributed solar generation on residential and commerical roofs, which could, for example, provide two-thirds of electricity use in California, USA (Kurdgelashvili et al. 2016)." Kurdgelashvili, L., J. Li, C.H. Shih, and B. Attia. 2016. Estimating technical potential for rooftop photovoltaics in California, Arizona and New Jersey. Renewable Energy 95: 286-302. [Patrick Gonzalez, United States of America]	Accept - section has been revised
6543	19	35	19	39	There is need for citation(s) to support the statements made in the Chapter. [Victor Ongoma, Kenya]	Accept - section has been revised
6744	19	36	19	37	This statement is odd. Solar in north-western Europe is not a surprise at all. In fact, Germany has led the way on the solar PV revolution. [Jennifer Morgan, Netherlands]	Accept - section has been revised
2237	19	36	19	37	Has not policy instruments had an impact on the technology attractiveness? A reference is needed. [Kenneth Möllersten, Sweden]	Accept - section has been revised
6745	19	38	19	39	"Another important factor is public acceptance, in particular for wind energy". This reference to local resistance to wind is exaggerated and is a much less frequent issue than positioned here. If you believe it is an important factor, please quote sources that prove that public acceptance was an issue for a significant share of the above 500 GW global wind capacity installed so far. [Jennifer Morgan, Netherlands]	Accept - section has been revised
14254	19	38	19	39	"Another important factor is public acceptance, in particular for wind energy, though research indicates that financial participation and serious community engagement can be effective in mitigating resistance." This should be cited. [Jason Donev, Canada]	Accept - section has been revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14255	19	38	19	39	"Another important factor is public acceptance, in particular for wind energy, though research indicates that financial participation and serious community engagement can be effective in mitigating resistance." This is also true of hydropowerplants (Site C in British Colombia Canada), natural gas cogen plants (Oakville Ontario, Canada), and nuclear power plants (many examples). To single out wind is disingenuous. [Jason Donev, Canada]	Accepted - added other renewables only as that is the sentence, not nuclear
14078	19	38	19	39	References missing. Also, the issue of public acceptance and community-based renewable energy initiatives could be described more here. [Elvira Poloczanska, Germany]	Accept - section has been revised
18710	19	39	19	39	Reference needed [Wilfran Moufouma Okia, France]	Accept - section has been revised
15405	19	40	19	40	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]	Accept - section has been revised
15406	19	40	19	40	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 standard IEEE 2030, published by the Standards Association of IEEE, "Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), and End-Use Applications and Loads ". IEEE Std 2030 was published in September 2011 and several newer revisions have been published since then. Smart grids also allow the coordination of end-user owned dispersed generation and make them economically viable by easing the selling of the energy to the network for private or small producers. [Francisco Javier Hurtado Albir, Germany]	Accept - section has been revised
16410	19	41	19	44	It really needs to be pointed out that both Jacobson et al. and Clack et al., at least, agreed that a transition to at least 80% renewables was possible over the next few decades, and this disagreement is really only about accomplishing the last 20% a few decades in the future--and as I recall, doing so with existing technologies rather than relying on new technologies that can be expected to emerge. This is really a rather esoteric argument given the pace of development of energy and efficiency technologies, and I would urge a bit of a reframing here to indicate the agreement of these authors rather than indicating that there is an important disagreement. [Michael MacCracken, United States of America]	Accept - section has been revised
12609	19	41	19	44	The debate of whether a fully RES electricity system is possible or not is not pertinent. Rather, the focus should be on at what cost such a system can be achieved - social, generational, economic. Life-cycle analysis on the different RES generation sources is necessary in terms of emissions, but also resource and mineral-use, souring countries contexts, etc and these analysis and findings need to be well evaluated and disseminated to avoid an occurrence of a new resource quandary and a perpetuation of exploitative dynamics in key minerals and raw materials countries. [Yana POPKOSTOVA, France]	Noted. This is addressed in the new approach to feasibility and also the geopolitical aspects are addressed in 4.3.2.2
559	19	41	19	45	…considerable debate exists on whether a fully renewable energy or electricity system, also excluding biomass, is possible. First, please state, "excluding biomass, nuclear power, and coal with carbon capture." Second, please provide all references to the 100 WWS roadmaps (Jacobson and Delucchi, 2009, 2011; Delucchi and Jacobson, 2011; Jacobson et al., 2013, 2014, 2015a,b, 2016, 2017) - all referenced above. Third, please don't cite the Clack paper without providing the response to it, Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, and B.A. Frew, The United States can keep the grid stable at low cost with 100% clean, renewable energy in all sectors despite inaccurate claims, Proc. National Acad. Sci., 114, ES021-ES023, doi:10.1073/pnas.1708069114, 2017, as the Clack paper is entirely misleading and contains inaccurate data and information. [Mark Jacobson, United States of America]	Accept - section has been revised
10855	19	41	19	48	see how Breyer et al. (DOI: 10.1002/pip.2885) have solved the bioenergy issue, with clear sustainability criteria, applied in the model, this may be a more balanced way [Christian Breyer, Finland]	Accept - section has been revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14259	19	42	19	43	"Studies estimating the use of renewable energy in the future, either at the global or at the national level, are plentiful and considerable debate exists on whether a fully renewable energy or electricity system, also excluding biomass, is possible (Jacobson et al. 2015) or not (Heard et al. 2017; Clack et al. 2017), and by what year." I am uncomfortable with this treatment of the controversy. Jacobson's paper has been widely hailed as wonderful, but not by people who have a deep understanding of the electrical grid. Both Heard et al and Clack et al have raised serious objections to the modeling problems put forth in Jacobson's paper. I strongly urge the authors of this document to read all three of those papers in depth and take a firmer stand on this issue. My opinion is that Jacobson's work is magical thinking, but encourage the authors of this paper to read all three papers and draw their own conclusions. I *wish* Jacobson's paper were true, but it simply doesn't seem to be based on sound modeling. Please also consider looking at: Pacala, Stephen, and Robert Socolow. "Stabilization wedges: solving the climate problem for the next 50 years with current technologies." Science 305, no. 5686 (2004): 968-972. Hong, Sanghyun, Corey JA Bradshaw, and Barry W. Brook. "Global zero-carbon energy pathways using viable mixes of nuclear and renewables." Applied Energy 143 (2015): 451-459. Williams, James H., Andrew DeBenedictis, Rebecca Ghanadan, Amber Mahone, Jack Moore, William R. Morrow, Snuller Price, and Margaret S. Torn. "The technology path to deep greenhouse gas emissions cuts by 2050: the pivotal role of electricity." science 335, no. 6064 (2012): 53-59. Brook, Barry W. "Could nuclear fission energy, etc., solve the greenhouse problem? The affirmative case." Energy Policy 42 (2012): 4-8. [Jason Donev, Canada]	Accept - section has been revised
11151	19	43	19	43	Why are studies "also excluding biomass" singled out? Biomass can be a renewable source of energy, is asubstantial part of the globalenergy mix and helpful in dealing with intermittency. [Michiel Schaeffer, Netherlands]	Accept - changed
922	19	43	19	43	Note that these studies pay no or limited attention to the technical requirement to operate a dynamically stable power system. [David Infield, United Kingdom (of Great Britain and Northern Ireland)]	Accept as text did include but has now been expanded
2238	19	45	19	45	This does not clearly explain the meaning and importance of the concept "disruptive innovation". [Kenneth Möllersten, Sweden]	Accept - changed
2597	19	47	19	48	It should be mentioned that the goal for Denmark in 2035 it is not only 100% renewable electricity but also heating [Maria Puig Arnavat, Denmark]	Accept - section has been revised
14256	19	47	19	48	"Several countries have adopted targets of 100% renewable electricity by e.g. 2035 (Denmark)." Once again, hydro is ignored. Please look at countries like Lesotho. [Jason Donev, Canada]	Accept - section has been revised
14257	19	47	19	48	"Several countries have adopted targets of 100% renewable electricity by e.g. 2035 (Denmark)." Also, this statement is misleading, we need carbon free, whether it's renewable or not is completely besides the point. We need to get away from political catch-phrases and focus on the science in this report. We can't ignore politics, and political science must be considered (and is elsewhere, quite well I may add!), but we must focus on our goal of reducing GHGs and not get sidetracked by a fascination for 'renewable'. Framing is very important. [Jason Donev, Canada]	Accept - section has been revised
14258	19	47	19	48	"Several countries have adopted targets of 100% renewable electricity by e.g. 2035 (Denmark)." Denmark's policy is quite misleading as it is not in any way shape or form an independent grid. Denmark has deep interties to other electricity grids to allow it to continue to have electricity when the wind isn't blowing. This supergrid situation is not widely available outside of Europe. To use Denmark as a case-study is misleading and mis-informative. [Jason Donev, Canada]	Accept - section has been revised
19395	19	47	19	48	If several countries have adopted goals for 100% renewable energy, then why mention just Denmark? [Sumetee Pahwa Gajjar, India]	Accept - section has been revised
756	19	48	19	48	It states e.g. 2035 (Denmark) this is not clear, does it mean - electricity e.g. Denmark by 2035 ? [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accept - section has been revised
10921	19	48			Cost of solar pannels decreases 10 % per year and batteries decrease steadily by 16 % (Tony Seba 2017). Those decreases will continue to decrease as they are technologies (J. DoyneFarmerabc & FrançoisLafondade 2015) and a tipping point will be reached when solar with batteries and demand response management through smart metering gives an electricity cost per kWh that is lower than grid transport cost and cheaper than diesel-generators. First one will happen around 2022 and second one already happened as a matter of fact, which is great news for developing countries. Here it is mainly the purchasing cost/investment that is a barrier, but financing scheemes are a solution here. The second issue is that poeople need to be aware that solar+battery is cheaper than diesel generators. Both financing this clear business case and information are easy low hanging fruits. There is also a counter-productive steps that some governments have taken or are about to take : Import duties and anti-dumping duties on solar PV. While protecting short-term local producers, those taxes (and also the threats to tax) are a massive hurdle and impeachment of energy transition to renewable energy. Same for stringent and discouraging permitting rules or anti-renewables regulations. Such anti-humanitarian renewable energy hindering should be forbidden at United Nations level and at national levels too! [Beat Brunner, Switzerland]	Noted
10856	19	51	19	54	Breyer et al. (DOI: 10.1002/pip.2885) have derived a high battery storage demand for the future; an updated energy transition study of the same authors in 'Progress in Photovoltaics' provides much mor detail on the demand development (the accepted manuscript can be provided upon requrest) [Christian Breyer, Finland]	Accept - section has been revised
20629	19	51	20	42	Missing storage options of synthetic gas in the natural gas grid and associated storage sites. This would allow storage of renewable energy and use of conventional technology. Synthetic fuels should also be discussed for use in ground transportation, air traffic and shipping. Use of biofuels comes with tradeoffs and conflict in landuse as well as risks for ecosystems and biodiversity, this should be addressed as well. For these purposes provision of renewable energy in excess of conventional demand requires consideration. [Hans Poertner, Germany]	Accept - section has been revised
2598	19	51	20	6	Maybe it would be worth introducing the concept/technology "vehicle-to-grid" (aka V2G or "EV-to-grid"). [Maria Puig Arnavat, Denmark]	Accept - section has been revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7810	19	51	20	6	The narrative veers from renewables—some renewable, some dispatchable—to the unwarranted tacit assumption that bulk electrical storage will be required for reliable grid integration. Neither the literature nor modern experience (with at least four EU countries with modest or no hydropower—Portugal, Denmark, Scotland, Spain—now half renewably powered with no bulk storage additions, competitive prices, and superior reliability) supports that assumption. There are in fact at least ten kinds of grid flexibility resources, many with large quantities but negative or low costs. Bulk storage is currently the costliest of these, and may even be necessary: for example, the difficult ERCOT power pool (Texas) can be 100%-renewably powered year-round in 2050 with no bulk storage and excellent economics. The evidence for these statements is far too voluminous to marshal here, but if you'd like a dozen-page summary currently in submission to El. J., please write me at amory@rmi.org. Meanwhile, just kindly recall that the US National Renewable Energy Laboratory's 2010 REFS multivolume report (https://www.nrel.gov/analysis/re_futures/, which cites the many peer-reviewed journal articles summarizing this extremely detailed and extensively peer-reviewed study) confirmed 80–90% renewable power's US practicality with 11% storage much less than parked bidirectional-interface electric vehicles could provide. Lovins & RMI (2011), using the same state-of-the-art grid simulation model but allowing half the renewables to be distributed, cut that need in half without counting most of the grid-= flexibility resources elucidated since then. [Amory Lovins, United States of America]	Accept - section has been revised
13514	19	51	20	6	I would suggest to add a sentence on the demonstrated fact that PHS (world) potential is insufficient for an energy system strongly based on renewables. A good reference to start from is Blanco and Faij, RSER 81, 2018 [Fabio Monforti-Ferrario, Italy]	Accept - section has been revised
1747	19	51	20	6	I think it should mention that energy storage is assumed to be needed associated with the roll-out of renewables. It could also be mentioned that the are other options such as the supergrid concept. [Levi Golston, United States of America]	Accept - section has been revised
7664	19	51	20	6	The narrative veers from renewables—some renewable, some dispatchable—to the unwarranted tacit assumption that bulk electrical storage will be required for reliable grid integration. Neither the literature nor modern experience (with at least four EU countries with modest or no hydropower—Portugal, Denmark, Scotland, Spain—now half renewably powered with no bulk storage additions, competitive prices, and superior reliability) supports that assumption. There are in fact at least ten kinds of grid flexibility resources, many with large quantities but negative or low costs. Bulk storage is currently the costliest of these, and may even be necessary: for example, the difficult ERCOT power pool (Texas) can be 100%-renewably powered year-round in 2050 with no bulk storage and excellent economics. The evidence for these statements is far too voluminous to marshal here, but if you'd like a dozen-page summary currently in submission to El. J., please write me at amory@rmi.org. Meanwhile, just kindly recall that the US National Renewable Energy Laboratory's 2010 REFS multivolume report (https://www.nrel.gov/analysis/re_futures/, which cites the many peer-reviewed journal articles summarizing this extremely detailed and extensively peer-reviewed study) confirmed 80–90% renewable power's US practicality with 11% storage much less than parked bidirectional-interface electric vehicles could provide. Lovins & RMI (2011), using the same state-of-the-art grid simulation model but allowing half the renewables to be distributed, cut that need in half without counting most of the grid-= flexibility resources elucidated since then. [Amory Lovins, United States of America]	Accept - section has been revised
13055	19	51	20	6	There are different technologies for the electric energy storage: given that enery storage will be a key factor for the development of the renewable energies, it would be important to analyze the subject more in detail. [Caserini Stefano, Italy]	Accept - section has been revised
14261	19	52	19	52	"1,7 GW" should probably be "1.7 GW" [Jason Donev, Canada]	Editorial.
7905	19	52	20	3	The section gives very short shrift to the declining battery costs. [Westphal Michael, United States of America]	Accept - section has been revised
20869	19	52	20	6	The section on electricity storage is lacking a remark to the newly emerging challenge of seasonal electricity storage (e.g. PV electricity from summer to winter). The prospects of batteries for economic seasonal storage are low. References can be provided upon request. [Daniel Sutter, Switzerland]	Accept - section has been revised
14260	19	52	20	5	"Most current electricity storage is done by pumped hydro (150 GW), but grid-connected battery storage is growing fast; by 50% between 2015 to 2016 to 1,7 GW (REN21 2017). Battery storage has been the main growth feature in energy storage since AR5. The cost of battery storage has decreased significantly. Although costs and technical maturity look increasingly positive, the feasibility 1 of battery storage may be negatively affected by the availability of resources and the environmental impacts of its production (Peters et al. 2017). The production of lithium, a crustal element, does not appear to be restricted and large increases in production have happened in recent years (Government of Western Australia 2016). One study suggests that the environmental impacts of the combination of solar PV with hydrogen fuel cells as energy storage would result in lower life-cycle greenhouse gas emissions (Belmonte et al. 2016)." – This paragraph grossly misrepresents the magnitude of this problem and the current condition of the science. The amounts talked about are tremendously smaller than is needed! Pumped hydro works in a very small fraction of hydro sites because of the specific topographic necessities associated with making pumped hydro work. Grid level battery storage is employed nowhere in the world at the moment, and we are a long ways off from doing so! Decreasing costs of battery storage still don't mean that their prices are remotely close to grid parity. If any grid had the ability to use batteries to help offset electricity demand peaking, they would already be used, independent of the deployment of wind and solar power. Simply put: electrical system operators would use them for coal fired power plants rather than running expensive simple cycle natural gas turbines. We can't 'just use batteries', or it would have already been implemented into existing grids. The demand has been there for decades, independent of the deployment of intermittent sources like solar, wind and tidal power. [Jason Donev, Canada]	Accept - section has been revised
13056	19	53	19	54	Some details on electricity storage costs trends should be addedd, since this is an important point; references also should be addedd, [Caserini Stefano, Italy]	Accept - section has been revised
18711	19	54	19	54	Reference and quantification for "the cost of battery storage" statement needed. Decreased by how much? [Wilfran Moufouma Okia, France]	Accept - section has been revised
15407	19	54	19	54	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]	Accept - section has been revised
930	20		20		I think that since using 100% renewable energy is a solution that many companies, including Facebook, Google, and Amazon Web Services are striving towards, there should be mention of the possible constraints to the transmission grids of countries if 100% renewable energy were employed. Should other constraints like the complementarity of resources and the lack of connections between international grids in small countries also be mentioned as barriers to 100% (or even increased) renewable energy penetration? Perhaps even some of the unintended consequences of the increased solar penetration on the grids in the US should be mentioned as case studies for what could happen with increased renewable penetration. [Elizabeth Aldrich, United States of America]	Accepted - text revised to include resilience of transmission lines in SOD.
788	20	1	20	2	I looked up Peters as found in References page 122 lines 5-58 but did not find that this citation supports the statement on these two lines. Is this the correct citation? [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Noted. It is the best reference for this.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16411	20	3	20	3	The new ultra-capacitor batteries do not require lithium or other rare elements--and are reaching energy densities that are comparable to lithium batteries. In that they are not based on chemical reactions, these new ultra-capacitor batteries can be fully discharged (unlike lithium batteries), do not deteriorate after 1000 or so cycles, and can be very rapidly recharged. So, I'd suggest that this indication of a potential lithium limit is likely to be overcome--and such a transition could occur quite rapidly. What is needed is a mechanism for promoting up and coming technologies that is much more aggressive than the quite slow development of the Gates et al. effort that was announced in Paris. [Michael MacCracken, United States of America]	Accept - section has been revised
923	20	3	20	3	typo - crucial ? Or is crustal intended? [David Infield, United Kingdom (of Great Britain and Northern Ireland)]	Noted. Crustal is correct
926	20	5	20	5	When the author mentions that one study says that combining PV with H fuel cells would lower overall lifecycle GHG emissions, this statement seems weak. Does one study merit inclusion in this report? If so (because it is revolutionary), then explain how these technologies working in tandem or in the joint usage of materials for them can lower lifecycle GHG emissions. [Elizabeth Aldrich, United States of America]	Accept - section has been revised
13057	20	6	20	20	Reference of Belmonte et al 2016 is missing, as too many other reference in the following. I will not mention all the reference missing, please check carefully all the text [Caserini Stefano, Italy]	Noted. More references added
12610	20	6	20	7	The cost of this technology is not communicated. [Yana POPKOSTOVA, France]	Accept - section has been revised
3074	20	7	20	12	This sentence is hard to understand "There is high agreement that mitigation and adaptation options for thermoelectric generation and, if that remains based on fossil fuels, CCS need to consider increasing water shortages." Thermoelectric? Do you mean generation based on fossil fuels? Technically thermoelectric refers to a voltage difference created by a temperature difference, typically across a semiconductor(s) or two thermoelectric materials. If I understand you correctly I would refrain from using the term "thermoelectric" and stick with "fossil fuel thermal electricity generation". [Christopher Bataille, Canada]	Noted. Thermoelectric has been changed to thermal electric generation
11191	20	9			This section on CCS in the power sector could highlight the risk of lock-in to fossil fuel infrastructure, or the lost opportunity of using CCS projects for the power sector when they could be used to provide negative emissions through BECCS or DAC with CCS. [Michiel Schaeffer, Netherlands]	Noted. No references provided. It is more of a point for chapter 2 anyway.
7097	20	9			What about DSM from households electricity demand? If it is not in the winners-list due to how uncertain and complicated it is (cf: E Nyholm,The role of Swedish single-family dwellings in the electricity system - The importance and impacts of solar photovoltaics, demand response, and energy storage, Chalmers University of Technology, 2016; and references therein), maybe this could be clearly stated? [Érika Mata, Sweden]	Taken into account. This is addressed in the buildings section (4.3.4)
6794	20	9		32	What is missing is the incompatibility with fracking. What about the additional energy demand for this technology? How does this infuence the overall equation? [Arnulf Jaeger-Waldau, Italy]	Taken into account. This was all extensively discussed in the SRCCS (2005) and the AR5.
6746	20	9	20	22	This is an unbalanced view of CCS (although it acknowledged that costs have risen), especially as very optimistic forecasts including by the IPCC and IEA has not materialized and several major CCS test projects have been recently terminated. It also does not mention the prohibitve costs and delays about the single power sector CCS that came online so far - despite its massive subsidies and technological circumstances (using captured CO2 in EOR). This latter model also increases GHG emissions through increased oil/gas production. [Jennifer Morgan, Netherlands]	Partly accept. Other reviewers found our assessment unbalanced the other way. We will mention more about the problems that power-sector CCS projects have encountered.
9706	20	9	20	22	There are evidences on CCS needed on 1.5 degree target in economic modeling in global scale. Tamaki, T.. W. Nozawa, and S. Managi. 2017. "Evaluation of the Ocean Ecosystem: Climate Change with Backstop Technologies", Applied Energy, Vol.205, pp.428-439. [Tetsuya Tamaki, Japan]	Noted. The reference was considered but does not add any insights to the assessment of feasibility of CCS.
10555	20	9	20	32	Recent research has shown that CCS is not a viable option in the long term due to the strong rebound Jevons' effect, besides of all the technical and economic restrictions (see the work of Acemoglu and other economists) [Jose Antonio Puppim de Oliveira, Brazil]	Noted, but not followed up on. We could not find the point made in what we think is the reference indicated.
1748	20	9	20	32	Perhaps mention the Allam cycle (Allam et al., Energy Procedia, Volume 114, July 2017, Pages 5948-5966), as a possible disruptive technology [Levi Golston, United States of America]	Noted. Interesting technology but the reference is unfortunately not peer-reviewed.
2789	20	9	20	32	In the context of 1.5oC the prospects for CCS are bleaker yet. The economics depend on capture from CO2 rich emissions streams (esp. coal and gas fired generation) and an economic value for the stored CO2 (so far enhanced oil recovery). For a 1.5oC scenario no new fossil fired generation plant will operate for its full design life so CCS must be retrofit and be amortised over a shorter period thus raising the cost. In addition, the virtual phase out of oil means that revenue from enhanced oil recovery disappears. [Erik Haites, Canada]	Reject. The modelling studies in Chapter 2 indicate a significant role for CCS, even in the power sector, and there is a lot of literature, also non-IAM-based, backing this up. No references provided leading to a different conclusion.
4664	20	10			Change the reference to "AR5" to be consistent in whole Report. [Radim Tolasz, Czech Republic]	Accept, done.
13058	20	10	20	32	Since CCS is a really key technology for 1.5°C scenario, I believe that the evaluation of the state of the art and perspectives of this technology deserve more space, in order to provide useful information on the different aspect that limit the expansion of this technology. Although something on CCS has been written in par. 2.4.2.3, here and in 4.3.6, the analysis is too week and with many repetitions. As an example, I believe that the problem of the storage of CO2 needs more attention and it deserve a specific chapter, independent from the source CO2 captured (power sector, BEECS or DACS) [Caserini Stefano, Italy]	Accept, we have made efforts to streamline the treatment of CCS through chapter 4 and in the SR1.5.
19299	20	10	20	32	In my opinion, CCS should not be presented as a mitigation solution without at least mentioning its drawbacks (i.e. the sustainability of storage) [Charlotte Vailles, France]	Reject. We are mentioning risks associated with storage as part of this feasibility assessment. The issue is that most of the literature, including earlier IPCC assessments, indicate that storage, if done well, is sufficiently permanent.
7906	20	10	20	32	CCS has not been deployed at scale, true, but this is an overstatement. There is very little CCS to date, and the section should actually discuss how many tCO2 are actually be sequestered, compared to the potential. In terms of incentives for CCS, are the authors referring to an implied carbon price? At what price is CCS even viable now? Certainly, we should not be advocating for enhanced oil recovery as a revenue stream. The social cost of the oil combustion would need to be factored in. [Westphal Michael, United States of America]	Accept, details have been included.
13059	20	13	20	14	references are needed on the "significant developments of the CCS in the power sector" (i.e. number of projects, capacity... ect.) [Caserini Stefano, Italy]	Taken into account. The sentence was removed as it is superfluous.
16412	20	13	20	14	Have not most of the CCS developments been negative (e.g., projects in US given up, etc.). I think it needs to be said that there is little likelihood that this technology will become feasible at a large-scale at acceptable cost and that existing coal-fired power plants will just need to be abandoned or fired totally with biomass. It would seem that too much money is being wasted on CCS and the fale hope that it will work is delaying important decisions and conversion to renewables. The favorable indication in the next paragraph sounds like wishful thinking and too much focus on keeping old technologies needing to be phased out. [Michael MacCracken, United States of America]	Noted. These views of the reviewer are not backed up by peer-reviewed literature.
6747	20	13	20	14	The only "significant" developments of CCS in the power sector over the years have been a series of high profil project cancellations. We still don't have a single fully integrated commerical-scale power plant capturing, transporting and storing its emissions. List of cancelled projects (as for 2016) can be found here: http://sequestration.mit.edu/tools/projects/index_cancelled.html. This list doesn't include the cancellation of Kemper in the US and projects in the EU in 2017. [Jennifer Morgan, Netherlands]	Taken into account, sentence is removed.
2239	20	13	20	14	The IPCC should inform what significant developments have occured rather being this general. [Kenneth Möllersten, Sweden]	Taken into account; this sentence is removed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
2240	20	14	20	15	What is the considerably advancement made up of, what areas? The technology has been mature enough to capture and store CO2 in Norway for over a decade. [Kenneth Möllersten, Sweden]	See comment 13059
17233	20	15	20	15	What are the reasons for rise in the cost. Are there any available options to reduce this cost? [Himangana Gupta, India]	See comment 927
927	20	15	20	15	Why have the costs of CCS increased in the last 10 years? This deserves mention since usually costs drop for technologies through technological advances and Moore's Law. Perhaps it would be worth mentioning the most expensive part of this process. Is it still the sequestration of the CO2 from the flue gases? It was about 10 years ago. [Elizabeth Aldrich, United States of America]	Accept, more details are given. In fact, the text was not correct: according to Rubin et al (2015), abatement costs have stayed roughly the same.
2241	20	15	20	15	By how much did costs rise and what does this imply? Why did costs rise? Did technology develop backwards? [Kenneth Möllersten, Sweden]	See comment 927
13060	20	18	20	22	Another important point should be mentioned, related to the real difficulties in the correct identification of a storage potential. It is true that many papers propose very large potential CO2 storage in underground reservoirs, but there are many methods to estimate CO2 storage resources, with no one methodology being uniformly adopted around the world. According to IEA (CCS 2014. What lies in store for CCS), "these methods have been used to make estimates of storage potential that, in some cases, conflict with each other, despite being of similar vintages and covering comparable areas. For example, some estimates of potential for individual countries or regions were larger than those for the entire world (Benson and Cook, 2005; Bradshaw et al., 2007)". Consequently, there remains uncertainty about what different methods to estimate potential are actually measuring, which methods are most appropriate in given settings, and whether the estimates produced by these methods provide a sound basis for policy making. Furthermore, the technically available storage capacity represents part of the story, as what is technically available and accessible may not be economically feasible. In addition to economics, regulatory constraints may impose yet another layer of complexity and constraint. Hence the practical real available storage capacity is a further subset of what might be technically available. (IEA, 2014) [Caserini Stefano, Italy]	Reject. Although the statements are true, our understanding of the assessment here is that it is the balance of the literature indicating useable storage potential.
20870	20	19	20	21	The sentence on communication strategies for CO2 storage projects could be read as an appeal for propaganda. It is important to give a reason for why an effective communication strategy is required for geological CO2 storage: "… in order to prevent public resistance and increas social acceptance by transfering knowledge and thus avoiding misconceptions, that are often based on a lack of understanding of the physico-chemical working principles of geological CO2 storage." [Daniel Sutter, Switzerland]	Accept. Text revised (but in a way briefer than done here)
2242	20	19	20	22	What are those insights and what can be said about decision makers that did and did not, respectively, notice? What is meant by "notice"? [Kenneth Möllersten, Sweden]	Accept, text revised. No room unfortunately to go into the insights.
11062	20	20	1	3	Please check Peters et al. 2017 is a meaningful reference here (see above). Maybe they refer to some primary source? [Jakob Wachsmuth, Germany]	Noted. Peters text is broad but infers that resource limitations need to be considered.
11063	20	20	10	22	Pushing CCS in the power sector may also pose a barrier to a fast and complete decarbonisation of the electricity sector, e.g. based on renewables. This is a very critical issue given the need for the CCS technology in general and should be carefully discussed. [Jakob Wachsmuth, Germany]	Noted, but not aware of references making this point.
13061	20	21	20	21	It is quite obvious that "not all decision-makers have taken notice" of the very few experiences of communication that have been done, for quite a novel technology. Please rephrase [Caserini Stefano, Italy]	Accept. Rephrased to "decision-makers are not consistently implementing the lessons".
6748	20	24	20	25	Not true. Governments have put a lot of money on the table in some countries and CCS still isn't getting off the ground due to technical reasons and dramatic cost overruns. The industry is expecting governments to cover the entire additional cost of CCS and, in some cases, accept any liability associated with stored CO2. This also fails to recognize that CCS is not cost effective in the power sector. http://www.annualreviews.org/doi/abs/10.1146/annurev-environ-032112-095222 [Jennifer Morgan, Netherlands]	Accept. Text revised to "are not sufficiently compensated by market or government incentives".
4855	20	24	20	25	…. mainly because, first mover demonstration projects in different sectors and development of Transport and Storage infrastructure have not been supported and the incremental costs are not compensated by incentives (IEA 2017). [Wilfried Maas, Netherlands]	Taken into account. The point is fair, but we need to be brief and the earlier formulation also covered the points made. The different sector argument belongs in the section on industry (4.3.5); will be picked up there.
13062	20	24	20	32	There should be an analysis of the logistic problems: CO2 storage site are not available for all the sites where power plants are located and needed. The counties of areas without the possibility of CCS, because too far from a CO2 storage, will have greater difficulties in decarbonizing the power sector. [Caserini Stefano, Italy]	Accept, text included on regional availability of storage capacity
20871	20	24	20	32	The paragraph has a pessimistic touch giving the impression that CCS is not economically viable. On the contrary, CCS is a commercially proven technology that needs a suitable economic framework in which the external costs of CO2 emissions are internalized. Compare also page 33, lines 36-47, where a much more optimistic assessment of the recent advances in CCS is given. [Daniel Sutter, Switzerland]	Accept. Taken into account. Text referred to on page 33 will be integrated in this section (to repair repetition and inconsistencies). As for the pessimistic tone, we will look at it but other reviewers feel that we are too optimistic.
928	20	24	20	32	Have CCS projects been canceled due to the lost cost of oil? Were these really EOR projects that were relying on the injected CO2 to enhance oil recovery? Often EOR projects will be termed as CCS projects since 80% of the CO2 stays in the ground. Carbon crediting systems have even begun to allow for carbon crediting of this type of sequestered carbon in Alberta. Since oil prices have dropped, perhaps these CCS projects are now not economical? I think some explanation of why these projects are no longer economical is needed. [Elizabeth Aldrich, United States of America]	Reject. It is the way it is stated: even with EOR, CCS in the power sector is not always economically viable and needs additional support, which is insufficiently given.
13063	20	25	20	25	More information of this full scale demonstration project should be added to understand his importance (i.e. capacity, Mton/y of CO2 stored, ect.) [Caserini Stefano, Italy]	Accept, limited more details will be given.
6088	20	25	20	25	There are two full-scale projects now, Petra Nova came online in January 2017. [Tim Dixon, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Will be corrected.
4873	20	25	20	26	Two full-scale demonstration projects (Boundary Dam and Petranova) .. Also reference to GCCSI 2017 in final report [Wilfried Maas, Netherlands]	Accept, see comment 6088
1543	20	25	20	27	EOR makes economic sense, but it negates climate benefit. In the cas of Weyburn CCS project, for example, it is known that 1 kg of CO2 injected allows to recover 0.97 kg of supplementary oil (See Greenpeace 2008 report : False Hope). The combustion of that oil will lead to emissions of 3.02 kg of CO2, approximatelly three times more than the amount sequestrated. So CCS with EOR cannot be considered to be a CDR technique but mainly an oil extraction technique. The fact that EOR negates any climate benefit of CCS should be mentionned wherever the report makes reference to EOR. [Noé Lecocq, Belgium]	Accept, see comment 6749
20321	20	25	20	27	There are two large-scale demonstration plants in operation in the power sector: Boundary Dam in Canada and Petra Nova in the United States. [Marine Gorner, France]	Accept, see comment 6088
7952	20	25	20	28	There are now two, Petra Nova became operational in January 2017. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Accept, see comment 6088

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6749	20	25	20	28	This mention of EOR should include mention of how it can negate any carbon benefit associated with storage, not to mention the risks of storing carbon in depleted oil and gas fields, which are often riddled with abandoned wells. The statement here is that at the moment, CCS can really only work in applications where captured CO2 is sold for EOR and EGR purposes and that runs entirely counter to the supposed climate benefit of CCS. http://www.greenpeace.org/usa/wp-content/uploads/legacy/Global/usa/planet3/PDFs/Carbon-Capture-Scam.pdf and http://pubs.acs.org/doi/abs/10.1021/es902006h See, e.g. Jaramillo et al (2009), Life cycle inventory of CO2 in an Enhance Oil Recovery System. Available at: http://pubs.acs.org/doi/pdf/10.1021/es902006h. [Jennifer Morgan, Netherlands]	Accept, text included on this. However, whether oil from EOR increases emissions does depend on the fuel oil it is replacing. A reference will be included.
19097	20	25	26		Not a huge difference, but important in this context: There are currently two industrial-scale power plant CCS applications: Boundary Dam (CA) and Petra Nova (US). [Ellina Levina, France]	Accept, see comment 6088
20201	20	29			…and Benson (2014) indicate…. [Ton Wildenborg, Netherlands]	Editorial
18396	20	29	20	29	Global CCS Institute 2017 not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted and addressed
20249	20	29	20	32	The local museum can provide a space where communities can come together with political leaders and investors on safe ground. [Morien Rees, Norway]	Noted
6751	20	29	20	32	Another important feasibility consideration are the CO2 storage induced earthquakes from large-scale CO2 injection: http://www.pnas.org/content/112/33/E4510.full.pdf. Also, it just doesn't work! http://www.sciencedirect.com/science/article/pii/S0301421516302750 [Jennifer Morgan, Netherlands]	Accept. The first point is an issue on which there is medium agreement; there are a few studies emphasising the earthquake risk but others indicating that it can (and must) be managed. This would go under geophysical feasibility. The second point is part of a more political feasibility point.
6089	20	29	20	32	Don't see the point being made in relation to the topic of the paragraph? [Tim Dixon, United Kingdom (of Great Britain and Northern Ireland)]	Accept, sentence removed.
6750	20	29	20	32	Another important feasibility consideration that isn't mentioned here at all is the size of the infrastruture that would need to be build. It's enormous. Vacliv Smil has written extensively on this. Smil says "... [I]n order to sequester just a fifth of current CO2 emissions we would have to create an entirely new worldwide absorption-gathering compression-transportation- storage industry whose annual throughput would have to be about 70 percent larger than the annual volume now handled by the global crude oil industry, whose immense infrastructure of wells, pipelines, compressor stations and storage took generations to build." http://vaclavsmil.com/wp-content/uploads/docs/smil-article-2011-AMSCI.11.pdf [Jennifer Morgan, Netherlands]	Accept, but we need to use more recent literature. When we find it, we will include this.
2243	20	30	20	30	What is "climate change action" htat key actors are to provide? [Kenneth Möllersten, Sweden]	Taken into account. Sentence will be removed as it's not really feasibility assessment.
10922	20	32			Worth mentioning here the natural CO2 capture using algues (pilot project is now done at cement production plant in Sweeden) looks very promising and very cost-effective for capturing most CO2 releases from cement. [Beat Brunner, Switzerland]	Noted. Interesting but no reference provided.
12691	20	32	20	34	The CCS technology is already feasible. Norway for instance is becoming a leader is using and plans to start exporting CCUS technologies abroad. The Gassnova project, partly run by Norway's state energy company Statoil, involves collecting the CO2 produced by a cement factory, a waste incineration site and a fertiliser factory and transporting it by boat off the west coast of Norway where it would be buried under the sea bed. If all goes according to plan, the first CO2 storage hub could come online in 2022, its promoters say. Shipped storage avoids the requirement for a pipeline transport network, reducing costs, and opening up CO2 storage to any industry near the North Sea, including industrial clusters such as Teesside or Rotterdam, for example. [Yana POPKOSTOVA, France]	Rejected. The Gassnova project is still a plan and plans don't necessarily demonstrate the feasibility of an option (many CCS plans have been cancelled in the past). Also, this section is on power, not (cement) industry.
6795	20	35		42	The evaluation of syfuels is missing. [Arnulf Jaeger-Waldau, Italy]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
1568	20	35	20	42	Apart from biofuels and energy efficiency, for distances shorter than about 800 km moving to other modes of transport such as high speed trains can contribute to making international travel more sustainable. A possible reference to include is: Jonas Akerman: The role of high-speed rail in mitigating climate change – The Swedish case Europabanan from a life cycle perspective. Transportation Research Part D: Transport and Environment 16, 3, 208-217, 2011. https://doi.org/10.1016/j.trd.2010.12.004 [Peter Van Velthoven, Netherlands]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
10857	20	35	20	42	latest research in the field of power-to-liquids indicate that there will be an alternative to biofuels, see Fasihi et al. (2016; doi: 10.1016/j.egypro.2016.10.115) and Fasihi et al. (2017; doi:10.3390/su9020306) [Christian Breyer, Finland]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
6578	20	35	20	42	Consider whether decarbonisation of global tourism derived from growth in flows and transport in this sector should be included in this section. [J. David Tabara, Spain]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
7523	20	36	20	36	Please consider replacing "is notoriously" with "has so far been challenging" i.e., and also shortly explain why. [Øyvind Christophersen, Norway]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
6752	20	36	20	42	Misses to mention the recent agreement on reducing aviation emissions. https://www.icao.int/Newsroom/Pages/Historic-agreement-reached-to-mitigate-international-aviation-emissions.aspx [Jennifer Morgan, Netherlands]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
7907	20	36	20	42	Any discussion of biofuels needs to reference issues of landuse change and food security. [Westphal Michael, United States of America]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
17693	20	37	20	37	Aviation emissions could be reduced by about a third by energy efficiency measures: the IATA roadmap on aviation technologies suggest an energy saving potnetial attaining cuts of 2/3 of the energy per revenue passenger km. I understand that this result includes a component of growth in activity, but I would recommend not to mix different parameters, focusing separately on a) activity projections; b) shifts; c) effciency improvements and d) fuel switching. [Pierpaolo Cazzola, France]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
18712	20	38	20	38	Reference needed [Wilfran Moufouma Okia, France]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
7524	20	38	20	38	Consider mentioning that the technology for electric airplanes seems very promising for shorter flights. [Øyvind Christophersen, Norway]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
17694	20	38	20	42	Despite cost-crlated challenges, you should at mention here the option of "power-to-X" fuels here, i.e. liquid fuels producing from electrolysis of water (relyng on cheap renewable electricity) and the combination of hydrogen with carbon monoxide (obtained from biomass gasification or CO2 capture and split) in Fischer Tropsch processes. These pathways could become viable in regions of the world with high ednowment in solas and wind enery at the same time (something that would enable high capacity utilization rates for electrolysers). [Pierpaolo Cazzola, France]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'

Comment No	From Page	From Line	To Page	To Line	Comment	Response
560	20	39	20	40	…most studies indicate that biofuels are the most viable alternative… Biofuels are not a low-carbon fuel in the least. The most likely alternative to jet fuel aircraft are a combination of electric (for short-haul flights) and hybrid hydrogen fuel cell-electric for long haul flights, as discussed in some detail in Jacobson, M.Z., M.A. Delucchi, Z.A.F. Bauer, S.C. Goodman, W.E. Chapman, M.A. Cameron, Alphabetical: C. Bozonnat, L. Chobadi, H.A. Clonts, P. Enevoldsen, J.R. Erwin, S.N. Fobi, O.K. Goldstrom, E.M. Hennessy, J. Liu, J. Lo, C.B. Meyer, S.B. Morris, K.R. Moy, P.L. O'Neill, I. Petkov, S. Redfern, R. Schucker, M.A. Sontag, J. Wang, E. Weiner, A.S. Yachanin, 100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for 139 countries of the world, Joule, 1, doi:10.1016/j.joule.2017.07.005, 2017 [Mark Jacobson, United States of America]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
929	20	41	20	42	Why are the emissions associated with the creation of aviation fuels from biofuels significant? Does it matter where these fuels are grown and how they are transported? Are these fuels best made with sugarcane, which is not grown in Europe where the fuel is being tested? Does the extra refining of these fuels create more emissions? I think this point needs more clarification since biofuels for aviation is what the EU is looking towards these fuels to reduce GHG in this sector. [Elizabeth Aldrich, United States of America]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
7525	20	42	20	42	Consider using "the origin of the feedstock" instead of "location". [Øyvind Christophersen, Norway]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
10923	20	42			Bio-fuels life-cycle CO2 emissions (fuels used in agriculture for biofuels) and use of soil for biofuels are two considerable issues for bio-fuels. Short-distance electric plans for distances up to 1000 km are expected to reach market by 2027 with economical and security advantages over current planes. The only part left is long flight and intercontinental flights, where even more battery energy/weight progress is needed to make electrification possible. An alternative fuel would be methanol produced by electricity and consumed in fuel-cels to power electric planes. More research needs to be done in this area, which makes long-distance electrified planes unlikely before 2030, but predictible by 2050. [Beat Brunner, Switzerland]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
1569	20	42	20	42	I suggest to add:"For aviation avoiding the formation of contrails and aviation induced cirrus can counteract part of the climate impact of CO2 emissions (Irvine et al., 2014). Implementing this may however require the introduction of market-based measures (Grewe et al, 2017)." References: E.A. Irvine et al: A simple framework for assessing the tradeoff between the climate impact of aviation carbon dioxide emissions and contrails for a single flight. Environ. Res. Lett. 9 064021, 2014, doi:10.1088/1748-9326/9/6/064021. V. Grewe et al.: Feasibility of climate-optimized air traffic routing for trans-Atlantic flights. Environ. Res. Lett. 12 034003, https://doi.org/10.1088/1748-9326/aa5ba0 [Peter Van Velthoven, Netherlands]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
15408	20	43	20	43	Here the reviewer proposes to refer also to the "more electric aircraft" or MEA (Rosero et al. "Moving towards a more electric aircraft" IEEE Aerospace and Electronic Systems Magazine, Volume: 22, Issue: 3, March 2007) also to the all-electric aircrafts (Amir S.Gohardani, Georgios Doulgeris, Riti Singh "Challenges of future aircraft propulsion: A review of distributed propulsion technology and its potential application for the all electric commercial aircraft", Progress in Aerospace Sciences Volume 47, Issue 5, July 2011, Pages 369-391). Although while MEA is a reality, all-electric plane is not yet that developed. [Francisco Javier Hurtado Albir, Germany]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
13404	20	44			A good starting poin on shipping would be a recent review by Bouman et al. 2017: Evert A. Bouman, Elizabeth Lindstad, Agathe I. Rialland, Anders H. Strømman, State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping – A review, In Transportation Research Part D: Transport and Environment, Volume 52, Part A, 2017, Pages 408-421, ISSN 1361-9209, https://doi.org/10.1016/j.trd.2017.03.022. [Helene Muri, Norway]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
10924	20	44			Around 50% of International shipping is fossil fuels. Replacing fossil fuels will electricity will remove 50 % of international shipping, a huge benefit for shipping emissions. International shipping is an important emitter of CO2, but it is also an enormous polluter of SO2 (20 biggest container ships emit same amount of SO2 as all cars of the world (documentary "cargos la face cachée du fret", but there are 60'000 large cargos) and NOx and black carbon (BC). So CO2 and BC are not the only problems of shipping. However, new types of sails are being developed for cargos, and Sweden has first local cargo line fully electrified and fully automated. More developments need to be done to solve the cargo problem. But it is also a regulatory one, as some countries without regulations are heaven to international cargos. Electrifying large cargo ports would be a first step to allow ships to get renewable electricity when docked, instead of generating megawats on-board and polluting portual cities, in addition of emitting unneeded CO2. [Beat Brunner, Switzerland]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
17388	20	44			There has been substantial research into low carbon trajectories for International shipping along with analysis of maritime renewables, alternative fuels and the potential for substantial CO2 emissions savings from the exiting basket of technologies and late stage R&D. The retrofitting and replacement of the world's 60,000 large vessels is not being held up by technology or alternative operating solutions but more by market and non-market failures and barriers. These include split incentives, regulatory inertia, fuel prices etc. Bows & Smith (2012) The (low-carbon) shipping forecast: opportunities on the high seas, Carbon Management, 3 (6), 525 - 528 Rehmatulla & Smith (2015) Barriers to energy efficiency in shipping: A triangulated approach to investigate the principal agent problem, Energy Policy, 84, 44-57. [Gavin Allwright, United Kingdom (of Great Britain and Northern Ireland)]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
17389	20	44			Propulsion alternatives for shipping include a slow move away from Heavy Fuel Oil (HFO) towards distiltate fuels and to a lesser degree LNG, with increasing interest in bio-fuels (2nd generation - waste derived), wind propulsion, battery and hydrogen. Renewable Energy Options for Shipping – Technology Brief International Renewable Energy Agency, Jan 2015. http://www.irena.org/DocumentDownloads/Publications/IRENA_Tech_Brief_RE_for%20Shipping_2015.pdf Assessment of the Possibilities for Selected Alternative Fuels for the Maritime Sector, J.Hansson, M.Grahn & S. Månsson 2017 http://www.lowcarbonshipping.co.uk/files/ucl_admin/SCC%202017/Papers/Hansson_et_al_2017_Assessment_of_the_potential_for_selected_alternative_fuels_for_the_maritime_sector.pdf [Gavin Allwright, United Kingdom (of Great Britain and Northern Ireland)]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
17390	20	44			The ENVI study took into account the IMO's own research which found that shipping GHG emissions are projected to grow by between 50% & 250% by 2050. Shipping could be responsible for upto 17% of global CO2 emissions in 2050 if left unregulated and along with Aviation could amount to 40% of total emissions Emission Target Reductions for International Aviation & Shipping, Study for the ENVI Committee [EU Commission], 2015 http://www.europarl.europa.eu/RegData/etudes/STUD/2015/569964/IPOL_STU(2015)569964_EN.pdf International Maritime Organisation, Reduction of GHG emissions from ships – Third IMO GHG Study 2014, (July 2014) http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/MEPC%2067-INF.3%20-%20Third%20IMO%20GHG%20Study%202014%20-%20Final%20Report%20(Secretariat).pdf [Gavin Allwright, United Kingdom (of Great Britain and Northern Ireland)]	Accept. The whole section on Aviation and Shipping has been revised taking into account these comments'
11152	20	47	21	29	The section "Options for adapting electricity systems to 1.5°C" could also include options for increasing the flexibility of the power sector (grid development, demand management, storage, flexible renewables, e.g. CSP, biomass). [Michiel Schaeffer, Netherlands]	Accepted - text revised to address power grid flexibility in SOD.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
19098	20	47	21	29	The section on electricity seems to cover water-related issues only, as if the scope was only about adaptation (?). This section would benefit from a more holistic look at the power system transformation, including production technologies, flexibility, smart grids etc. etc. [Ellina Levina, France]	Accepted - text has been revised to better reflect multiple aspects of power system transformation. See responses to comments 876, 878.
20826	20	48			It would be helpful to state (briefly) why reliability is decreasing, e.g. irregular rainfall / droughts? [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - text revised.
7908	20	48	21	29	There is no discussion of distributed generation with renewables. This has both mitigation and adaptation benefits (e.g. increased resilience to extreme weather events). [Westphal Michael, United States of America]	Accepted - discussion on distributed generation has been added.
3073	20	48	21	5	Small errors in comma placement (e.g. after "high penetration wind generation", etc. starting to arrive after nearly perfect grammar to this point. [Christopher Bataille, Canada]	Editorial
6754	20	52	21	6	Again, no mention here of the pace of change and the potential for battery storage to fundmentally disrupt the energy system. Batteries are being deployed with home systems and along with EVs can create new and interesting demand flexibility options that will lower the cost of transitioning to 100% RE while also accelerating the pace of change. At the same time, batteries are also being used on the bulk system to provide better balancing of renewable energy. https://www.ethz.ch/content/dam/ethz/special-interest/gess/energy-politics-group-dam/documents/Journal%20Articles/Malhotra%20et%20al._2016_Renewable%20and%20Sustainable%20Energy%20Reviews.pdf Also, no mention of R&D into new battery technology that could avoid some of the resource limitation issues. http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/battery-storage-the-next-disruptive-technology-in-the-power-sector [Jennifer Morgan, Netherlands]	Accept - section has been revised
6753	20	53	20	54	“Climate change has started to disrupt electricity generation and it is predicted these disruptions will be lengthier and more frequent” Maybe it would be worth mentioning that fossil and nuclear power plants have been affected more by these extreme weather events; on the other side solar and wind parks proved resilient; Examples exist worldwide. [Jennifer Morgan, Netherlands]	Accepted - text revised.
19396	20	53	21	5	Does the recommendation on hybrid systems find resonance with recommendations in other chapters? [Sumetee Pahwa Gajjar, India]	Noted - need to check with other chapters.
16413	21	3	21	5	Should there not be discussion here of the potential value of high-voltage/direct-current transmission networks for moving electricity relatively long distances at acceptable cost. Such lines basically allow transmission at scales that are larger than weather systems, so provide a means to help overcome problems of solar and winds varying over days, etc. and allow location of renewable sources in optimal locations even if far from population centers. [Michael MacCracken, United States of America]	Accepted - text revised to reflect this in the SOD
12693	21	5	21	6	In addition, it is crucial for the food, water and energy management systems to be integrated in a cohesive, integrative and interdependent management planning following the principles of the FEW (Food-Energy-Water) nexus dynamics and the interdependencies of the sectors on each other. FEW management systems should be developed on governance levels and transcend the boundaries of individual ministries and cabinets to a transversal integrated system. [Yana POPKOSTOVA, France]	Taken into account - text revised to reflect this in this section, but it is also covered in Section 4.3.3.
10925	21	5			Hydro-electricity with dams have also an opportunity to convert turbining into pumping-turbining and use the dams as electricity storage, and depending on size, even as a seasonal storage, allowing to compensate for worst winter month(s) in the northern parts. However a cost-benefit calculation needs to be made, keeping in mind the exponential price decrease of batteries at 16 % per year on $/kWh storage. For large storage where power density is not important, salt batteries have several big advantage over Lithium-Ion ones : 1. They are environmentally neutral and safe, 2. They can't catch fire or explode, 3. They allow for full cycling (depletion is not a problem) and a much higher number of cycles. These advantages add major sustainability benefits. Those batteries manufacturers have a hard time against Li-Ion economic competition, but from a scientific environmental and sustainability perspective, thus they could be strategic and should probably be supported by government research funds. [Beat Brunner, Switzerland]	Accepted - Additional adaptation options are being considered for SOD
15409	21	6	21	6	Smart grids contribute to make electric power generation, transmission and distribution more robust by a better coordination of generation and a better support to the reconfiguration of a power network in case a of a fault. [Francisco Javier Hurtado Albir, Germany]	Accepted - text revised to include smart grids.
15410	21	6	21	6	Also FACTS (Flexible AC Transmission Systems) should be mention because of its contribution to a stable electric power supply (Klaus Habur, Danal O'Leans, "FACTS-Flexible Alternating Current Transmission Systems: For Cost Effective and Reliable Transmission of Electrical Energy". World Bank document. August 2004. [Francisco Javier Hurtado Albir, Germany]	Accepted- text revised.
6796	21	7		12	Nuclear and CSP are missing: both technology need significant amounts of water. [Arnulf Jaeger-Waldau, Italy]	Noted. Water cooling option is inclusive of all technologies that require it.
9448	21	9	21	9	I don't understand 'CCS need to consider increasing water shortages'. Could you explain or reformulate the whole sentence?. [Isabelle Czernichowski-Lauriol, France]	Taken into account - text revised.
18713	21	12	21	12	Reference needed [Wilfran Moufouma Okia, France]	Accepted. Added reference (van Vliet et al. 2016)
15411	21	13	21	13	In the part of the report, the impact of energy disruption in water cooling is addressed. In opinion of the reviewer, something should be said about the impact of power disruption in food conservation, because of the impaczt 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. [Francisco Javier Hurtado Albir, Germany]	Taken into account - text revised, with additional adaptation options included in SOD. The relationship with food is covered in Section 4.3.3.
12694	21	20	21	20	- what type of bioenergy? Classification is important because bioenergy is a not a homogenic concept. [Yana POPKOSTOVA, France]	Taken into account - covered in Section 4.3.3.
18397	21	21	21	22	References not linked to Mendeley [Wilfran Moufouma Okia, France]	Editorial
10926	21	22			Coal and shale oil consume (and pollute) enormous amounts of water. Decarbonization should save water scaricity in those areas. Also with closing coal plants and fossil-fuels plants, cooling them will not be a problem anymore. [Beat Brunner, Switzerland]	Accepted - Text revised. However, in the interim, countries are already applying cooling technologies to deal with current temperature increases and the text also reflects this reality.
6797	21	24		29	There is much emphasis on water consuming technologies, but no metioning of the possibility to swich to enrgy source, which do not require these amounts of water. [Arnulf Jaeger-Waldau, Italy]	Taken into account - text revised, with other adaptation options included in SOD
19397	21	25	21	25	Can there be more text on the potential and barriers associated with bio-energy and nuclear energy. If they are covered in chapter 2 or 3, please provide reference, to relevant section. [Sumetee Pahwa Gajjar, India]	Taken into account - covered in Section 4.3.3.
12695	21	27	21	30	The integration of climate impacts in the planning and development of power projects, as well as the integrated FEW management will enable them to forecast future needs and anticipate impacts better. [Yana POPKOSTOVA, France]	Accepted - text revised to reflect this in SOD.
2487	21	32	21	32	This section would be made stronger by discussing ground-breaking work by Amanda Logan on the long-term impacts of colonial systems on traditional agriculture; basically, in pre-colonial times, people could deal with food insecurity due to their reliance on diverse subsistance strategies (vs. cash crops, mono-cropping during colonial periods): Logan, Amanda. 2016. “Why Can't People Feed Themselves?”: Archaeology as Alternative Archive of Food Security in Banda, Ghana. American Anthropologist 118:508-524 [Lisa Lucero, United States of America]	Rejected - outside the scope of the chapter

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7814	21	32	23	18	The conventional list of options considered overlooks most of the proven and promising early results with perennial polyculture and other natural-systems agriculture (and forestry and grazing) approaches. [Amory Lovins, United States of America]	Taken into account - text revised
7815	21	32	23	18	Section 4.3.3.2: Prof. John DeCicco (U. Michigan) found in Climatic Change (2016) 138:667–680, DOI 10.1007/s10584-016-1764-4, that much of the literature on biomass energy production's carbon balance reflects a confusion between stocks and flows. Such systems decarbonize only if the increase the ecosystem's net carbon uptake; most do not. [Amory Lovins, United States of America]	Taken into account - text revised
9624	21	32	23	18	fishing sector may be added in this section [Jianguo Wu, China]	Taken into account - text revised
7668	21	32	23	18	The conventional list of options considered overlooks most of the proven and promising early results with perennial polyculture and other natural-systems agriculture (and forestry and grazing) approaches. [Amory Lovins, United States of America]	Taken into account - text revised
7669	21	32	23	18	Section 4.3.3.2: Prof. John DeCicco (U. Michigan) found in Climatic Change (2016) 138:667–680, DOI 10.1007/s10584-016-1764-4, that much of the literature on biomass energy production's carbon balance reflects a confusion between stocks and flows. Such systems decarbonize only if the increase the ecosystem's net carbon uptake; most do not. [Amory Lovins, United States of America]	Taken into account - text revised
10340	21	34	21	35	Do you refer to Agiculture or AFOLU here, please clarify. It seems the reference is AFOLU. The use of the terms agriculture or AFOLU, please be precise across the chapter (even the report as a whole). [Maria Jose Sanz Sanchez, Spain]	taken into account - text revised
5121	21	34	21	35	The literature cited indictes that "The AFOLU sector is responsible for just under a quarter (~10–12 GtCO2eq/yr) of anthropogenic GHG emissions mainly from deforestation and agricultural emissions from livestock, soil and nutrient management (robust evidence; high agreement) [11.2]" (pg 816) -- rather than agriculture alone. Because agriculture and forests are treated often separately in policy discussions, including in the UNFCCC, it is critical to be precise in referencing the amount of GHG emissions from agriculture, forests, and other land use -- and not reducing this to all agriculture. [Tonya Rawe, United States of America]	Rejected - this section should only examine what are the land transitions and the possible technologies to be used to cope with them. Numbers about impacts and possibilities will be given in Chapter 3 and section 3.3.6
19398	21	40	21	43	Are there additional references for this positive trend? [Sumetee Pahwa Gajjar, India]	taken into account - text revised
21175	21	43	21	46	A precautionary approach would suggest that deforestation should not exceed 20% of original forest area, fire for clearing should be minimized and global climate warming should be kept below 2°C in order to avoid this tipping point. [David Cooper, Canada]	Rejected - This is policy prescriptive. The IPCC cannot prescribe policies or actions
12696	21	44	21	44	Currently, the level of deforestation stands at X %. [Yana POPKOSTOVA, France]	taken into account - text revised
19725	21	49			Section on agriculture and food. See this publication on gender, climate justice and agriculture by Jafry, T. (2016) Making the case for gender sensitive climate policy – lessons from South Asia/IGP. Online at http://www.emeraldinsight.com/doi/full/10.1108/IJCCSM-04-2015-0049 [Tara Shine, Ireland]	noted, it was impossible to accommodate this due to the cuts related to lowering the number of words
9271	21	49			Add: AgMIP regional integrated assessment results for Sub-Sahran Africa and South Asia from Rosenzweig and Hillel, 2015. [Cynthia Rosenzweig, United States of America]	taken into account - text revised
9272	21	49			Forthcoming papers on AgMIP CGRA 1.5 from Rosenzweig et al and Ruane et al [Cynthia Rosenzweig, United States of America]	noted, will be considered for the next draft
5124	21	49	22	18	The section on agriculture and food focuses on reducing impacts of climate change on agriculture. What about reducing emissions from agriculture? Mitigation and agriculture is usually a conversation about potential for soil carbon sequestration, but emissions from agriculture must also be addressed, including as they may be associated with particular models of agriculture. What is the feasibility of mitigation options to reduce methane or nitrous oxide? Are there models of agriculture that are lower in emissions naturally? [Tonya Rawe, United States of America]	Rejected - The section focuses on land transitions. Not exactly about reporting emissions. We only report emissions when appropriate. The emissions will be reported in Chapters 2 and 3.
1473	21	49	22	18	A useful section. However, the emphasis on technical solutions means there is too little on behaviour change elements in my view. In particular, more on dietary trends and choice would be useful, summarising issues around emission intensity of diets, overconsumption, and the potential for upstream GHG mitigation through dietary change. Likewise, food loss and waste is not afforded much discussion yet the mitigation potential appears high (e.g. Porter et al. 2016), with important links to adaptation (to reduce supply chain losses) and behaviour change (to reduce consumer-phase wastage) . [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	taken into account - text revised
7953	21	49	23	18	This whole section 4.3.3.1 misses a discussion on the role of dietary change and food waste reduction as a means to ease pressure on agricultural systems. Especially as the title of the chapter is "Strenghtening and implementing the global response". [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	taken into account - text revised
18794	21	49	23	18	Section 4.3.3.1 on agriculture and food should include evidence regarding shifting of diets as a key mitigation option in particular. For example, Ranganathan, J. et al. 2016. "Shifting Diets for a Sustainable Food Future." Working Paper, Installment 11 of Creating a Sustainable Food Future. Washington, DC: World Resources Institute. Accessible at http://www.worldresourcesreport.org. There is a growing body of literature in this field. [David Waskow, United States of America]	Accepted - text revised
18828	21	49	23	18	Section 4.3.3.1 on agriculture and food should include evidence regarding shifting of diets as a key mitigation option in particular. For example, Ranganathan, J. et al. 2016. "Shifting Diets for a Sustainable Food Future." Working Paper, Installment 11 of Creating a Sustainable Food Future. Washington, DC: World Resources Institute. Accessible at http://www.worldresourcesreport.org. There is a growing body of literature in this field. [David Waskow, United States of America]	Accepted - text revised
6374	21	49	23	18	This section should have made a clear link to the finding in chapter 2 that mitigation of non-CO2 gases plays an important role in achieving the 1.5 temperature goal. Agriculture is the biggest source of non-CO2 emissions. Please add a substantive assessment here of approaches to help reduce agricultural non-CO2 emissions consistent with food security objectives to deliver on the chapter's scope. Relevant approaches include productivity improvements coupled with policies to enable land-sparing (either for lower emitting activities or for afforestation or bioenergy), and consumption changes (dietary changes or use of trade to reduce emissions intensity of dietary intake, and reduction of waste including recycling of food material). I recommend to get one or two competent contributing authors to deliver such a discussion for the SOD - this deserves substantial space. Also ensure discussion in section 4.4 picks this up (e.g. accelerating change through linking food security, land-use policies and alternative land-uses and livelihoods, and dietary and food system choices). Remember that food security is flagged up explicitly in the Paris Agreement - it is a key dimension of strengthening the global response to climate change and consistency with SD. [Andy Reisinger, New Zealand]	taken into account - text revised
5126	21	49	24	36	Both the section on ag & food and on ecosystems and forests would be enhanced with more discussion of the various aspects of feasibility -- including economic and social. [Tonya Rawe, United States of America]	Rejected - feasibility will be part of another section in the chapter. There will be a table and discussion on that.
10341	21	50	21	51	Do you refer to Agiculture or AFOLU here, please clarify. It seems the agriculture. The use of the terms agriculture or AFOLU, please be precise across the chapter (even the report as a whole). [Maria Jose Sanz Sanchez, Spain]	Noted, agriculture
931	22		22		Are there any C3 or C4 crops that will do better with increased CO2 emissions? Will there be higher and lower latitudes where crops previously could not grow and now they will be able to grow? [Elizabeth Aldrich, United States of America]	Rejected - there is no space to deepen to this level
20630	22	1		10	Text should mention that ultimate evolutionary limits exist for shifting thermal limits through adaptation, set by temperature and humidity for livestock in the high 30ies and in the 40ies for plants. [Hans Poertner, Germany]	Noted, it did not fit in the storyline of the item after having to cut towards a lower number of words.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
5122	22	1	22	15	The discussion of food should ensure reference (brief is fine) to sufficient "nutritious" food and should consider the need for projections of climate impacts on yields of more diversified foods than staples. [Tonya Rawe, United States of America]	Noted, this disappeared form the text after cuts to accommodate to the number of words
10342	22	1	22	3	This is very simplistic statement, from a relative old paper. Suggest to quoe more recent literature and take into account not only production, but also distribution and waste aspects. [Maria Jose Sanz Sanchez, Spain]	Accepted - food wastage is now a new item in the text
15412	22	3	22	3	Alternatively, the reference to cooking stoves or furnaces using solar heat or biomass are al alternative for autonomous food processing could come here. Also to off-grid thermal processing (e.g. sun drying). [Francisco Javier Hurtado Albir, Germany]	Rejected - there is no space to deepen to this level due to the number of words
12697	22	3	23	4	This is why it is imperative to integrate the management and planning of the food, water and energy systems into a common framework. [Yana POPKOSTOVA, France]	accepted - text revised
10343	22	6	22	8	Change in nutrients of food due to climate change is certanly a possible issue, but there is still little evidence that this can be only atributable to cc and if it will be for a number of crops and in all cultivars. I suggest ot be cautions with this statement. [Maria Jose Sanz Sanchez, Spain]	Noted, there is an increasing number of references reporting composition changes in food
9894	22	7	22	8	The most recent study on the impact of elevated CO2 on wheat is by Broberg et al., 2017. Refer to - Broberg, M.C., Hogy, P. and Pleijel, H. 2017. CO2-induced changes in wheat grain composition: meta-analysis and response functions. Agronomy 7(2): 32. [Shipra Shah, Fiji]	taken into account - text revised
1452	22	8			On this point please quote this review (not only for protein but also Zn , Fe for instance): Myers et al 2014. Increasing CO2 threatens human nutrition, Nature [Philippe Roudier, France]	Noted - to keep below the permitted number of words it was impossible to accommodate this information
10344	22	10	22	15	The reduction in yield in some areas yes, but it could be an increase in others…. Please consider all the possibilities. This will change the geographical distribution of some crops, it will be good to include some lines of what this may imply for trade and price. [Maria Jose Sanz Sanchez, Spain]	taken into account - text revised
1453	22	11	22	12	I am wondering about this kind of sentence ("this could be reduces etc…"), the definition of an adaptation strategy is to reduce the impact of future CC, so it seems pretty obvious that adaptation will minimize impacts [Philippe Roudier, France]	taken into account - text revised
19399	22	12	22	13	Each time the pathways are r-emphasised as socio-economic, socio-technical or socio-ecological - can these facets not be explained upfront, and not need to be repeated throughout the chapter? [Sumetee Pahwa Gajjar, India]	Taken into account - text revised
1454	22	14			there are actually more than 3 options available, please precise that you are going to study in details 3 of them. [Philippe Roudier, France]	Taken into account - text revised
1455	22	14			By the way, what about food losses ?(for ex: Mediterra 2016. Zero Waste in the Mediterranean, FAO/CIHEAM) [Philippe Roudier, France]	Accepted, there is a new item dedicated to food wastage
1456	22	17			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 [Philippe Roudier, France]	taken into account - text revised
1457	22	17			you could also refer to agroecology which is more diverse: it includes organic agriculture (less chemical inputs=> 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.) [Philippe Roudier, France]	taken into account - text revised
10250	22	17	22	23	It is worth mentioning that there is currently a trend for creating "multifunctional forests and value chains" (see.https://ec.europa.eu/eip/agriculture) [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this is within the idea of using REDD+, but not explicitly expressed in the text
10345	22	17	22	35	There is a very limited information of which practices can be use. CA is mentioned and specifically the latest on non tillage… this should be better reflected, across many SLM practices that can be used. There are several recent compilations that can help. [Maria Jose Sanz Sanchez, Spain]	taken into account - text revised
1458	22	20			irrigation is a touchy point and is definitely not a no-regret strategy. [Philippe Roudier, France]	taken into account - text revised
20828	22	21	22	23	On page 21 it says that this section will consider both adaptation and mitigation options, but this section is almost entirely about adaptation - even though agriculture accounts for 25% of emissions. It is only this half-sentence (lines 21-23) that mentions mitigation, through an indirect reference to dietary change. I was expecting a clearer statement about the options for mitigation in agriculture, including explicit reference to shifting away from animal produce towards plant-based alternatives, and also reducing emissions from nitrogen fertilisers. There should also be reference to the fact that soil carbon storage is covered in a later section. [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - Mitigation will be dealt with by Chapter 2
9895	22	23	22	25	Although of immense importance as a low cost climate adaptation strategy agroforestry finds a cursory mention in section 4.3.3.2 on ecosystems and forests. Apart from conservation agriculture, agroforestry is an important Climate Smart Agriculture (CSA) option which can enhance the resilience of communities to the changing climate, refer to - Mbow, C., Van Noordwijk, M., Luedeling, E., Neufeldt, H., Minang, P.A. and Kowero, G. 2014. Agroforestry solutions to address food security and climate change challenges in Africa. Current Opinion in Environmental Sustainability 6: 61-67. Integrated Food Energy Systems (IFES) in the form of agroforestry or integrated crop–livestock–biogas systems are a viable CSA strategy to improve food security and access to energy for resilient livelihoods, refer to - Bogdanski, A. 2012. Integrated food–energy systems for climate-smart agriculture. Agriculture & Food Security 1: 9. [Shipra Shah, Fiji]	Noted, there is no space to add this to text due to the maximum number of words allowed to this item.
1471	22	28	22	28	Typo: should read '…combined with two other…' [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
1459	22	29	22	30	I agree that CA (with its three pillars) would increase yields in many regions. However it does not mean that is an adaptation strategy to future CC, You have to demonstrate that the added value in the future with CC is larger than the added value right now. [Philippe Roudier, France]	taken into account - text revised
12698	22	31	23	32	A campaign promoting less food waste, more sustainable household grocery shopping and cooking practices, as well reduced meat consumption have demonstrated to be effective tool at changing behaviours and inducing more sustainable lifestyles. Such campaigns should be intensifies in the developed and replicated in the developing world at school level to introduce a behavioral awareness at an early age. [Yana POPKOSTOVA, France]	Taken into account, food waste is now assessed in the SOD
10494	22	33	22	33	Could it be made clear that (increased) efficiency in this context is not about labour or financial efficiency but about more efficient use of land/other natural ressources [Harold Leffertstra, Norway]	Rejected, this belongs to another section
1460	22	33	22	35	Do you have references for this statement? Because I am not sure that most of the food waste is a the production stage (rather elsewhere in the value chain), Please remove this sentence if you do not have serious arguments, [Philippe Roudier, France]	accepted - text revised
5123	22	38	22	42	Can more be said about the barriers to applying climate information (and perhaps to scaling up conservation agriclture)? This would be particularly valuable, given the factors of feasibility being considered in the special report. i.e. From a social perspective, how does gender impact the feasibility of scaling up this adaptation option? Are there other barriers to scaling up this option, given varying scales of agriculture? Are the mitigation co-benefits to conservation agriculture? [Tonya Rawe, United States of America]	Accepted, some info was added about climate information
10346	22	39	22	41	There are also cultural and social barriers. [Maria Jose Sanz Sanchez, Spain]	Rejected - no space to include
1462	22	41			Generally about climate services: note that they are useful not only for agriculture but also health, water management, energy, DRR etc… I think this should be highlighted ==>see for example the GFCS website [Philippe Roudier, France]	Taken into account - text revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1461	22	41	22	42	You could precise that many african countries are developping their national plans for climate services==> so there is a will to scale-up local initiatives [Philippe Roudier, France]	Taken into account - text revised
19400	22	44	22	48	How do these successes relate to the barriers listed in the previous paragraph? [Sumetee Pahwa Gajjar, India]	Taken into account - text revised
10347	23	1	23	1	There is an excesive optimism about the bioingeniering. Trade offs should be better reflected (sud as farmers dependency of seeds firms). [Maria Jose Sanz Sanchez, Spain]	Taken into account - text revised
1463	23	1	23	10	what about local genetic diversity? As demosntrated by Sultan et al (2013), the traditional photoperiodic cultivars are less impacted by CC than the modern improved cultivars (sorghum and millet). [Philippe Roudier, France]	Rejected - there is no space to deepen to this level
11153	23	1	23	18	This section on genome modifification could also mention the need for safeguards for smallholder farmers and careful consideration of the risks. [Michiel Schaeffer, Netherlands]	Rejected - there is no space to deepen to this level
18398	23	2	23	2	CRISPR Cas 9 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
18399	23	6	23	6	Challinor et al. 2014 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
18400	23	8	23	8	De Souza et al. 2016 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
2631	23	12	23	18	mention how applicable this is from a feasibility perspective? Eg. in relation to local livelihoods, cultures and values, whether it would be more applicable in some regions rather than others [Zoha Shawoo, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - feasibility will be part of another section in the chapter. There will be a table and discussion on that.
19401	23	12	23	18	references for this section are missing - especially those related to precision agriculture, since it is expected to increase efficiency [Sumetee Pahwa Gajjar, India]	editorial
12699	23	15	23	15	In addition, establishing a global, regional and local carbon budgets to the extent possible and adjusting crop selection and growth would be imperative to avoid biomass which creates an inconsistent carbon budget borrowing. [Yana POPKOSTOVA, France]	Noted - unfortunately there is no space to deepen to this level
14079	23	16	23	16	Address disadvantages of use of genetics and plant transformation for farmers, i.e. loss of control over seeds. [Elvira Poloczanska, Germany]	Taken into account - this is in fact not a disadvantage, but a constraint of the method for it to work properly.
10927	23	18			It would be well worth citing permaculture as a way to increase drastically agricultural yield while lowering need of chemicals. Way higher yield per square meter means less agricultural area needed, which also has a very positive effect on deforestation (for agriculture) and way less dry soils, with better water retention and evaporative cooling potential. At same time, due to better yield, manual local work is possible and as a result it decreases distances travelled by food, which helps decarbonizing food transportation and distribution as well. [Beat Brunner, Switzerland]	Taken into account - text revised
19726	23	21			section on ecosystems and forests: see Mey Eltayeb Ahmed, (2016) "A gender justice approach to eliminating Sudan's Savannah belt's vulnerability to climate change", International Journal of Climate Change Strategies and Management, Vol. 8 Issue: 4, pp.539-558, https://doi.org/10.1108/IJCCSM-06-2015-0085 [Tara Shine, Ireland]	Noted, due to the specificity of the subject the maximum number of words did not permit inclusion
14125	23	21			Section 4.3.3.2 includes much discussion around agriculture (eg livestock management, agricultural wáter demand) which is the topic of the section above. A focus on land and coastal ecosystems is needed in this section [Elvira Poloczanska, Germany]	Taken into account - text revised
14124	23	21	23	21	Forests are ecosystems, maybe using the WGII term natural and managed ecosystems will capture this section (eg native and plantation forests are included) [Elvira Poloczanska, Germany]	Rejected, we prefer to use Forest and Ecosystems
10628	23	21	23	41	Although not emerging or new, sustainable (economically and biologically) forest management is a mitigation option that could saveguard forested areas and shift deforestation. Lack of strict and adequate management plans give way to deforestation often in the tropics [Elemer Briceño-Elizondo, Costa Rica]	Taken into account - text revised
5125	23	21	24	36	Portions of this section are directly related to the preceding section on agriculture, which renders this section on ecosystems and forests less effective in highlighting options in the forest sector. Can the two sections be combined or might a section on land & ecosystems be created that transitions thedsicussion from agriculture and food to land to forests? [Tonya Rawe, United States of America]	Taken into account - we kept the separation but tried to improve the text and connections.
20545	23	21	25	9	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, references are cited according to the context. There is no space to add more.
9622	23	21	25	9	Please change the title "forest and ecosystem" into "ecosystems and biodiversity",because forest is also the ecosystem type. This section only decribe the mitigation response,the measurements about how to adaptation is limited, there are much more assessments for the mitigation response in chapter 2 in this report, here much more assessments about adaptation options should be given,such as measurements of wetland management or controlling desertification,biodiversity conservation for response to climate change. [Jianguo Wu, China]	Rejected, we prefer to use Forest and Ecosystems
20546	23	21	25	9	This section should make due reference to 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 eta la. 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, references are cited according to the context. There is no space to add more.
3882	23	22	23	22	The carbon stocks and net primary productivity values need citations. Also, say "terrestrial carbon stock" to be most precise. [Patrick Gonzalez, United States of America]	Noted, this belongs to section 4.3.6, where citations are given

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1080	23	22	23	28	This paragraph needs elaboration as it is ambiguous. Yes the prodictivity rate seems to show a decrease but the paper in question has a short time sample and, the rates are still on the positive side in a way it anbles offsetting carbon emissions. http://www.nature.com/nature/journal/v519/n7543/full/nature14283.html?foxtrotcallback=true and https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5285296/. As such the rate of sequestration needs to be recongnized and complemented into the overal estimates by the models. Once forest reach stability, those will be only guarantors of the sequestered dynamic carbon remaining as such. There ar two sides to this and both are being mixed: one is reducing emissions from D&D. The other one is sequestering emissions sources from other sectors that the remaining forests are doing. Here, only the second one is mentioned but under a "negative" somehow dismissive perespective. This is most worrisome since the amount of emissions sequestered is by no means minimal. [naikoa aguilar-amuchastegui, United States of America]	Noted, text was modified and shortened and this became out of the context.
10349	23	23	23	24	It will be worth to mention that the Amazon biome is critical for the overall water cycels in the region, not to mention that even the energy mix of Brazil, Paraguay and Argentina are have a heavy share of hydro due to the existenceo of the Amazone forest. [Maria Jose Sanz Sanchez, Spain]	Noted, the Amazon will be one of the Case Studies in the chapter
16414	23	25	23	26	I thought there were new papers suggesting that with a modest warming there could be a sharp reduction in the ability of the Amazon to take up carbon--so a tipping point. Would it not be appropriate to mention this possibility? [Michael MacCracken, United States of America]	Taken into account, the Amazon will be one of the Case Studies in the chapter
10348	23	25	23	26	This sentence needs a reference. [Maria Jose Sanz Sanchez, Spain]	Noted
21176	23	26	23	28	note desoite some recent reversals,there has been an 80% reduction in the rate of deorstation in the brazilian amazon in previous 10 years [David Cooper, Canada]	Taken into account, the Amazon will be one of the Case Studies in the chapter
14080	23	27	23	28	In section 4.3.3 the statement regarding 80% decrease of deforestation in the Amazon sounds rather optimistic. The language should be coherent and the message of how the trend is should be clear. [Elvira Poloczanska, Germany]	Taken into account, the Amazon will be one of the Case Studies in the chapter
13516	23	30	23	31	The exact meaning of the sentence seems less clear. Please improve [Harold Leffertstra, Norway]	Taken into account, text changed
6658	23	30	23	32	Shallow marine ecosystems capable of accumulating great amount of muddy sediment very rich in organic matter (estuarine ecosystems, saltmarshes, etc) and strongly affected by warming could be also listed here. [Castor Muñoz Sobrino, Spain]	Taken into account, Coastal transitions is assessed
13520	23	31	23	32	The expression "a considerable proportion of carbon" raises the question of which carbon. Suggest either "a considerable proportion of the Earth's carbon", or "a considerable amount of carbon" [Harold Leffertstra, Norway]	Noted, text was modified and shortened and this became out of the context.
14361	23	33	23	33	Add full stop before "Options" [Ioannis Daliakopoulos, Greece]	accepted - text revised
11192	23	33	23	34	Options such as afforestation and bioenergy and CCS - bioenergy alone (without CCS) should also be included in this list, as it is a form of land-based mitigation that uses land, unless this section is only focusing on negative emissions (in which case this could be made clearer) [Michiel Schaeffer, Netherlands]	Noted, this issue is fully addressed in section 4.3.6. We have modified the text in this section so that a cross section call is made
7954	23	33	23	37	Fully agree. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted
14081	23	34	23	34	BECCS has been spelled out before, here the acronym is fine. [Elvira Poloczanska, Germany]	Taken into account - text revised
20631	23	36			safeguarding ecosystems and associated biodiversity (should be included)... [Hans Poertner, Germany]	Taken into account - text revised
10350	23	39	23	40	Other complementary approaches… to which ones?... Unclear sentence. [Maria Jose Sanz Sanchez, Spain]	Taken into account - CDR options are now exclusively assessed in section 4.3.6, the sentence was out of context and has been deleted.
13521	23	39	23	41	Consider to erase the word "directly", becauses it can be perceived that they might compete indirectly and in that case how? The end of the sentence "could have substantial co-benefits in terms of raising crop yields seems also to indicate that an eventual interaction will be positive, thus the opposte of competition [Harold Leffertstra, Norway]	Taken into account - CDR options are now exclusively assessed in section 4.3.6, the sentence was out of context and has been deleted.
4665	23	44			Change "GtCO2eq/year" by "GtCO2eq yr-1" [Radim Tolasz, Czech Republic]	Accepted- units have been harmonized.
7816	23	44	23	44	The AR5 LULUCF uptake potential of up to 10.6 GtCO2eq/y could usefully be updated by the important compilation of Griscom et al., due out in PNAS in the next few weeks. On p 4-23 line 53, Smith et al (2007) could be updated with recent and highly favorable experience of range restoration and carbon uptake by intensive rotational grazing. [Amory Lovins, United States of America]	Accepted - Griscom et al. cited in the ecosystems restoration subsection.
7670	23	44	23	44	The AR5 LULUCF uptake potential of up to 10.6 GtCO2eq/y could usefully be updated by the important compilation of Griscom et al., due out in PNAS in the next few weeks. On p 4-23 line 53, Smith et al (2007) could be updated with recent and highly favorable experience of range restoration and carbon uptake by intensive rotational grazing. [Amory Lovins, United States of America]	Accepted - Griscom et al. cited in the ecosystems restoration subsection.
4666	23	45			Change "100 USD tCO2eqivalent" by "100 US$ tCO2eq" [Radim Tolasz, Czech Republic]	Accepted- units have been harmonized.
12702	23	48	23	48	Demand side management cannot simply be ignored as under-researched. Without consideration of the demand-side management measures and how to push for acceleration on this vector, we cannot realistically expect to enter into a 1.5C pathway. This is a substantial omission of the report. [Yana POPKOSTOVA, France]	Noted - However, the text has changed substantially after the FOD and placeholders have been dropped.
1081	23	48	23	50	Estimates need be estimated here. Numbers are missing. Once those are in plkace the points in previous comment need be addressed. [naikoa aguilar-amuchastegui, United States of America]	Noted - However, the text has changed substantially after the FOD and placeholders have been dropped.
10351	23	49	23	49	Numerical value for the percentages are missing [Maria Jose Sanz Sanchez, Spain]	duplicate
18401	23	53	23	53	Smith et al. (2007) not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
19402	24	2	24	5	Please look reference on porkbush (portulacaria afra) as a ground cover in arid and semi-arid zones with an even higher potential for carbon sequestration than deciduous forests - Mills, A.J. & Cowling, R.M. 2006. Rate of carbon sequestration at two thicket restoration sites in the Eastern Cape, South Africa. Restoration ecology Vol. 1, No. 1 pp. 38 - 49 [Sumetee Pahwa Gajjar, India]	Rejected, too specific. The text of the chapter had to be shortened

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7817	24	5	24	5	The sugarcane comment reminds me that the Bornean sugar palm Arenga pinnata has ~5–10x the net primary productivity of sugarcane (contrary to old textbooks that ignore what a C4 plant with the highest known optical leaf efficiency can do). This tree, widely cultivated in Kalimantan and Sulawesi for its extraordinary sugar yield and >50 other benefits, is the keystone species for Dr. ing. Willie Smits's integrated ecological and economic restoration of devastated Indonesian (and other tropical) rainforests. His technical papers are mainly in Bihasa but are starting to gain proper attention in English. Being familiar with his work and walked tens of sq km of his key projects, I'm convinced he has demonstrated a fundamentally important innovation for restoring rainforests and their cultures, and for incentivizing their inhabitants to protect and sustain them. The Indonesian government has asked Dr. Smits to apply his system, already demonstrated in six significant sites, on about a million ha. A McKinsey due diligence funded by the Norwegian government in 2016–17 found a 35% IRR for his restoration method if the wages are 3x those paid to Kalimantan oil-palm workers and if only one of the 50+ benefits (ethanol production). Dr Smits's latest innovations hold major promise of equally competitive long-chain hydrocarbon production, and his global GIS overlays suggest sufficient global tropical potential to roughly displace the world's current oil extraction. Though you may not feel that this work is yet ripe for full description, my personal experience of Dr. Smits's remarkable work over many years suggests that you could and should refer (perhaps in the context of p 4-24 line 27 on co-benefits) to emerging promising methods of economic/ecological integration to restore tropical rainforests (even after they're thoroughly logged and burned) with economics superior to those of the activities now destroying those forests. These methods' carbon uptake is well demonstrated, as is their application to restoring burned or burning Kalimantan peat swamps. [Amory Lovins, United States of America]	Noted. There are indeed species that are potentially more productive than sugarcane. However, none have reached the commercial level and the applications in large scale as a bioenergy source as sugarcane did.
7671	24	5	24	5	The sugarcane comment reminds me that the Bornean sugar palm Arenga pinnata has ~5–10x the net primary productivity of sugarcane (contrary to old textbooks that ignore what a C4 plant with the highest known optical leaf efficiency can do). This tree, widely cultivated in Kalimantan and Sulawesi for its extraordinary sugar yield and >50 other benefits, is the keystone species for Dr. ing. Willie Smits's integrated ecological and economic restoration of devastated Indonesian (and other tropical) rainforests. His technical papers are mainly in Bihasa but are starting to gain proper attention in English. Being familiar with his work and walked tens of sq km of his key projects, I'm convinced he has demonstrated a fundamentally important innovation for restoring rainforests and their cultures, and for incentivizing their inhabitants to protect and sustain them. The Indonesian government has asked Dr. Smits to apply his system, already demonstrated in six significant sites, on about a million ha. A McKinsey due diligence funded by the Norwegian government in 2016–17 found a 35% IRR for his restoration method if the wages are 3x those paid to Kalimantan oil-palm workers and if only one of the 50+ benefits (ethanol production). Dr Smits's latest innovations hold major promise of equally competitive long-chain hydrocarbon production, and his global GIS overlays suggest sufficient global tropical potential to roughly displace the world's current oil extraction. Though you may not feel that this work is yet ripe for full description, my personal experience of Dr. Smits's remarkable work over many years suggests that you could and should refer (perhaps in the context of p 4-24 line 27 on co-benefits) to emerging promising methods of economic/ecological integration to restore tropical rainforests (even after they're thoroughly logged and burned) with economics superior to those of the activities now destroying those forests. These methods' carbon uptake is well demonstrated, as is their application to restoring burned or burning Kalimantan peat swamps. [Amory Lovins, United States of America]	Noted. There are indeed species that are potentially more productive than sugarcane. However, none have reached the commercial level and the applications in large scale as a bioenergy source as sugarcane did.
1082	24	13	24	15	What specifically about it? CBNRM can man anything done by communities and many have unsustainable practices. Yes there are several studies showing how community management helsp but there are other cases in which it fails. The use of CBNRM as an umbrella is ill advised. The sepcifics of the practices are the one that deliver. [naikoa aguilar-amuchastegui, United States of America]	Noted, text has been retrieved
10251	24	13	24	18	It is worth mentioning that there is currently a trend for creating "multifunctional forests and value chains" (see.https://ec.europa.eu/eip/agriculture) [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - text revised.
19727	24	13	24	18	Note that community based natural resource maagemnet also offers useful lessons and principles for mitigation - especially when related to land use (e.g. for renewable energy) [Tara Shine, Ireland]	Accepted - text revised to incorporate reference to mitigation.
10681	24	13	24	18	Successful implementation requires however attention to dynamics in the uptake, modification, abandonment and replacement of land-based adaptation strategies (Sietz and Van Dijk 2015). This attention is a pre-requisite for land-based management decisions that appropriately address heterogeneity in global adaptation challenges. ---- reference: Sietz, D. and Van Dijk, H. (2015) Land-based adaptation to global change: What drives soil and water conservation in western Africa? Global Environmental Change 33: 131-141. [Diana Sietz, Netherlands]	Accepted - Text revised to incorporate this concern and reference.
10353	24	13	24	37	This section it is based in a very limited references, and it is very superficial and unbalance. It will be more appropiated if all urban related aspects are addressed at once. And not in a fragmented way. [Maria Jose Sanz Sanchez, Spain]	Noted, text has been retrieved
2571	24	20	24	32	water demand management is an effective way for adaptation to future climate change, and mangy of the literature has showed that demand management is useful. Pls add it, and some literature"Potential impact of climate change on future water demand in Yulin city, Northwest China,Water resources management strategy for adaptation to droughts in China,Water demand management instead of water supply management a case study of Yulin City in northwestern China,Historic water consumptions and future management strategies for Haihe River basin of Northern China" Wang Xiaojun?Zhang Jianyun?Wang Jianhua?He Ruimin?Amgad ElMahdi?Liu Jinhua?Wang Xingong?David King?Shamsuddin Shahid?Climate change and water resources management in Tuwei river basin of Northwest China?Mitigation and Adaptation Strategies for Global Change?2014?19?1??107-120? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Amgad ElMahdi?He Ruimin?Bao Zhenxin?Mahtab Ali?Water resources management strategy for adaptation to droughts in China?Mitigation and Adaptation Strategies for Global Change?2012?17?8??923-937? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Amgad ElMahdi?He Ruimin?Wang Xingong?Mahtab Ali?Gini Coefficient to Assess Equity in Domestic Water Supply in the Yellow River?Mitigation and Adaptation Strategies for Global Change?2012?17?1??65-75? [Xiaojun WANG, China]	Taken into account, water management is discussed in some of the options
2584	24	20	24	32	water demand management is an effective way for adaptation to future climate change, and mangy of the literature has showed that demand management is useful. Pls add it, and some literature"Potential impact of climate change on future water demand in Yulin city, Northwest China,Water resources management strategy for adaptation to droughts in China,Water demand management instead of water supply management a case study of Yulin City in northwestern China,Historic water consumptions and future management strategies for Haihe River basin of Northern China" Wang Xiaojun?Zhang Jianyun?Wang Jianhua?He Ruimin?Amgad ElMahdi?Liu Jinhua?Wang Xingong?David King?Shamsuddin Shahid?Climate change and water resources management in Tuwei river basin of Northwest China?Mitigation and Adaptation Strategies for Global Change?2014?19?1??107-120? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Amgad ElMahdi?He Ruimin?Bao Zhenxin?Mahtab Ali?Water resources management strategy for adaptation to droughts in China?Mitigation and Adaptation Strategies for Global Change?2012?17?8??923-937? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Amgad ElMahdi?He Ruimin?Wang Xingong?Mahtab Ali?Gini Coefficient to Assess Equity in Domestic Water Supply in the Yellow River?Mitigation and Adaptation Strategies for Global Change?2012?17?1??65-75? [Xiaojun WANG, China]	Taken into account, water management is discussed in some of the options

Comment No	From Page	From Line	To Page	To Line	Comment	Response
2545	24	20	24	32	water demand management is an effective way for adaptation to future climate change, and mangy of the literature has showed that demand management is useful. Pls add it, and some literature"Potential impact of climate change on future water demand in Yulin city, Northwest China,Water resources management strategy for adaptation to droughts in China,Water demand management instead of water supply management a case study of Yulin City in northwestern China,Historic water consumptions and future management strategies for Haihe River basin of Northern China" Wang Xiaojun?Zhang Jianyun?Wang Jianhua?He Ruimin?Amgad ElMahdi?Liu Jinhua?Wang Xingong?David King?Shamsuddin Shahid?Climate change and water resources management in Tuwei river basin of Northwest China?Mitigation and Adaptation Strategies for Global Change?2014?19?1??107-120? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Amgad ElMahdi?He Ruimin?Bao Zhenxin?Mahtab Ali?Water resources management strategy for adaptation to droughts in China?Mitigation and Adaptation Strategies for Global Change?2012?17?8??923-937? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Amgad ElMahdi?He Ruimin?Wang Xingong?Mahtab Ali?Gini Coefficient to Assess Equity in Domestic Water Supply in the Yellow River?Mitigation and Adaptation Strategies for Global Change?2012?17?1??65-75? [Xiaojun WANG, China]	Taken into account, water management is discussed in some of the options
12703	24	23	24	23	Attention should be paid also to policy and civic mentality shift to an integrated FEW management and planning. Promotion of more consciousness on the interlinkages of food waste, energy consumption and water access would induce change from the bottom-up and legitimate top-down initiatives. [Yana POPKOSTOVA, France]	Noted, addressed in 4.3.4
10629	24	29	24	36	In deed a adaptation strategy that fulfills the human needs of food security but increases carbon stocks as agroforestry systems is more efficeint as a M&A than simple economically compensated conservation [Elemer Briceño-Elizondo, Costa Rica]	Noted
19403	24	34	24	36	Are there more examples of agroforestry? Is agroforestry an example of complex adaptive systems approach? Some reflection on how agro-forestry and other practices are undertaken may produce evidence of how the objective of iterative decision-making and evaluation is to be achieved. [Sumetee Pahwa Gajjar, India]	Noted - However, the text has changed substantially after the FOD and placeholders have been dropped.
7820	24	34	24	36	An end-use (light-duty vehicles) that uses a fourth of the world's oil and is undergoing radical change merits more than nine words about efficiency (weakened by a rebound effect that most literature finds unimportant) and one sentence about electrification. Lovins (2018) is the latest update on the extraordinary developments in automotive efficiency, electrification, and transformation of business models, all reinforcing each other. In brief, developments synthesized in Lovins et al. (2004), Cramer & Lovins (2004), Lovins & RMI (2011), and Lovins (2015) are now coming rapidly into full flower. They permit profitable and uncompromised autos with 2–4x efficiency gain without or 4–8x with electrification. (This is not just theoretical: such vehicles entered the global market in 2013 and I drive one—the best car I ever had.) The 2015–16 electrification history (somehow cited in p 2-18 line 39 to a 2015 source) was dramatic—60% global EV sales growth in 2015, 42% in 2016 when China sold more than the world did in 2014, and far more to come, including the 10x further 2015–20 growth slated in China's 13th Five Year Plan. One would never guess from lines 34–36's extremely brief summary that industries that are by some measures the world's two largest—cars and oil—are entering a period of unprecedented disruption. Lovins (2018) also shows from three industry vehicle designs or design studies that the conventional method of analyzing potential automotive efficiency gains (technology-by-technology supply curves) understates potential savings' quantity and overstates their cost, both by >2x. [Amory Lovins, United States of America]	Noted, the issue of electrification is dealt with in section 4.3.4
7674	24	34	24	36	An end-use (light-duty vehicles) that uses a fourth of the world's oil and is undergoing radical change merits more than nine words about efficiency (weakened by a rebound effect that most literature finds unimportant) and one sentence about electrification. Lovins (2018) is the latest update on the extraordinary developments in automotive efficiency, electrification, and transformation of business models, all reinforcing each other. In brief, developments synthesized in Lovins et al. (2004), Cramer & Lovins (2004), Lovins & RMI (2011), and Lovins (2015) are now coming rapidly into full flower. They permit profitable and uncompromised autos with 2–4x efficiency gain without or 4–8x with electrification. (This is not just theoretical: such vehicles entered the global market in 2013 and I drive one—the best car I ever had.) The 2015–16 electrification history (somehow cited in p 2-18 line 39 to a 2015 source) was dramatic—60% global EV sales growth in 2015, 42% in 2016 when China sold more than the world did in 2014, and far more to come, including the 10x further 2015–20 growth slated in China's 13th Five Year Plan. One would never guess from lines 34–36's extremely brief summary that industries that are by some measures the world's two largest—cars and oil—are entering a period of unprecedented disruption. Lovins (2018) also shows from three industry vehicle designs or design studies that the conventional method of analyzing potential automotive efficiency gains (technology-by-technology supply curves) understates potential savings' quantity and overstates their cost, both by >2x. [Amory Lovins, United States of America]	Noted, the issue of electrification is dealt with in section 4.3.4
1305	24	38		41	This recognises the policy- and financing-related complexities of ecological restoration, but initiatives such as the Water Funds advocated by the Nature Conservancy and implemented in South America (and now Africa) may offer a working model that could be scaled up. [Debra Roberts, South Africa]	Noted
10680	24	38	24	39	To rapidly take action once climate opportunities or risks emerge, planning requires managerial flexibility that allows continuous adaptation of interventions, including the timing of interventions according to existing environmental conditions and critical thresholds in ecosystem trajectories (Sietz et al. 2017). ---- Reference: Sietz, D., Fleskens, L. and Stringer, LC. (2017) Learning from non-linear ecosystem dynamics is vital for achieving Land Degradation Neutrality. Land Degradation and Development. Online First. DOI: 10.1002/ldr.2732. http://onlinelibrary.wiley.com/doi/10.1002/ldr.2732/full [Diana Sietz, Netherlands]	Taken into account, a final section was added about management and this reference was included
19404	24	38	24	42	Why is there no mention of SDG's here - some of these observations are captured in SDGs, for terrestrial ecosystems for instance. and recommendaitons for achieving transnational governance structures have been made within those SDG's goals and targets. I noticed that overlaps with SDG's appears later in the chapter. Would it be possible to make linkages throughout? [Sumetee Pahwa Gajjar, India]	Taken into account - SDGs are covered in Ch. 5, but we will clearly reference relationship to SD in general.
10630	24	38	24	52	In deed as it is mentioned, the challeges that REDD+ faces are rooted on other secytors as well and the adaptation of REDD+ itself t the local conditions is a key to its implementation. An example of the diversity of implementation can be seen in a region as small as Central America, where the approach to community work varies from country to country. [Elemer Briceño-Elizondo, Costa Rica]	Agreed
20250	24	43	24	52	There is a need to communicate these successful stragegies, globablly to give other similar communities knowledge and an awareness of not being alone in meeting the challenges that climate change brings with it. [Morien Rees, Norway]	Accepted
932	24	43	24	52	Should any comment be made on how REDD+ projects can sometimes lead to locals holding existing trees hostage and threatening to cut them unless they are paid for each tree left standing. [Elizabeth Aldrich, United States of America]	Noted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
21177	24	43	24	52	note that REDDneeds to be compelmented by measures in other ecosystems to maximize mitigstion opportunities and avoid tradeoffs.see Popp A, et al. 2014a. Land-use protection for climate change mitigation. Nature Climate Change 4:1095-1098.see als Epple, C., García Rangel, S., Jenkins, M., & Guth, M. (2016). Managing ecosystems in the context of climate change mitigation: A review of current knowledge and recommendations to support ecosystem-based mitigation actions that look beyond terrestrial forests. Technical Series No.86. Secretariat of the Convention on Biological Diversity, Montreal, 55 pages.) available at: https://www.cbd.int/doc/publications/cbd-ts-86-en.pdf: [David Cooper, Canada]	Accepted - text revised to include reference to this research.
5127	24	43	25	5	The discussion of REDD+ is well rounded and includes very useful information on the challenges, as they relate to some of the other dimensions of feasibility. How might this discussion be replicated for solutions in the agriculture space? Or can this discussion inform the kind of analysis that is not yet reflected in literature on agriculture solutions (particularly related to ag & mitigation/soil carbon sequestration)? How might the analysis of REDD+, as it relates to property rights and structural causes of deforestation, inform identification of research gaps to be flagged later or in other chapters of the report? [Tonya Rawe, United States of America]	Accepted, text has been rewritten
1083	24	43	25	10	REDD+ is presented here as potentially failing endeavour. Most of references refer to the difficulties of its implementation. Particularly the social aspects. The Authors fail to recognize its potentials and relevance once afforestation and reforestion have been implemted. The socioa and environmental safeguards that make REDD+ implimentation so hard are relevant for afforestation, reforestation as well as BECCS and any mitigation measure implemented. Yet REDD+ implementation is the only one teckling and moving these agendas forward. A big error is in line 44. REDD+ is not a startegy. Its one of the 16 mechanims under UNFCCC and it the most advanced in implementation. It is different from Carbon projects and/or REDD+ projects that do not work under the mechanism. A more comprehensive assessment of REDD+ or the inclusion of some experts on the mechanism is highly advised. Inclusion of assotiated cost estimates is also advised as BECCS estimates are so high compared with potential cost for REDD+. Please, these comments attempt to give REDD+ is right estimate as part of the big picture/combined approaches needed for attemting to reach the 1.5 and 2.0 degrees targets. [naikoa aguilar-amuchastegui, United States of America]	Accepted - discussion of multiple aspects and implications of REDD+ have been incorporated into the text.
2747	24	45	24	46	Controversial - need to present other perspectives here. Although this is theoretically true, the way in which REDD+ has been implemented to date has not optimised adaptation - and perhaps not even development. The Africa chapter in AR5 (Niang et al 2014) could be a starting point. [Penny Urquhart, South Africa]	Taken into account - a more balanced approach to discussing REDD+'s relationship to adaptation has been adopted in the SOD.
12826	24	54	25	5	The issue of tenure security is a major constraint in the successful implementation of REDD+ programs and should be adequately discussed, please refer to -Sunderlin, W.D., Larson, A.M., Duchelle, A.E., Pradnja Resosudarmo, I.A., Huynh, T.B., Awono, A. and Dokken, T. 2014. How are REDD+ proponents addressing tenure problems? Evidence from Brazil, Cameroon, Tanzania, Indonesia, and Vietnam. World Development 55: 37-52. Holmes, I., Potvin, C. and Coomes, O.T. 2017. Early REDD+ Implementation: The Journey of an Indigenous Community in Eastern Panama. Forests 8: 67. [Shipra Shah, Fiji]	Taken into account - addressed in SOD
10352	24	54	25	9	It is quite woring that only negative issues are highlited on REDD+. While it is an unprecedent process that lead to a fair number of countries to take seriosuly the protection of their forest, due to this all the challenges are now seen and can be addressed. It is not fair to only mention the bad, and forget about the good. The message that this paragrphas send is quite unbalance and do not reflect at all the efforts made. But rather discourage to continue and strhenthen the process. [Maria Jose Sanz Sanchez, Spain]	Taken into account - combined with other comment, discussion of multiple aspects and implications of REDD+ (positive and negative) have been incorporated into the text
19405	25	1	25	9	These challenges with REDD have been covered well, given that the technology has been around for more than 20 years. Some lessons can be learnt here for new technologies and approaches which are being proposed now - it is imperative that they be tested amongst stakeholders and a democratic approach be adopted towards their implementation. [Sumetee Pahwa Gajjar, India]	Accepted
1306	25	12			The value of urban green infrastruture has recently been highlighted in the following World Bank Report: White, Roland, Jane Turpie, and Gwyneth Letley, 2017. “Greening Africa’s Cities: Enhancing The relationship between urbanization, environmental assets and ecosystemservices.” World Bank, Washington, DC. [Debra Roberts, South Africa]	Agreed. Findings added in the form of new text in 4.3.4
1307	25	12			Also important to note that many cities in the global south not only have the more traditional urban green spaces within their borders, but large areas of significant biodiversity which has an important role in increasing adaptive capacity see e.g. Roberts, D., Boon, R., Diederichs, N., Douwes, E., Govender. N., McInnes, A., Mclean, C. O’Donoghue, S., and Spires, M. (2012). Exploring ecosystem-based adaptation in Durban, South Africa: “learning-by-doing” at the local government coal face. Environment and Urbanisation, 24 (1): 167-195. This need to protect landscape scale biodiversity requires a different understanding of "what urban is" and necessitates that local governents must now take on the responsibility for managing sizeable conservation areas and factor that into their spatial planning. [Debra Roberts, South Africa]	Agreed. Findings added in the form of new text in 4.3.4
9273	25	12			Add results from McPhearson, T., Karki, M., Herzog, C., Santiago Fink, H., Abbadie, L., Kremer, P., Clark, C. M., Palmer, M. I., and Pernini, K. (2018). Urban ecosystems and biodiversity. In C. Rosenzweig, W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, and S. Ali Ibrahim (eds.), Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network. Cambridge University Press. In Press. [Cynthia Rosenzweig, United States of America]	Accepted. General findings included.
2748	25	12	25	19	Urban green cover is important, but there should be more on ecosystem-based adaptation in general, with urban green cover as a subset of this. [Penny Urquhart, South Africa]	Taken into account - text revised
13133	25	12	25	37	The section on Urban green cover (4.3.3.3) summarises well some of the key challenges, but does not seem to capture the significant interplay between the sheer scale of growth and pressure of urbanisation and need to preserve / develop green cover, which in many urban development models are in conflict. The grown of urban green spaces may well lead to 'concern over their governance', but this is within the complex governance context of the city as a planned / un planned growing system. (Pg 25 line 54 to Pg 26 line 8 address this obliquely). [Carla-Leanne Washbourne, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
9623	25	12	25	37	Urban green land may be options for adaptation and mitigation of climate change,pollution controlling. [Jianguo Wu, China]	Taken into account - text revised
19407	25	12	26	55	There are considerable overlaps in section 4.3.3.3 on urban green cover and section 4.3.4.1.2 green infrastrcuture and ecosystem services. While there must be a logic in the flow of the sections, to separate them, the essence of how green cover is part of green infrastrutre and provides ecosystem services is lost. moreover, recent grey and academic literature on nature based solutions exists which can be sourced and added. [Sumetee Pahwa Gajjar, India]	Taken into account. Sub-sections 4.3.3 and 4.3.4 are being revised to improve structure.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12071	25	12	37		The other points are important to highlight relating to urban green cover. The first is the concept of blue-green infrastructure which connects waterways and vegetation cover in urbanised areas. The second is the need for integrated responses between land-use and water resource planning to maximise the implementation of blue-green infrastructure in urbanised areas. Sugested references include: Voskamp I. M. & Van de Ven, F. H. M. 2015, 'Planning support system for climate adaptation: Composing effective sets of blue-green measures to reduce urban vulnerability to extreme weather events', Building and Environment, vol. 80, 159-167.; Schuch, G., Serrao-Neumann, S., Morgan, E. & Choy, D. L. 2017, 'Water in the city: Green open spaces, land use planning and flood management - An Australian Case Study', Land Use Policy, vol. 63, pp. 539-550; Serrao-Neumann, S., Renouf, M., Kenway, S. J. & Choy, D. L. 2017, 'Connecting land-use and water planning: Prospects for an urban water metabolism approach', Cities, vol 60, pp. 13-27. [Silvia Serrao-Neumann, Australia]	Accepted, text added in appropriate places
19406	25	13	25	37	There are several additional publications on this topic in relation to cities and locations across the world, some of which can be found on the TNOC. Dagmar Haase et al (2017), Elmqvist et al (2016) among others. References are somewhat limited. [Sumetee Pahwa Gajjar, India]	Taken into account - text revised
20829	25	13	25	37	This section would benefit from a clearer and more comprehensive list of the mutiple benefits of urban green infrastructure. Adaptation benefits include: flood protection / stormwater management, improved rainwater infiltration, local cooling and shading. Mitigation benefits arise from the carbon storage and sequestration in vegetation and soils. Co-benefits include a range of other ecosystem services - not just pollination and urban food production, but also noise reduction, improvement of air and water quality, and cultural ecosystem services including aesthetic value, opportunities for recreation, education about nature, interaction with wildlife, and a 'sense of place' (local identity). The section on 'active' and 'passive' benefits needs to explain what these terms mean in this context, e.g. by 'passive' do you mean the benefits of viewing nature (i.e. aesthetic value), and by 'active' do you mean physical recreation? The whole section also overlaps with section 4.3.4.1.2 [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - text revised
18402	25	14	25	14	Green et al., 2016 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
1915	25	14	25	16	It is not clear to me what links the five components and their enumeration appears quite ad hoc to me. I would rephrase this sentence. [Jasper Meya, Germany]	Taken into account - text revised
2790	25	15	26	45	Widespread adoption of atonomous vehicles could have a significant impact. Far fewer vehicles would be needed and much less land would need to be devoted to parking, thus facilitating denser development. Sorry I don't have a reference for this. Also relevant for p. 29 lines 17 to 25. [Erik Haites, Canada]	Noted. We will look into potential literature and see whether it makes sense from a 1.5C perspective to include it.
9339	25	16	25	16	The reference "Brink et al. (2016)" may be provided in parenthesis since it is not used within the sentence structure [Siir KILKIS, Turkey]	editorial
6544	25	16	25	16	Brink et al. (2016) should be modified to (Brink et al. 2016) [Victor Ongoma, Kenya]	editorial
1000	25	17			Add the words "along with cool roofs and pavements" before "reduction of urban heat islands". [Stephen Wiel, United States of America]	Taken into account - text revised
14126	25	17	25	17	It is not clear what pollination of numerous areas means as it is currently worded [Elvira Poloczanska, Germany]	Taken into account - text revised
18403	25	18	25	19	References not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
18404	25	22	25	22	Lin et al. 2018 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
1293	25	22	25	24	This statement that 'urban dwellers will benefit more from passive means' needs to be better explained, for example by citing the principle of the "leading-edge effect" (Spronken-Smith, R. A., T. R. Oke, and W. P. Lowry (2000), "Advection and the Surface Energy Balance Across an Irrigated Urban Park") [Colin Raymond, United States of America]	Noted, passive means is defined two lines above. It simply refers to the availability of green
18405	25	24	25	24	Lin et al. 2018 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
18406	25	25	25	25	Green et al. 2016 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
7909	25	26	25	27	Milan and the urban forest inventory. This is hardly very novel. Tens of large American cities are doing this. [Westphal Michael, United States of America]	Taken into account - text revised
4667	25	27			Change "hectares" to "ha". [Radim Tolasz, Czech Republic]	editorial
18407	25	27	25	27	Sanesi et al. 2017 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
18408	25	37	25	37	Li et al. 2017 not linked to Mendeley [Wilfran Moufouma Okia, France]	editorial
9625	25	40	25	40	add the content,there are only title, [Jianguo Wu, China]	Taken into account - text revised
4892	25	43	30	37	Waste management is generally hardly covered in section 4.3., although there are close links to greenhouse gas emissions (sound waste management is key to reduce GHG emissions, also see earlier comment to Chapter 2). Here in this section '4.3.4. Urban, infrastructure and industrial transitions', a new subsection 'Waste Management and Circular Economy' should be introduced. Alternatively, waste management could be discussed as part of section 4.3.4.1.3 'Sustainable Water and Environmental Services', and then the topic of circular economy could be expanded in section 4.3.4.3 'Industrial Transitions'. [Sigrid Kusch, Germany]	Taken into account. Waste management will be included in 4.3.3. A separate section on industry will be created (the new 4.3.5) that will include circularity. Note that only new literature relative to AR5 will be discussed; AR5 had a significant discussion of waste management.
11466	25	43	30	42	While there is some consideration of poverty and equity in Section 4.3.4 this is largely confined to disaster risk reduction and food provisioning. The sections on urban transitions treat the cities of the developed world as the norm and pay inadequate attention to the challenges and opportunities facing those in the developing world. Among other challenges, cities in the world's tropics face the twin prospects of rapid population growth and the need to adapt to climate states with no present day analogues. A 1.5 degree world poses many more questions for Kinshasa or Manilla than it does for most cities in Europe or North America. See the State of the Tropics 2014 report at stateofthetropics.org [Stewart Lockie, Australia]	Accepted and text amended to reflect risks and opportunities Global South cities
1914	25	43	30	43	My general impression is that this Section is still weaker than the rest of chapter 4. For instance statements like "will be defined by four critical elements" need reasoning and further qualification. [Jasper Meya, Germany]	Accepted. Section is being revisited and substantially revised.
9274	25	45	25	51	Cite: Grafakos et al., 2018 (In Press) and Rosenzweig et al., 2015 [Cynthia Rosenzweig, United States of America]	Accepted. Rosenzweig cited (will look out for Grafakos) in substantially revised text.
14316	25	51	25	52	The Under2 Coalition is a great example of sub-national governments who drive local/regional action and nurture wide-stakeholder engagement and acceptance. [Yana POPKOSTOVA, France]	Noted. We are trying to assess literature not organisations, but the sub-national network point is included in revised text.
11465	25	52	26	8	There are some big claims in this paragraph that do not bear scrutiny. The claim that what happens in cities and other urban centres will be THE defining influence on climate change is highly contestible and completely unnecessary. We do not need to argue that land-use change, de-forestation, energy generation, food production etc. are either less important than or, in some way subservient to, 'the city'. The claim that local government will be the key driver of global ambition is just as contestible and unnecessary. The paragraph as a whole should be stripped of jargon. [Stewart Lockie, Australia]	Accepted. Text revised.
20637	26		41		All mitigation technologies should be discussed including the trade-offs, side-effects and impacts on human and natural systems. A starting point may be: Key impacts of climate engineering on biodiversity and ecosystems, with priorities for future research CG McCormack, W Born, PJ Irvine, EP Achterberg, T Amano, J Ardron, ... Journal of Integrative Environmental Sciences 13 (2-4), 103-128 [Hans Poertner, Germany]	Taken into account. The mitigation options are assessed for feasibility in the six categories introduced in 4.3.1, which include the issues mentioned. Thank you for the reference; we will explore whether it adds value to the assessment to include it.
10928	26	3			Missingg blank line above caption [Beat Brunner, Switzerland]	Editorial.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9340	26	3	26	7	The statement "a new type of city/urban science will be desirable that bridges disciplinary boundaries and practices a mix of approaches to create an evidence base for action (Solecki et al. 2013; McPhearson et al. 2016)" may include an emphasis on the emerging role of composite indicators for supporting the "science of cities." Composite indicators are particularly well suited to address multi-disciplinary complex issues. One such example is the Sustainable Development of Energy, Water and Environment Systems (SDEWES) Index that has been developed as a composite indicator based on 7 dimensions and 35 indicators to trigger policy learning, action, and cooperation to bring cities closer to sustainable development. The SDEWES Index has been applied to 120 cities around the world and may be featured in an information box that will be gladly provided by the Reviewer in support of indicator oriented evidence bases supporting urban action. References for the SDEWES Index include K?lk??, ?. Composite index for benchmarking local energy systems of Mediterranean port cities, Energy 92 (2015) 622-638 <http://dx.doi.org/10.1016/j.energy.2015.06.093> ; K?lk?s, S., Sustainable development of energy, water and environment systems index for Southeast European cities, Journal of Cleaner Production 130 (2016) 222-234<http://dx.doi.org/10.1016/j.jclepro.2015.07.121> ; K?lk??, ?., Sustainable Development of Energy, Water and Environment Systems (SDEWES) Index for policy learning in cities, Int. J. Innovation and Sustainable Development (Article in Press) ; K?lk??, ?., Benchmarking South East European Cities with the Sustainable Development of Energy, Water and Environment Systems Index, Journal of Sustainable Development of Energy, Water and Environment Systems DOI:<http://dx.doi.org/10.13044/j.sdewes.d5.0179> [Siir KILKIS, Turkey]	Accepted. Citations reviewed but not specifically included in substantially revised section as they refer to an index.
19728	26	11			section on urban areas. This secton needs to discuss the importance of the right to participation in urban planning. [Tara Shine, Ireland]	Accepted and participation in urban planning now included. Rights frameworks and the right to participation addressed under "enabling environment".
17696	26	11	27	55	Transportation infrastructure is part of the built environment, and policies aiming at its devlopment/modification (such as the choice to support high capacity urban rail more than roads) may have major impacts on the energy intesity of mobility in cities. This is not covered at all in this section. [Pierpaolo Cazzola, France]	Accepted. Transport infrastructure included.
9693	26	11	27	55	Currently, huge amount of energy (GHGs) is inefficiently used by energy generation and cosumption facilities such as buildings, industrial plants. Many of energy intensive appliances can be operated more energy efficient manner by regular monitoring of performance, weakpoint analysis, energy efficiency control of the facilities. [Hyung Ju Kim, Republic of Korea]	Accepted. Energy efficiency of buildings and appliances included in revised text.
9275	26	15			Raven, J., Stone, B., Mills, G., Towers, J., Katzschner, L., Leone, M., Gaborit, P., Georgescu, M., and Hariri, M. (2018). Urban planning and design. In C. Rosenzweig, W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, and S. Ali Ibrahim (eds.), Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network. Cambridge University Press. In Press. [Cynthia Rosenzweig, United States of America]	Taken into account. But that particular reference is not included.
17695	26	15	26	45	I think that this whole section should open up to integrate important considerations on the opportunities that may be associated with the ICT-enabled concept of "mobility as a service". This is something that may strengthen high capacity public transport systems, especially in regions where ther economic viability is limited today, thanks to the provision of feeder services. This is also the place to bring up important points on the risks posed by "mobility as a service". For example, it is necessary to underline the need for policy to ensure that "mobility as a service" is effectively coupled with electrification. Given the importance of autonmous driving and the likely upward impact on transport activity (due to lower costs a likely lower value of time loss, likely to lead to greater travel times and distances), as well as the risk for upward impacts on travel demand if autonomus driving intersects the concept of "mobility as a serivce", this is also the place where you should be underlining the relevance of polices aiming at maintaining uran structures compact as a way to counterbalance the likely increasing push towards sprawl comin from the development of these technologies. [Pierpaolo Cazzola, France]	Noted. ICT, technology and IoT included in revised section. Transport section also notified of this comment.
14082	26	16	26	21	This is a really long sentence, not sure by the end what it is that 'promotes diversity and vitality' – suggest breaking down into shorter sentences. [Elvira Poloczanska, Germany]	Editorial.
14362	26	16	26	21	There is also evidence that a mixed-objective land management in Mediterranean forests and rangelands contributes to their resilience . Riva, M.J., Baeza, J., Bautista, S., Christoforou, M., Daliakopoulos, I.N., Hadjimitsis, D., Keizer, J.J., Liniger, H., Quaranta, G., Ribeiro, C., Salvia, R., Tsanis, I.K., Urgeghe, A., Valdecantos, A., Schwilch, G., 2017. How does land management contribute to the resilience of Mediterranean forests and rangelands? A participatory assessment. Land Degradation & Development (accepted). [Ioannis Daliakopoulos, Greece]	Noted. Not clear that forest land management belongs in this urban section.
20830	26	16	26	25	This paragraph contains several important points but they are not clearly explained. It would be good to make it clear that i) compact development and mixed land-use (housing close to employment, schools, retail etc) help to reduce total demand for travel and create the opportunity for increased active travel (walking and cycling); ii) this provides benefits for health from increased physical activity (Milner et al), and also reduces air pollution, noise, congestion and accidents, as well as improving opportunities for social interaction. The ref cited by Puppim de Oliveira does not refer to climate adaptation - it deals with public transport, waste management and industrial emissions. It is not clear how mixed land use can contribute to resource use efficiency - if this refers to reduced transport fuel demand, for example, then this should be clearly stated. The last sentence appears to have a word missing as it does not make sense. [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. De Oliviera ref removed in revised text.
7910	26	16	26	46	There is a whole body of work coming out of the New Climate Economy project that shows the benefit of compact urban development (http://www.coalitionforurbantransitions.org/home/publications-and-resources). Ahlfedlt and Piertostefani ("Demystifying Compact Urban growth") have done a review of 300 studies on the impacts of compact urban growth. [Westphal Michael, United States of America]	Noted. Some of this work has been cited in Chapter 4. The sections of the work that are published are already being considered for inclusion. as "grey literature".
7011	26	16	26	25	The urban climatic map and the World Urban Database and Access Portal Tools (WUDAPT) initiatives which promote sustainable urban planning and improve city ventilation and thermal comfort should also be mentioned and discussed in this section. Some relevant references: 1. Cai et al., 2016 : Local Climate Zone Study for Sustainable Megacities Development by Using Improved WUDAPT Methodology – A Case Study in Guangzhou, Procedia Environmental Sciences, Volume 36, 2016, Pages 82-89 2. NG Yan Yung, and REN Chao (ed.), 2015, The Urban Climatic Map: A Methodology for Sustainable Urban Planning, London: UK, Routledge, Tayler & Francis Group, 476 pgs, ISBN-13: 978-1849713764, ISBN-10: 1849713766, published in Sep. 2015. 3. Ng, E and C. Ren, 2017 : China's adaptation to climate & urban climatic changes: A critical review, Urban Climate, published online, https://doi.org/10.1016/j.uclim.2017.07.006. [Sai Ming Lee, China]	Taken into account. The Cai et al citation has not been used as it refers to a very specific analytical approach to LCZs. The two Ng papers have been reviewed by not specifically used although points MLG have been included. The second Ng and Ren paper is also well suited to the section on 'enabling environment' (4.4.1)
7819	26	23	26	25	Peter Calthorpe—surprisingly absent from this discussion, since he is implementing new-urbanist design in >50 cities—has just posted at https://www.ted.com/talks/peter_calthorpe_7_principles_for_building_better_cities#t-37942 a TED talk nicely encapsulating the principles of sustainable urban form and design. I don't know if he has published them more formally. [Amory Lovins, United States of America]	Accepted. Included a reference to Calthorpe 2010. Ideally we would have more recent peer reviewed literature.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7673	26	23	26	25	Peter Calthorpe—surprisingly absent from this discussion, since he is implementing new-urbanist design in >50 cities—has just posted at https://www.ted.com/talks/peter_calthorpe_7_principles_for_building_better_cities#t-37942 a TED talk nicely encapsulating the principles of sustainable urban form and design. I don't know if he has published them more formally. [Amory Lovins, United States of America]	Accepted. Included a reference to Calthorpe 2010. Ideally we would have more recent peer reviewed literature.
1659	26	27	26	28	I would also include a note that the real estate sector is central to advancing both mitigation and adaptation. See, Keenan, J.M. (2015). Sustainability to Adaptation and Back: A Case Study of Goldman Sach's Corporate Real Estate Strategy. Building Research & Information, 43(6), 407-422. doi:10.1080/09613218.2016.1085260 [Jesse Keenan, United States of America]	Rejected. The paper appears to be about the firm's sustainability strategy less about urban climate responses.
9276	26	28			Cite McPhearson et al., 2018 (In Press). [Cynthia Rosenzweig, United States of America]	Accepted.
11154	26	30	26	31	Cycling is not mentioned, despite being more popular than walking in many cities. [Michiel Schaeffer, Netherlands]	Taken into account and text revised to include a reference to multiple modes of non-motorised transport.
5146	26	37	26	45	I feel that a key issue for changing urban form and fabric is omitted here. Georgescu et al (Georgescu, M., W.T.L. Chow, Z. Wang, A.J. Brazel, M. Roth, and V. Benson-Lira. 2015: "Prioritizing urban sustainability solutions: coordinated approaches must incorporate scale-dependent built environment induced effects." Environmental Research Letters. 10 (6): 061001. DOI:10.1088/1748-9326/10/6/061001) argue that effective technologies to adapt & mitigate climate change are constrained by policy or stakeholder decisions made at larger planning scales. This should be mentioned here or elsewhere in the document [Winston Chow, Singapore]	Accepted and the notion of urban form, scale and urban green solutions added to the revised text. Georgescu text not specifically included.
5147	26	37	26	45	I suggest the following amendment: A range of studies have shown how oil-based greenhouse gas emissions associated with high-density, mixed-use walking city urban fabric are much lower than in a medium-density, partially mixed transit city urban fabric and these are much lower than low-density, highly zoned automobile urban fabric (Ewing et al. 2016; Newman et al. 2016). However, the effectiveness of these urban adaptation options can be constrained by planning decisions made across spatial scales (Georgescu et al. 2015), and judicious analysis of changes in urban form or fabric must be considered before these strategies are applied. [Winston Chow, Singapore]	Taken into account and combined with edits regarding multi-level governance and enabling environment.
7335	26	43	26	43	Delete the text "oil-based greenhouse gas emissions" and replace with "energy-based greenhouse gas emissions". [Eleni Kaditi, Austria]	Rejected. Removing oil from the mobility/ transport sector is what the cited literature speaks to. Oil placed with fossil fuel.
10556	26	48	26	55	The section on green (and blue) infrastructure should be expanded significantly to reflect the recent work in the area. Due to the high volume of investment in infrastructure, this is one area that shoud be emphasized. [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account in the revised wording.
13134	26	48	27	2	The section on Green infrastructure & Ecosystem services (4.3.4.1.2) could benefit from the inclusion of some additional concepts such as 'Nature-based Solutions' (NbS) or Ecosystem Approach, which are used frequently to refer to this class of approaches. [Carla-Leanne Washbourne, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account in the revised wording.
14127	26	50	26	50	biophilic urbanism needs a defintion [Elvira Poloczanska, Germany]	Accepted. The term has been removed.
11155	26	50	26	50	Can "biophilic urbanism" be explained? [Michiel Schaeffer, Netherlands]	Accepted. The term has been removed.
9896	26	50	26	52	The discussion on urban green infrastructure only discusses the positive aspects of urban greening. Although green infrastructure may play a vital role in climate amelioration and energy conservation but poor management practices may actually contribute to greenhouse gas emissions rather than their offsetting, refer to Cameron, R., Blanusa, T., Taylor, J., Salisbury, A., Halstead, A., Henricot, B. and Thompson, K. 2012. The domestic garden: its contribution to urban green infrastructure. Urban Forestry and Urban Greening 11 (2): 129-137. [Shipra Shah, Fiji]	Accepted and text amended to include ecological infrastructure.
5148	26	52	26	52	Common nomenclature needed; Chapter 3 refers to UHI effect, but here effect is included in the acronym UHIE. Suggest authors reconclile this term [Winston Chow, Singapore]	Editorial.
2749	26	52	27	2	The discussion on community-based adaptation and ecosystem-based adaptation could be enhanced, and integration between the two conecpts discussed as a useful way forward - here and elsewhere in the chapter. Suggest Schipper et al 2014 'Community based adaptation to climate change - scaling it up' as a useful collection of articles. [Penny Urquhart, South Africa]	Accepted in revised text and reference added.
14083	26	55	26	55	Examples of EbA specifically in the context of cities would be helpful, as well as their potential and limitations. [Elvira Poloczanska, Germany]	Taken into account in the revised wording. EBA section has been rewritten with cited examples.
10253	26	55	27	1	Current ecosystem management approach is top down driven/target driven as opposite to bottom up/inductive led (see: Mendas, Z. (2016) "Studying island archipelagos as ecosystems: Reflections and Considerations", The Centre for Sustainable Development, 4th July, Preston: University of Central Lancashire. Available at: https://www.uclan.ac.uk/research/explore/groups/assets/csd-summer-2016-edition.pdf (page11) [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Rejected. One example of "island archipelagos" in the grey literature is not enough to substantiate the argument. Please do not the references to multi-level governance and accountability for a critique of "top down" approaches.
935	27		27		Could more emphasis be given to how building efficiency improvements could lower overall GHG emissions in the future? [Elizabeth Aldrich, United States of America]	Accepted. Included in revised text.
7336	27	1	27	1	Delete the text "hard". [Eleni Kaditi, Austria]	Editorial.
10252	27	2	27	3	a gap is needed between these two paragraphs [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Editorial.
9277	27	3			Cite Vicuña et al., 2018 (In press). [Cynthia Rosenzweig, United States of America]	Noted. The citation will be considered when public.
2572	27	3	27	12	water demand management is an effective way for adaptation to future climate change, and mangy of the literature has showed that demand management is useful. Pls add it, and some literature"Potential impact of climate change on future water demand in Yulin city, Northwest China,Water resources management strategy for adaptation to droughts in China,Water demand management instead of water supply management a case study of Yulin City in northwestern China,Historic water consumptions and future management strategies for Haihe River basin of Northern China" [Xiaojun WANG, China]	Taken into account in revised text.
2585	27	3	27	12	water demand management is an effective way for adaptation to future climate change, and mangy of the literature has showed that demand management is useful. Pls add it, and some literature"Potential impact of climate change on future water demand in Yulin city, Northwest China,Water resources management strategy for adaptation to droughts in China,Water demand management instead of water supply management a case study of Yulin City in northwestern China,Historic water consumptions and future management strategies for Haihe River basin of Northern China" [Xiaojun WANG, China]	Taken into account in revised text.
19408	27	3	27	12	Would urban sanitation services feature in section 4.3.4.1.3? If yes, then the considerable health impacts from lack of proper sanitation and hygiene, linked to risks, especially for the urban poor in under-serviced settlements could be highlighted. [Sumetee Pahwa Gajjar, India]	Taken into account and text added.
2546	27	3	27	12	water demand management is an effective way for adaptation to future climate change, and mangy of the literature has showed that demand management is useful. Pls add it, and some literature"Potential impact of climate change on future water demand in Yulin city, Northwest China,Water resources management strategy for adaptation to droughts in China,Water demand management instead of water supply management a case study of Yulin City in northwestern China,Historic water consumptions and future management strategies for Haihe River basin of Northern China" [Xiaojun WANG, China]	Taken into account in revised text.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
3984	27	12			I think its worth referencing the excellent work of Singapore on water retention and recycling and green infrastructure with the aim of reducing its dependence on Malysia and at the same time achieving co benfits for the urban environment and human heath [Barbara Norman, Australia]	Noted.
14329	27	12	27	14	Furthermore, the concept of the Food-Energy-Water (FEW) nexus initiated by the World Economic Forum which states that siloed approached to food, water and energy management lead to high inefficiencies and waste across the value chain needs to be promoted and integrated in urban city management in a nexus framework to allow for an urban development conscious of the interlinkages between the food, energy and water systems. [Yana POPKOSTOVA, France]	Accepted. Text amended to include this nexus. From Debbie: "Agreed, this is discussed in 4.3.3"
9278	27	15			Cite McPhearson et al., 2018 (In Press). [Cynthia Rosenzweig, United States of America]	Noted.
14128	27	15	27	15	This concept needs an introduction/explanation sentence in the text [Elvira Poloczanska, Germany]	Editorial
9279	27	25			Cite: Jean-Baptiste, N., Olivotto, V., Porio, E., Kombe, W., and Yulo-Loyzaga, A. (2018). Housing and informal settlements. In C. Rosenzweig, W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, and S. Ali Ibrahim (eds.), Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network. Cambridge University Press. In Press. [Cynthia Rosenzweig, United States of America]	Noted. Will have to wait for publication to appear.
4932	27	25	27	30	Historical building stock represent a major proportion of buildings that will be in use over coming decades. Therefore, making effective use of historical buildings and extending their use lives is an important component of meeting emissions reductions targets. As well, additional studies indicate that maintenance of historic neighborhoods also supports small businesses, community resilience, and other social and climate benefits. Relevant references from the gray literature include: National Trust for Historic Preservation (2011). The Greenest Building: Quantifying the Environmental Value of Building Reuse; and National Trust for Historic Preservation (2014). Older, Smaller, Better Measuring how the character of buildings and blocks influences urban vitality. [Marcy Rockman, United States of America]	Noted. But not directly related to 1.5C and we have not (yet) come across peer reviewed literature that references the link between ambitious mitigation targets and old buildings in this way.
10864	27	26	27	30	This analysis/framing is rather short-term oriented. Barrington-Leigh and Millard-Ball have argued that for long term climate policy, the road networks laid down during initial construction of new residential developments are immutable and affect emissions, somewhat irreversibly, for centuries. Therefore drastic/urgent policy action may be needed in such areas where the payoff is gradual, but the opportunity only exists in the short-term (during the current, final phase of the one-time process of urbanization). Overall, more of an introductory framing about the built environment of our cities having complex impacts on energy and emissions, and on different aspects of that built environment being changeable on different time frames, would be useful. See Barrington-Leigh, C. P. and Adam Millard-Ball, “A Century of Sprawl in the United States,” Proceedings of the National Academy of Sciences, doi:10.1073/pnas.1504033112, 15 June 2015; and Barrington-Leigh, C. P. and Adam Millard-Ball, “More connected urban roads reduce US GHG Emissions,” Environmental Research Letters, doi:10.1088/1748-9326/aa59ba, Vol. 12, No. 4, 2017 [Barrington-Leigh Christopher, Canada]	Taken into account and the citations reviewed but not included as part of significantly revised text in the context of long-lived infrastructure
7911	27	26	27	47	Built environment section should actually discuss low carbon, climate-resilient options and measures. The section is too generic. For example, the importance of building codes (see Westphal et al. 2017. Powering Cities in the Global South: How Energy Access for All Benefits the Economy and the Environment. World Resources Institute.), passive design, or new material materials like low-carbon cement. [Westphal Michael, United States of America]	Taken into account. Citation not included as grey literature. The point about building codes is accepted and added.
7100	27	32		33	on "first":by "changing weather condicions" the authors may mean "increased variability in the short time periods"? This also challenges the installed capacity of the heating and cooling systems both at the building scale and at the energysystem level. [Érika Mata, Sweden]	Editorial.
4186	27	32		37	There is also the question over exisiting infrastructure. In many cities across the world, infrastructure was built decades if not centuries ago. In many cases it was not built to withstand explosive population growth or to account for the impacts of changing weather patterns and extreme events. A project of this magnitude would be unaffordable for average homeowners and most likely for the municipalities that would have to undertake such large projects. What would policies and economics look like for retrofits and large scale changes to existing infrastructure to make buildings more resiliant etc. [Michelle Leslie, Canada]	Taken into account in section about "enabling environment"
7099	27	32		37	see an extended summary of impacts of climate change in buildings in the introductions of: Nik VM, Mata É, and Sasic Kalagasidis A. A statistical method for assessing retrofitting measures of buildings and ranking their robustness against climate change, Energy and Buildings (2015) 88: 262–275; Nik VM, Mata É, Sasic Kalagasidis A, and Scartezzini, J.-L. Effective and robust energy retrofitting measures for future climatic conditions - Reduced heating demand of Swedish households, Energy and Buildings (2016) 121: 176-187. [Érika Mata, Sweden]	Taken into account in revised text. References reviewed but not included.
7103	27	32		37	I missed in this paragraph a reference to the impacts on well being and health for the building occupants. E.g. reducing uncontrolled ventilation of dwellings helps to improve energy efficiency and can protect against the ingress of pollutants from the outdoor environment. However, simulation studies (Milner et al, 2015) suggest that at very low permeability there is a potentially steep rise in pollutants of indoor origin, whose adverse effects on health may outweigh the benefits of reduced energy use, lower CO2 emissions, and protection against outdoor pollution. (Milner, J, et al., What should the ventilation objectives be for retrofit energy efficiency interventions of dwellings?, Building Services Engineering Research and Technology 36.2 (2015): 221-229) [Érika Mata, Sweden]	Taken into account in revised text provided we can find literature that refers to 1.5C target or ambitious mitigation and adaptation.
5149	27	32	27	37	References are missing [Winston Chow, Singapore]	Editorial
10865	27	32	27	37	References missing in this paragraph [Barrington-Leigh Christopher, Canada]	Editorial.
7101	27	33		35	on "second": could be linked specifically to new buildings or to the need of new construction materials to be clearly differentiaten from "fourth". [Érika Mata, Sweden]	Editorial.
1660	27	33	27	33	Please see the following citation for potential inclusion: Hertin, J., Berkhout, F., Gann, D., & Barlow, J. (2003). Climate change and the UK house building sector: perceptions, impacts and adaptive capacity. Building Research & Information, 31(3-4), 278-290; Wedawatta, G., Ingirige, B., Jones, K., & Proverbs, D. (2011). Extreme weather events and construction SMEs: Vulnerability, impacts, and responses. Structural survey, 29(2), 106-119; Alshebani, M. N., & Wedawatta, G. (2014). Making the construction industry resilient to extreme weather: lessons from construction in hot weather conditions. Procedia Economics and Finance, 18, 635-642; Shahin, A., AbouRizk, S. M., & Mohamed, Y. (2010). Modeling weather-sensitive construction activity using simulation. Journal of Construction Engineering and Management, 137(3), 238-246; Roaf, S., Crichton, D., & Nicol, F. (2009). Adapting buildings and cities for climate change: a 21st century survival guide. London, UK: Routledge. [Jesse Keenan, United States of America]	Noted. Citations that are not since AR5 are not include. The Alshebani paper was reviewed but not included in the revised text.
1661	27	33	27	35	I would add the following citation for this second point. Bosher, L. (Ed.). (2008). Hazards and the built environment: attaining built-in resilience. New York: Routledge; Bosher, L., & Dainty, A. (2011). Disaster risk reduction and ‘built?in’resilience: towards overarching principles for construction practice. Disasters, 35(1), 1-18. [Jesse Keenan, United States of America]	Noted. References re not since AR5.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7102	27	35		36	on "fourth", demands for building repair will change not only due to the increase of extreme weather events, but also due to consistent changes in the long-term. In particular, the increased precipitations in Scandinavia will systematically cause mold problems in attics (VM Nik, AS Kalagasidis, E Kjellström,Assessment of hygrothermal performance and mould growth risk in ventilated attics in respect to possible climate changes in Sweden, Building and environment 55, 96-109) and facades (VM Nik, SO Mundt-Petersen, AS Kalagasidis, P De Wilde,Future moisture loads for building facades in Sweden: Climate change and wind-driven rain, Building and Environment 93, 362-375) with potential effects in health. [Érika Mata, Sweden]	Taken into account in revised text.
1662	27	35	27	35	Please see the following citation for potentional inclusion. Sailor, D. J. (2014). Risks of summertime extreme thermal conditions in buildings as a result of climate change and exacerbation of urban heat islands. Building and Environment, 78, 81-88 (extreme heat causes building systems to fail); Nikolowski, J., Goldberg, V., Zimm, J., & Naumann, T. (2013). Analysing the vulnerability of buildings to climate change: Summer heat and flooding. Meteorologische Zeitschrift, 22(2), 145-153; Golz, S., Schinke, R., & Naumann, T. (2015). Assessing the effects of flood resilience technologies on building scale. Urban Water Journal, 12(1), 30-43; [Jesse Keenan, United States of America]	Taken into account in revised text.
1663	27	36	27	37	Please see the following citation for potentional inclusion. Keenan, J.M. (2014). Material and Social Construction: A Framework for the Adaptation of Buildings. Enquiry: Journal of Architectural Research, 11(1), 18-32. doi: 10.17831/enq:arcc.v11i1.271. [Jesse Keenan, United States of America]	Taken into account in revised text. That particular reference is not included.
15413	27	38	27	38	The reviewer proposes the insertion of this paragraph. "Several consequences emanate from these impacts in the construction and housing sector. The use of thermal insulation technologies with adaptation potential 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. " Alternatively (or simultaneously) the same paragraph could be inserted in Chapter 5, page 18, line 38, in a more condensed version (commensurate with the level of detail in 5.4.1.1). This possibility has been proposed for chapter 5. [Francisco Javier Hurtado Albir, Germany]	Editorial.
1664	27	39	27	40	Given the focus on critical economies and infrastruture assets, the following citation would be useful. National Institute of Standards and Technology (NIST). Community Resilience Planning Guide for Buildings and Infrastructure Systems. Washington, DC: U.S. Department of Commerce. doi:10.6028/NIST.SP.1190v1 [Jesse Keenan, United States of America]	Noted. Grey literature and country specific.
5748	27	39	27	47	As contribution of the UN-HABITAT, the author may add here a sentence like: "Setting very long-term targets for deep cuts in emissions, if taken seriously, can actually lead to accelerated climate action in cities already in the shorter term" (http://www.climate2020.org.uk/creating-low-carbon-cities/). "UN-Habitat led an effort to develop "Guiding Principles for City Climate Action Planning", launched at COP-21 with the endorsements of 45 partners, starting from Principle No. 1 ("be ambitious")". Another relevant publication is UN-Habitat, 2014, "Addressing Climate Change in National Urban Policy". [Valentino Piana, Italy]	Taken into account in section on "enabling environment"
1665	27	44	27	47	Specific to housing, I would include a brief reference to the role of insurance relative to the accumulation and provision of housing in a post-disaster context. See, Lamond, J., & Penning-Rowsell, E. (2014). The robustness of flood insurance regimes given changing risk resulting from climate change. Climate Risk Management, 2, 1-10. doi: 10.1016/j.crm.2014.03.001 [Jesse Keenan, United States of America]	Accepted and text revised.
15414	27	48	27	48	Under "urban built environment" it would be interesting to introduce a reference to the use of local available building materials , of vegetal origin (e.g. thatching or straw), of animal origin (e.g. wool or feathers), stone or recycled materials (e.g. used tires). 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. Paper will be reviewed for consideration in revised text with regards to its relevance to 1.5C pathways.
9280	27	50			Cite: Marcotullio et al., 2018 (In Press) [Cynthia Rosenzweig, United States of America]	Noted subject to review of text when it is out.
6798	27	50		55	What about zero-energy or even energy-producing buildings? [Arnulf Jaeger-Waldau, Italy]	Taken into account in revised text.
20322	27	50	27	50	One could mention in this section local energy supply opportunities in cities as means to increase their resilience, e.g. waste-to-energy, industrial or commercial excess heat for district heating or cooling, rooftop PV or renewables in peri-urban areas. [Marine Gorner, France]	Accepted. Text to be revised.
4895	27	50	27	55	When discussing resilient urban energy systems, two key topics should be added: 1) decentralized urban energy schemes, and 2) community-based (renewable) energy schemes. [Sigrid Kusch, Germany]	Taken into account in revised text.
7337	27	51	27	53	Delete the text "The heavy dependence of the urban economy, infrastructure, services and residents on electricity and fossil fuels means far-reaching consequences, if supplies are unreliable or disrupted, as has been demonstrated in extreme events (UNISDR 2011; IPCC 2012)." [Eleni Kaditi, Austria]	Rejected on the basis of the cited literature. But this section has been revised in ways that don't detract from this message.
7912	27	51	27	55	The section could mention distributed renewables as critical for cities. They have mitgation and adaptation benefits and also can help with issues of access (SDG #7). See Westphal et al. 2017. Powering Cities in the Global South: How Energy Access for All Benefits the Economy and the Environment. World Resources Institute [Westphal Michael, United States of America]	Accepted - text revised to include discussion of distributed renewables.
15415	27	55	27	55	District solutions (district heating, local energy networks) should be mentioned here, since they contribute to resilient and autonomous energy supply in cities [Francisco Javier Hurtado Albir, Germany]	Taken into account in the revised section that refers to multi-level governance.
1666	27	55	27	55	Specific to urban energy resilience, I would review the following citations: Sharifi, A., & Yamagata, Y. (2016). Principles and criteria for assessing urban energy resilience: A literature review. Renewable and Sustainable Energy Reviews, 60, 1654-1677. doi: 10.1016/j.rser.2016.03.028; Hodbod, J., & Adger, W. N. (2014). Integrating social-ecological dynamics and resilience into energy systems research. Energy Research & Social Science, 1, 226-231. doi: 10.1016/j.erss.2014.03.001; Roege, P. E., Collier, Z. A., Mancillas, J., McDonagh, J. A., & Linkov, I. (2014). Metrics for energy resilience. Energy Policy, 72, 249-256. doi: 10.1016/j.enpol.2014.04.012 [Jesse Keenan, United States of America]	Noted. Referenced reviewed but not included in substantially revised text.
10929	27	55			Positive-Energy zero-emissions buildings in cities can be self-sustaining their own energy and lower their energy demand to the grid massively in winter time and have a positive reliability impact on the electricity grid. Some cities in Canada are making it mandatory that new buildings are net yearly energy positive (ref to be found). Through such stringent building regulations, corresponding to current technical state, cities can become mostly self-sustainable and resilient to long power outages. Such buildings require a good thermal insulation, high-efficiency equipment and solar PV systems on roofs and facades. Esthetic colored solar panels are now available and can be architecturaly well integrated into urban buildings, making them very resilient. [Beat Brunner, Switzerland]	Accepted. Reference to the importance of building design in the energy balance included in revised text.
17697	28	2	28	47	I recomment tho integrate information on electric mobility from comprehensive and up to date IEA literature (and related sources): see https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf and https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf. [Pierpaolo Cazzola, France]	Accepted in revised text. Thank you for useful reference.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9281	28	3			Add information from Mehrotra et al., 2018 (In press) [Cynthia Rosenzweig, United States of America]	Taken into account. Citation will be considered once out.
9341	28	3	28	11	The indicators of the European Climate Adaptation Platform and the adaptation indicators of Sustainable Energy and Climate Action Plans (SECAP) include "Length of transport network (e.g. road/rail) located in areas at risk (e.g. flood/drought/heat wave/ forest or land fire)" that may be represented in the related paragraph. Other sector oriented indicators as well as indicators of the European Climate Adaptation Platform may also be integrated into the text. [Siir KILKIS, Turkey]	Noted. The indicators will be reviewed as we compile our own MCE in revised text.
2372	28	3	28	3	Sustainable and Resilient Transport systems, in this instance and all other instances in this report surely it should be " Resilient and Sustainable….." , something can not be sustainable if it is not resilient. [David Viner, United Kingdom (of Great Britain and Northern Ireland)]	Editorial.
19409	28	3	28	36	This section says very little about why the urban design solutions which were recommended for reducing emissions from transport systems have not translated into a changed urban form. And how certain strategies or solutions contradict others. For example, greater efficiency and engine performance technologies may encourage longer travel times etc. [Sumetee Pahwa Gajjar, India]	Taken into account in section on behaviour change as "rebound effects" and perverse outcomes relates to a wider context than covered here.
20104	28	3	29	32	The section should be more clear on the role of biofuels in global landgrabbing processes, in the displacement of local and indigenous communities, on the associated human rights issues and detrimental impacts on biodiversity and ecosystem integrity of large-scale biomass plantations for biofuels. The organisation Biofuelwatch has published extensively and critically on these issues. Biofuelwatch.org.uk [Lili Fuhr, Germany]	Taken into account in the section on BECs and their implications for land and land markets. If you have peer reviewed literature please forward it.
7818	28	3	28	40	A major May 2017 publication by India's strategic planning agency NITI Aayog and Rocky Mountain Institute (India Leaps Ahead, http://niti.gov.in/writereaddata/files/document_publication/RMI_India_Report_web.pdf) was announced by NITI Aayog's CEO Amitabh Kant (reporting directly to Prime Minister Modi, who chairs the agency) as the policy of the Government of India. It lays out a highly progressive and substantive mobility/IT mashup with some remarkable institutional and technical innovations of global significance. Almost daily headlines announce the Indian private sector's ambitious plans to carry it out. It should be mentioned here. [Amory Lovins, United States of America]	Noted. Revised text does not pick particular countries - except in text boxes - but will consider the Indian citation.
7672	28	3	28	40	A major May 2017 publication by India's strategic planning agency NITI Aayog and Rocky Mountain Institute (India Leaps Ahead, http://niti.gov.in/writereaddata/files/document_publication/RMI_India_Report_web.pdf) was announced by NITI Aayog's CEO Amitabh Kant (reporting directly to Prime Minister Modi, who chairs the agency) as the policy of the Government of India. It lays out a highly progressive and substantive mobility/IT mashup with some remarkable institutional and technical innovations of global significance. Almost daily headlines announce the Indian private sector's ambitious plans to carry it out. It should be mentioned here. [Amory Lovins, United States of America]	Noted. Revised text does not pick particular countries - except in text boxes - but will consider the Indian citation.
10868	28	3	29	32	A major gap in this section appears to be the possibility of disruption and transformation due to technological change. Currently, a backward-looking perspective dominates. For this to be useful, a backcasting (goal/vision and implementation) perspective to planning must dominate the predict-and-provide fallacy. In particular, I am thinking about the disruption by driverless cars as an example. They could reverse "peak car", could radically exacerbate sprawl, and reverse the reversal in street network sprawl documented by Barrington-Leigh and Millard Ball, PNAS 2015, and will certainly make congestion charging and parking charges mandatory. That is, they represent a huge change in incentives. How to deal with this in SR15? The same way every city already is: make clear that mitigation requires talking about it, imagine what life will be like with 30% of urban space freed up from parking, imagine what new restrictions will need to be in place to keep emissions-intensive behaviours down, etc. In general, please look forward as much as possible, giving a sense that boldness and creativity and imagination and future-thinking and experimentation will be needed, not 20-year-old applications. Driverless cars are mentioned much later, in 4.4.6.2, as though they are a speculative possibility. This is not in line with decisions planners are faced with in reality today. It seems policy must be much more proactive to reduce the "rebound effects" mentioned there (suggestively, reactively?). [Barrington-Leigh Christopher, Canada]	Taken into account in revised text. Note the need to reflect realities from developed and developing country cities - and the continued rapid rise in (diesel) car ownership in developing countries, with only isolated leap-frogging.
1667	28	3	29	32	This section is almost entirely focused on sustainability. I do not see any meaningful reference to urban transporation resilience. As such, please see the following citations. Turnbull, K. F. (2016). Transportation Resilience: Adaptation to Climate Change and Extreme Weather Events. Summary of the Fourth EU–US Transportation Research Symposium. In Transportation Research Board Conference Proceedings (No. 53). Washington, DC: National Academies of Sciences, Engineering and Medicine; Vugrin, E. D., Turnquist, M. A., & Brown, N. J. (2014). Optimal recovery sequencing for enhanced resilience and service restoration in transportation networks. International Journal of Critical Infrastructures, 10(3-4), 218-246; Faturechi, R., & Miller-Hooks, E. (2014). Measuring the performance of transportation infrastructure systems in disasters: A comprehensive review. Journal of infrastructure systems, 21(1), 04014025. doi: 10.1061/(ASCE)IS.1943-555X.0000212; Reggiani, A., Nijkamp, P., & Lanzi, D. (2015). Transport resilience and vulnerability: the role of connectivity. Transportation Research Part A: Policy and Practice, 81, 4-15. doi: 10.1016/j.tra.2014.12.012. [Jesse Keenan, United States of America]	Taken into account in substantially revised text.
7913	28	4	28	38	The section does not reference recent work (BNEF) that shows the EV's being competitive with ICE's in most regions in the 2020s, nor does it mention all the new political commitments for phasing out ICEs. In addition, the possible impacts of AV's on congestion and emissions should be mentioned. [Westphal Michael, United States of America]	Accepted. Future commitments now mentioned.
2791	28	4	29	29	Two technologies that have evolved significantly since AR5 are electric vehicles (the draft mentions batteries) and atonomous driving. Sales clearly demonstrate that plug-in electric and hybrid dominate all other alternative power systems. Atonomous driving may complement that trend. Such vehicles might lead to a reduction in the size of the vehicle fleet although total vehicle kms might rise (positioning to provide fast response times for riders). Operating costs will be very important given the large distance travelled annually by such vehicles; low operating costs favours electric vehicles. The increase in total fleet vehicle kms will not matter if virtually all electricity id from non-emitting sources. [Erik Haites, Canada]	Taken into account in revised text.
11156	28	4	29	32	In the section on transport the main focus is on electrification. Any reference to modal changes is extremely convoluted and cycling is left unmentioned. [Michiel Schaeffer, Netherlands]	Accepted. Modal shifts covered in revised text.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10866	28	18	28	19	This analysis is too short-term [see general comment above]. Barrington-Leigh and Millard-Ball have argued that for long term climate policy, the road networks laid down during initial construction of new residential developments are immutable and affect emissions, somewhat irreversibly, for centuries. Therefore drastic/urgent policy action may be needed in such areas where the payoff is gradual, but the opportunity only exists in the short-term (during the current, final phase of the one-time process of urbanization). Modal shift in the future may be highly constrained by whether the road network is adaptable (high-connectivity), like a grid is. Road networks are nearly impossible to change, so there is extra urgency to ensure new ones are laid down in a way which allows future densification, introduction of public transit, resource sharing, introduction of mixed use, etc, etc, even if those things are not initially present. See Barrington-Leigh, C. P. and Adam Millard-Ball, “A Century of Sprawl in the United States,” Proceedings of the National Academy of Sciences, doi:10.1073/pnas.1504033112, 15 June 2015; and Barrington-Leigh, C. P. and Adam Millard-Ball, “More connected urban roads reduce US GHG Emissions,” Environmental Research Letters, doi:10.1088/1748-9326/aa59ba, Vol. 12, No. 4, 2017 [Barrington-Leigh Christopher, Canada]	Accepted. Revised text to combine vehicle technology with modal shifts and urban/ road network form.
14334	28	19	28	20	Furthermore, an assessment as to what are the most cost-effective and highest potential options to reduce GHG emissions will be noteworthy with an emphasis on life-cycle analysis and potential trade-offs. [Yana POPKOSTOVA, France]	Taken into account in section on "feasibility"
4187	28	21		26	In order for public transit to be efficient, it must be readily available, accessible to all persons (including those with mobility issues) and more cost and time efficient than taking vehicles if there is to be success in encouraging mass populations to take public transit over vehicles as is the case in Canada. Additionally, the harsh winter climates places added challenges on mass transit adoption. Warming shelters etc. may need to be considered to protect people and encourage year-round adoption of public transit. [Michelle Leslie, Canada]	Taken into account in revised text.
10867	28	21	28	21	This “Shi and Yang 2015” reference must be the incorrect reference. There is no evidence on CO2 emissions in the cited publication. [Barrington-Leigh Christopher, Canada]	Rejected. The reference is about adaptation.
1380	28	21	28	26	Basing a paragraph on a single citation does not seem to bulld a strong text, instead I would suggest elaborating in a topic-wise mode paragraph by paragraph. [Roger Cremades, Germany]	Accepted. Text has been thoroughly revised.
7526	28	28	28	28	Consider mentioning in which parts of the world this has been a trend. [Øyvind Christophersen, Norway]	Taken into account in revised text that delineates developed and developing.
7527	28	28	28	36	Are trains the most important trend? Otherwise consider starting with describing the trends for passenger vehicles and buses. [Øyvind Christophersen, Norway]	Accepted and text revised.
20632	28	28	29	32	Electric cars are not the only option and continuing to cause CO2 emissions when coal and oil are used for power generation. Windgas (methane) driven cars use established combustion technology and have the potential to compete with electric cars. [Hans Poertner, Germany]	Accepted and text revised.
1381	28	30	28	32	I would suggest to put a number on the current share of global electric rail and mention the main challenges ahead for it to spread. [Roger Cremades, Germany]	Accepted and text revised based on IEA 2017.
7338	28	31	28	32	Delete the text "with significant co-benefits for the oil importing nations". [Eleni Kaditi, Austria]	Rejected. Revised text to cite literature suggesting these co-benefits are significant.
17698	28	34	28	36	Tthere is way more comprehensive information on fuel economy developments, and way borader global coverage, in this IEA/GFEI paper: https://www.globalfueleconomy.org/media/418761/wp15-ldv-comparison.pdf [Pierpaolo Cazzola, France]	Taken into account, and will consider citation if approved as grey literature in this section and in Section 4.4.1 "Enabling Environment".
9692	28	34	28	47	Not only electrification of powertrain but also lightwieghting of vehicle body structure have lots of potential to reduce GHG emission (Kim et al. 2010). High strength steel, aluminum are currently competitive and complementary material. However, GHGs savings for aluminum lightweighting varies strongly with location where the aluminum is produced and whether secondary aluminum can be utilized (Kim at al. 2010). [Hyung Ju Kim, Republic of Korea]	Taken into account as a general point in revised text, but with literature since AR5.
17699	28	34	29	32	These themes have been widely covered in the transport sections of the two following IEA report (featuringextensive policy recommendations): https://www.iea.org/etp2017 and https://www.iea.org/etp2016. [Pierpaolo Cazzola, France]	Taken into account, and citation included in this section and in Section 4.4.1 "Enabling Environment".
14335	28	35	28	36	The trade-offs have not been examined. The rapid growth of electricity vehicles creates a new mineral and raw resources use mainly for the batteries and could induce new dependencies, exploitation dynamics and at times high(er) GHG emissions at the extraction centers. Social justice issues need to be better examined. As well as indirect impacts of the EV trend. [Yana POPKOSTOVA, France]	Accepted and taken into account in 4.4.1 "Enabling Environment".
7528	28	39	28	39	Is PUV a common abbreviation? [Øyvind Christophersen, Norway]	Editorial
18409	28	39	28	39	Carlin, Rader and Rucks, 2015 not linked to Mendeley [Wilfran Moufouma Okia, France]	Editorial
2371	28	39	28	40	Growth in Plug-in Electric Vehicles (PUV's) anre not more commonly referred to as PEVs, see literature, manufacturers websites, motoring press etc. [David Viner, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
10930	28	44			Renewable energy electricity is sure best, but even with 70 % fossil-fuels generated electricity, electric cars have a better carbon footprint, specially if their production is made with renewable energy. But since cars CO2 emissions calculations only display tank-to-wheels emissions, for a fair CO2-comparison, fossil cars should also display CO2 emissions and electricity use from well-to-tank. Since new fossil extractions have a much worse energy extracted / energy to extract ratio (typically 5:1 and down to 2:1, compared to first wells that had 100:1 ratios (Albert A. Bartlet 2012 and others). This means 20-50 % additional CO2 emissions due to the well. Refining oil consumes 6 kWh electricity per barel (source US DOE 2009) or 1.5 kWh per liter, not counting fossil-fueled thermal needs. If that electricity is fossil-fuels-generated like in most cases for refineries with a 33 % thermal cycle efficiency, we get another 30 % increase in CO2 emissions just for refining. Account pumping through pipelines, shipping and distribution with another 20 %, and we have to add 70-100 % CO2 emissions to fossil-cars. Add securing oil (including all oil-related wars), and real-world use that is 50 % higher than marked values, and the fossil-cars emit well-to-wheels around 250-350 % of the CO2 that they are marked. Additionally, while fossil-fuels well-to-tank energy consumption and related CO2 emissions are steadily increasing, the CO2 of the electricity grid is steadily decreasing. So comparisons should be made over the useful lifetimes of vehicles. [Beat Brunner, Switzerland]	Noted. This text has been revised.
10931	28	44			Interestingly, to extract, pump and refine a liter of car gas (or diesel), 1.5 kWh is used to refine (US DOE 2009) and around 0.5 kWh electricity is needed to extract, pump and distribute, for a total of 2 kWh electricity per liter. An average car in real-world mixed trafic uses 7.5 liters gas per 100 km. This represents 75 kWh for 100 km, in line with the average efficiency of ICE fossil-fuel car engines. But these 7.5 liters each needed 2 kWh electricity, representing 15 kWh electricity to create the gas to travel 100 km. Now if you take an average electric car, it will be using on average also 15 kWh electricity to travel same 100 km. But it will use no gas. And won’t pollute, nor emit CO2 or noise. Thus : 1. Electrifying transport won’t use more electricity globally. 2. Taking in account the above, the move to electric vehicles is reducing CO2 even with coal-powered electric plants. [Beat Brunner, Switzerland]	Taken into account in general rewrite of the section. Difficult to include these facts without a literature reference.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7821	28	44	28	44	It would be more accurate to say “especially if non-fossil…”, since the US literature using Argonne National Lab’s GREET model shows that EVs’ higher efficiency (compared to gasoline autos) generally makes them carbon-reducing if recharged from grid power (which is itself rapidly decarbonizing), and often even if recharged with coal power. Of course, recharging with renewable electricity is far preferable, and now generally cheaper. [Amory Lovins, United States of America]	Accepted. Text has been substantially revised.
7914	28	44	28	44	Mitigation potential of EV's. This really dependent on how carbon-intensive is the electricity supply. See Kennedy, C. 2015. "Key Threshold for Electricity Emissions." Nature Climate Change 5(3): 179–81 [Westphal Michael, United States of America]	Accepted. Citation included with note that efficiency usually more carbon efficient than oil and easier to improve.
7675	28	44	28	44	It would be more accurate to say “especially if non-fossil…”, since the US literature using Argonne National Lab’s GREET model shows that EVs’ higher efficiency (compared to gasoline autos) generally makes them carbon-reducing if recharged from grid power (which is itself rapidly decarbonizing), and often even if recharged with coal power. Of course, recharging with renewable electricity is far preferable, and now generally cheaper. [Amory Lovins, United States of America]	Accepted. Text has been substantially revised.
10932	28	49			When taking in account the complete energy and CO2 of biofuels lifecycle, they compare very badly with battery-electric vehicles, and are justified only for extra-long routes without fast recharging possibilities. Thus developing an ultra-fast charging network is very important, and political action is needed to facilitate such buildups. [Beat Brunner, Switzerland]	Noted.
14084	28	49	28	49	What is meant with “geographies” in this context? [Elvira Poloczanska, Germany]	Editorial.
14085	28	49	28	50	Specify the reason for this particular case in Sao Paulo, is it an example? [Elvira Poloczanska, Germany]	Accepted. This case study requires greater explanation in the context of Brazil's leading biofuel programme. Text has been revised. Sao Paulo is no longer used.
7529	28	49	28	52	This is a assertion that appears anecdotal to the reader, since only one study from one city is mentioned, without describing the limitations of the study. [Øyvind Christophersen, Norway]	Accepted Text has been revised.
561	28	49	28	49	Biofuels may emerge as a viable mitigation option in some geographies… Biofuels are in no way a carbon mitigation option, and they enhance air pollution even compared with gasoline or diesel in many cases (Jacobson, M.Z., Effects of ethanol (E85) versus gasoline vehicles on cancer and mortality in the United States, Environ. Sci. Technol., 41 (11), 4150-4157, doi:10.1021/es062085v, 2007; 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; Ginnebaugh, D.L., J. Liang, and M.Z. Jacobson, Examining the temperature dependence of ethanol (E85) versus gasoline emissions on air pollution with a largely-explicit chemical mechanism, Atmos. Environ., 44, 1192-1199, doi:10.1016/j.atmosenv.2009.12.024, 2010) [Mark Jacobson, United States of America]	Accepted. Text revised to reflect a broader span of literature.
21155	28	49	29	2	I think that the sentence in line 54-2: “Fuel cells have been identified as..” is misleading. In fact the reference (Badwal et al. 2015) titled “Direct ethanol fuel cells for transport and stationary applications – A comprehensive review.” argued only about “direct ethanol fuel cells” (in coherence with the precedent sentence, line 49-52). Then I suggest or to modify line 54 specifying “direct ethanol fuel cells” or give also the reference to the IEA “Technology Roadmap: Hydrogen and Fuel Cells” (2015 IEA “Technology Roadmap: Hydrogen and Fuel Cells”, <http://www.iea.org/publications/freepublications/publication/TechnologyRoadmapHydrogenandFuelCells.pdf > and IEA, Körner A. “Technology Roadmap Hydrogen and Fuel Cells Technical Annex”, < https://www.iea.org/media/freepublications/technologyroadmaps/TechnologyRoadmapHydrogen_Annex.pdf >). [Mario Valentino Romeri, Italy]	Taken into account. Text revised drawing on peer reviewed literature.
7915	28	54	28	55	Re: fuel cells, the source of the hydrogen (e.g. natural gas) is important when considering mitigation impact. [Westphal Michael, United States of America]	Taken into account in revised text that refers to importance of feedstock choices. This section now has a specific "urban" focus. Industry is dealt with elsewhere.
10933	28	54			Fuel-cells vehicles have a very poor efficiency when considering the complete system (electricity mix-to-hydrogen-transported-distributed-to-electricity-to-wheels) besides of a very long hydrogen-station refueling time. They also don’t allow the democratization of the renewable energy like battery-electric cars, where people-owned solar pannels can recharge the car. Often it is forgotten that electric car owners are environmentally-sensible and often also own solar PV pannels to recharge their cars, which is globally very positive to energy transition. Thus fuel-cell hydrogen cars are imho not a viable option and a loss of investments. [Beat Brunner, Switzerland]	Taken into account, but need peer reviewed literature on the behavioural aspects of EV owners to include that point. Chapter does include a separate section (4.4.3) on behavioural aspects of change.
757	28	54	29	2	Not sure what this paragraph is trying to say. Badwal et.al, discuss 'Direct ethanol fuel cells' and talk about the problems of scaling up ethanol fuel cells. They also state in their abstract that "…The major deterrents to the commercialisation of fuel cell technologies, especially for the transport sector, are the hydrogen storage and almost non-existence of hydrogen transportation and distribution infrastructure. The utilisation of bio-fuels such as methanol and ethanol instead of hydrogen as a fuel in fuel cells..." their mention of hydrogen was to give weight to ethanol fuel cells. This paragraph is a misquote and does not explain that it is talking about ethanol and not hydrogen fuel cells, which can be up-scaled. Please note from their conclusion about direct ethanol fuel cells "Overall, the technology is still at an early stage of development. Due to issues discussed above with commercialisation still further away. Thus far there have been very few systems demonstrated at prototype level based on PEM based fuel cells either directly fed with ethanol solutions (DEFC) or with hydrogen obtained by ethanol reforming with sizes varying from few watts to kW range." [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text revised so that Badwell quote is no longer used.
19321	28	55	29	1	The argument that the hydrogen infrastructure is lacking appears to me to be too trivial. It's obvious that in the long run, the infrastructure can be changed, and this should be emphasized. The real issue is how to incentivize the change of a distributed infrastructure such as the one that serves personal mobility. I would like to see this comment somewhere in this chapter. [Marco Mazzotti, Switzerland]	Taken into account in revised text.
7199	29	2			A recent scenario study by Oldenbroek et al. shows that solar, wind combined with hydrogen vehicles can provide power, heat and mobility for society, in a cost effective energetically feasible mode (Oldenbroek et al., 2017), Vincent Oldenbroek, Leendert A. Verhoef, Ad J.M. van Wijk, Fuel cell electric vehicle as a power plant: fully renewable integrated transport and energy system design and analysis for smart city areas, International Journal of Hydrogen Energy 42, Jan 2017, 8166-8196 [Leendert Verhoef, Netherlands]	Accepted. A useful citation that has been incorporated in the revised text.
15416	29	2	29	2	Another issue is the origin of the hydrogen used in the fuel cells. 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]	Taken into account in revised text. Citations have not been used, as renewable hydrogen is dealt with elsewhere, but with the new focus on "urban" in this section the high-level points about urban design and feedstocks and storage has been included.
937	29	3	29	10	I wonder if more information about how decarbonizing the transport sector requires the coordination of fueling stations and infrastructure for the new chosen fuel, which are difficult to convert. [Elizabeth Aldrich, United States of America]	Taken into account in revised text.
7916	29	3	29	4	No mention of carbon pricing as an important policy measure [Westphal Michael, United States of America]	Taken into account in section 4.4.1.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9122	29	10	29	19	Mittal et al. (2017) show how much emissions from transport can be reduced by changing behavior and found that reduction potential can be increased to 42% by combining behavioral and technology related mitigation options like mass-transit system speed improvement, transit oriented development, efficiency improvement, preference towards eco-friendly technologies and high vehicle occupancy. S Mittal, H Dai, S Fujimori, T Hanaoka, R Zhang (2017): Key factors influencing the global passenger transport dynamics using the AIM/transport model. Transportation Research Part D Transport and Environment, Volume 55, 373-388. http://dx.doi.org/10.1016/j.trd.2016.10.006 [Shinichiro Fujimori, Japan]	Taken into account in section on behaviour change and in this section.
19410	29	12	29	15	Paragraph appears out of place, or not woven in well with the larger narrative [Sumetee Pahwa Gajjar, India]	Taken into account in revised text.
14086	29	13	29	13	The framework seems isolated here. Be more explicit about what these four strategies imply. [Elvira Poloczanska, Germany]	Taken into account in revised text.
9342	29	14	29	14	The statement "Cities that have developed adaptation plans usually include attention to more resilient transport systems" may also be supported by the SECAP adaptation indicator on ""Length of transport network (e.g. road/rail) located in areas at risk (e.g. flood/drought/heat wave/ forest or land fire)" as noted in Comment 47 above. In this way, reference to SECAP guidelines may be included in addition to the existing reference on (UN-HABITAT, 2011). [Siir KILKIS, Turkey]	Noted, but not subsequent to AR5 nor peer reviewed literature.
955	29	17	29	29	I found that this section on 'peak car' has overstated the empirical findings on this topic. This is especially the case, when a claim that "global data on these trends are now apparent" is based on a citation that is from a source that has not been peer-reviewed. Recent studies have looked at the 'peak car' issue and have found that changes in GDP and fuel prices are important in explaining why certain countries (such as the US, France, the UK, Australia and Germany) have had a temporary plateau in car travel. My concern is based on whether there is enough data and peer-reviewed publications that find that there has been a peak, rather than a plateau. The slow down in the Global economy is one of the issues here and finding that a peak has occured is likely to only become a consensus with a long period of observation (possibly decades). While I would like the concept to be true (and do not own a car myself), I am drawn towards the research that finds that the slowdown in GDP and increases in fuel prices have created a plateau. Here is a list of the papers I refer to: 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]	Accepted and additional citations reviewed for inclusion in revised text but not included in substantially revised sections. The point about peak car is now contextualised with a counter point fro developing countries.
14129	29	18	29	18	An sentence defining peak car would be useful or a definition in box 4.10 and citing the box [Elvira Poloczanska, Germany]	Editorial
19411	29	18	29	18	How does the concept of peak car apply to cities which are still becoming, and not reached pollution or congestion levels that have been experienced in cities which adopted or experienced modal shifts, resulting in peak car? [Sumetee Pahwa Gajjar, India]	Taken into account in revised text to denote differences between developed and developing country cities.
7822	29	19	29	19	Peak car is now reaching the United States, as noted in a Rocky Mountain Institute 2017 study at https://rmi.org/insights/reports/peak-car-ownership-report/. [Amory Lovins, United States of America]	Noted.
7676	29	19	29	19	Peak car is now reaching the United States, as noted in a Rocky Mountain Institute 2017 study at https://rmi.org/insights/reports/peak-car-ownership-report/. [Amory Lovins, United States of America]	Noted.
18410	29	20	29	20	Move "Schipper" into grey shaded Mendeley field with "(2011)" [Wilfran Moufouma Okia, France]	Editorial
1382	29	20	29	22	Is the difference between "Geels and Schot (2010) explain the trend as a socio-technical innovation" and "Newman et al (2017) as a disruptive innovation" relevant in the context of this review? does it add value? would not be better to just describe it as an "innovation"? [Roger Cremades, Germany]	Accepted and revised in new text to highlight the importance of innovation, not the difference between the two. The respective of change do hold policy implications and are dealt with elsewhere.
18411	29	21	29	21	Newman et al (2017) not linked to Mendeley [Wilfran Moufouma Okia, France]	Editorial
11064	29	29	31	32	Given that the role of freight transport in GHG emissions is as important as of passenger transport, the discussion of freight transport is rather limited here. There are other important fuelling options like electricity-based synthetic fuels and electrification of ODVs via trolley trucks (already tested in the US and Europe). Even more, limiting transport distance and modal shifts are important aspects to be mentioned here. [Jakob Wachsmuth, Germany]	Taken into account. Industry and transport are now separate sections as this section tries to focus on "urban" in the revised structure. Text to be reviewed after looking for literature on freight transport.
17700	29	31	29	32	This is extremely light. There is an extensive analysis of the status of road freight transport and the opportunities available the ambition of the Paris Agreement (plus other goals aligned with the SDGs). See https://www.iea.org/publications/freepublications/publication/TheFutureofTrucksImplicationsforEnergyandtheEnvironment.pdf. [Pierpaolo Cazzola, France]	Accepted. Text revised.
7530	29	31	29	32	Please consider referring to the mitigation options for aviation and freight described in 4.3.2.4 - International transport options [Øyvind Christophersen, Norway]	Accepted. Text revised to update AR5.
20105	29	31	29	32	As regards global levels of freight and air travel, the IPCC should not only consider decarbonisation, which is problematic if done via biofuels as pointed out in the comment above, but also explore literature on possibilities of reducing absolute numbers, drawing on literature on restructuring international trade and commerce relations. [Lili Fuhr, Germany]	Taken into account in section 4.4.5 on behaviour change.
19412	29	31	29	32	What percentage of emissions are associated with the air transport sector, and what does that mean for the continuing trend of decarbonising - is there repetition in the content? [Sumetee Pahwa Gajjar, India]	Editorial.
758	29	31	29	32	Why is hydrogen not mentioned here as a decarbonisation fuel? A Google Scholar search on "hydrogen + aviation" indicates that it has been in the literature since at least 1990 [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Text will be revised if literature subsequent to AR5 can be sourced.
7823	29	31	29	32	My foregoing comments on section 4.3.4 show how inadequate this summary is if it refers to efficiency and fueling improvements rather than to current operating patterns. If instead it’s meant to refer to growth of service demand, that should be clarified, but then the second half of the sentence doesn’t fit the first half. My comments above about the severalfold gain underway and available in heavy-truck efficiency, and even more in airplane efficiency, don’t even count freight logistics. A 2016 Shenzhen seminar found that the fraction of Chinese truck-km run empty is about twice the OECD norm (http://www.rmi-china.com/static/upfile/news/nfiles/Freight_Charrette_Report_English.pdf), and the Chinese authorities are moving aggressively to close or reverse that gap through a software platform akin to “Uber for freight”. [Amory Lovins, United States of America]	Accepted. Text revised to place greater emphasis on transport systems.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
957	29	31	29	32	There is a limited discussion of future trends in freight. A recent special issue has focused on long-term transport scenarios that include freight transport. Here are the relevant papers: Detlef P. van Vuuren, Oreane Y. Edelenbosch, David L. McCollum, Keywan Riahi, A special issue on model-based long-term transport scenarios: Model comparison and new methodological developments to improve energy and climate policy analysis, Transportation Research Part D: Transport and Environment, Volume 55, 2017, Pages 277-280; O.Y. Edelenbosch, D.P. van Vuuren, C. Bertram, S. Carrara, J. Emmerling, H. Daly, A. Kitous, D.L. McCollum, N. Saadi Failali, Transport fuel demand responses to fuel price and income projections: Comparison of integrated assessment models, Transportation Research Part D: Transport and Environment, Volume 55, 2017, Pages 310-321; S. Carrara, T. Longden, Freight futures: The potential impact of road freight on climate policy, Transportation Research Part D: Transport and Environment, Volume 55, 2017, Pages 359-372. [Thomas Longden, Australia]	Accepted. Text revised to update AR5.
7677	29	31	29	32	My foregoing comments on section 4.3.4 show how inadequate this summary is if it refers to efficiency and fueling improvements rather than to current operating patterns. If instead it's meant to refer to growth of service demand, that should be clarified, but then the second half of the sentence doesn't fit the first half. My comments above about the severalfold gain underway and available in heavy-truck efficiency, and even more in airplane efficiency, don't even count freight logistics. A 2016 Shenzhen seminar found that the fraction of Chinese truck-km run empty is about twice the OECD norm (http://www.rmi-china.com/static/upfile/news/nfiles/Freight_Charrette_Report_English.pdf), and the Chinese authorities are moving aggressively to close or reverse that gap through a software platform akin to "Uber for freight". [Amory Lovins, United States of America]	Accepted. Text revised to place greater emphasis on transport systems.
14087	29	32	29	32	In section 4.3.2.4 the statement regarding the potential of alternative fuels for air travel is rather pessimistic, but it is not addressed here. The message should be coherent across this chapter. [Elvira Poloczanska, Germany]	Accepted. Text will be revised if literature subsequent to AR5 can be sourced.
7198	29	32			A recent study by Verhoef et al. (2017) on the potential of additive manufacturing on the transport sector, shows that in the aerospace sector, energy savings of 5–25% can be made, depending on global co-operation and penetration of the technology, with the largest effect in the use phase because of weight reduction, thus suggesting energy policy makers to also focus on these and oterh disruptive technologies, as they may be very influential on CO2 emissions. Leendert Verhoef, Bart W. Budde, Cindhuja Chockalingam, Brais García Nodar, Ad van Wijk, 2017, The Effect of Additive Manufacturing on Global Energy Demand: An Assessment Using a Bottom-up Approach, Energy Policy, under review [Leendert Verhoef, Netherlands]	Noted. This section now focuses on urban and infrastructure and not manufacturing.
1571	29	33	29	33	Add "Short distance air travel can be replaced by high speed train networks." [Peter Van Velthoven, Netherlands]	Accepted.
6799	29	35		42	see comment in line 21; there is a competition between biomass feedstock for energy use and idustrial use. [Arnulf Jaeger-Waldau, Italy]	Accept. This is addressed in the feasibility assessment.
6205	29	35	29	52	This is seems a particularly short section fro something which is widely regarded as a particularly thorny question for decarbonisation - cement and steel in particular, both of which entail direct CO2 emissions as well as the energy-related emissions. Warrants a fuller discussion I thinik. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accept. See response to comment #3075.
3075	29	35	29	53	Industry section 4.3.4.3 is weak considering the scale of associated emissions, especially compared to the following much longer and fuller sections on CCUS, BECCS and DACS. I would state this explicitly. [Christopher Bataille, Canada]	Accept. A separate section (4.3.5) was created to review "industrial system transitions".
4894	29	35	29	53	The industrial transition should be covered in more detail and with more perspectives. As examples, internet of things, industry 4.0, are currently not even mentioned. [Sigrid Kusch, Germany]	Accept. A separate section (4.3.5) was created to review "industrial system transitions" to provide more detail. The general purpose technologies are discussed in section 4.4.4 in the SOD.
19322	29	35	29	53	I believe that this chapter shoudl be expanded. [Marco Mazzotti, Switzerland]	Accept. See response to comment #3075.
3618	29	35	30	1	Only 2 paragraphs on the changes required in industrial sector? Given the relative share of GHG contributions from industry this is a major gap. At very least the authors should point to need for further research here. [Stewart Fast, Canada]	Accept. A separate section (4.3.5) was created to review "industrial system transitions".
4893	29	35	29	53	The topic of circular economy, including recycling, should be covered in more detail. Circular economy and more widespread implemetation of renewable energy and green technologies are closely interlinked. As an example, Rare Earth Elements, and more generally Critical Raw Materials, are fundamental materials for many green technologies, including wind power plants, batteries for electric vehicles, and many more technologies. Their availability is a bottleneck to more widespread adoption of green technologies, and recycling is clearly required if the scenarios for technology changes are to be considered feasible. [Sigrid Kusch, Germany]	Taken into account, to the extent that literature related to 1.5C in this context is available, in section 4.4.1 and the new section 4.3.5. However, we are lacking the space (and the literature!) to make a more extensive assessment.
7824	29	36	29	42	This discussion of decarbonizing energy-intensive industry leaves out the three most important terms that should come first: advanced energy efficiency, alternative processes (e.g. for cement-making—order-of-magnitude energy reductions are available from process alternatives now entering the market), and materials efficiency (such as those that let New York's World Trade Center save two-fifths of its cement through better design using higher-quality materials). ERI (2017) found major knock-on benefits from such methods in China. But the first term, advanced energy efficiency, is more ubiquitous and immediate. Lovins (2017, 2018) show its importance, profitability, and expanding returns. I have led the design of such improvements in more than $40 billion worth of diverse industrial facilities, old and new, around the world, and have yet to find a place where they're not broadly applicable. Indeed, a line of work from Lovins & Lovins (1991) through Lovins (2005, 2007, 2010) and Lovins & RMI (2011) to Lovins (2017) shows that standard assessments, including prior ones by IPCC, completely omit the fluid-handling opportunity (from making pipes and ducts fat, short and straight rather than thin, long, and crooked) that could save about 1/5 of the world's electricity with extremely short paybacks. Even the world's most efficient heavy-industrial firms, such as Dow, don't yet do this, and as far as I know, it is in no official study, industry forecast, or engineering textbook—simply because it's not a technology but a design method (and a lost Victorian one at that). It would be a great lost opportunity if this study, tackling the most urgent questions of climate protection, continued to look modern energy efficiency and tacitly to suppose that past analyses have settled its modest potential and rising cost—neither of which is empirically demonstrable (Lovins 2017). It is also important to note that as in buildings (Bendewald et al. 2014, 2015, Muldavin 2010), industrial efficiency virtually always has important positive externalities to the owner/operator (IEA 2010, Worrell et al 2003). [Amory Lovins, United States of America]	Accepted. Revised text in new section contains greater emphasis on energy efficiency.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7678	29	36	29	42	This discussion of decarbonizing energy-intensive industry leaves out the three most important terms that should come first: advanced energy efficiency, alternative processes (e.g. for cement-making—order-of-magnitude energy reductions are available from process alternatives now entering the market), and materials efficiency (such as those that let New York's World Trade Center save two-fifths of its cement through better design using higher-quality materials). ERI (2017) found major knock-on benefits from such methods in China. But the first term, advanced energy efficiency, is more ubiquitous and immediate. Lovins (2017, 2018) show its importance, profitability, and expanding returns. I have led the design of such improvements in more than $40 billion worth of diverse industrial facilities, old and new, around the world, and have yet to find a place where they're not broadly applicable. Indeed, a line of work from Lovins & Lovins (1991) through Lovins (2005, 2007, 2010) and Lovins & RMI (2011) to Lovins (2017) shows that standard assessments, including prior ones by IPCC, completely omit the fluid-handling opportunity (from making pipes and ducts fat, short and straight rather than thin, long, and crooked) that could save about 1/5 of the world's electricity with extremely short paybacks. Even the world's most efficient heavy-industrial firms, such as Dow, don't yet do this, and as far as I know, it is in no official study, industry forecast, or engineering textbook—simply because it's not a technology but a design method (and a lost Victorian one at that). It would be a great lost opportunity if this study, tackling the most urgent questions of climate protection, continued to look modern energy efficiency and tacitly to suppose that past analyses have settled its modest potential and rising cost—neither of which is empirically demonstrable (Lovins 2017). It is also important to note that as in buildings (Bendewald et al. 2014, 2015, Muldavin 2010), industrial efficiency virtually always has important positive externalities to the owner/operator (IEA 2010, Worrell et al 2003). [Amory Lovins, United States of America]	Accepted. Revised text in new section contains greater emphasis on energy efficiency.
7339	29	41	29	41	Delete the text "and the development of a circular economy industry". [Eleni Kaditi, Austria]	Rejected. The circular economy is an important feature in the literature on low carbon transformations. The text has, however, been revised to be clearer.
10934	29	42			In developed countries, industry often accounts for a third of energy use and as much CO2 emissions. So, additionally, energy-intensive industrial processes can usually be massively improved. Such improvements include : 1. Better enery efficiency by better thermal insulations of buildings and machinery 2. Reuse of waste heat with heat-exchangers, industrial high-temperature thermal pumps (today high temperature thermal pumps can exceed 160°C with sometimes COP of up to 5). 3. Improved processes using less energy (e.g. using very high pressure instead of high temperatures for baking concrete) 4. Use of concentrated thermal solar pannels for high-temperature generation. Governments can help industries achieve energy efficiency with programs sponsoring energy studies (e.g. Canton de Vaud in Switzerland sponsors up to 10,000$ in studies, and then a part of the efficiency improvement costs). Often 50 to 80 % energy use decrease result from this program, which then also helps increasing competitiveness in addition of decarbonization. [Beat Brunner, Switzerland]	Accepted. The industry section has been revised and expanded with a more extensive discussion on energy efficiency. However, not all examples given in the comment could be found in the literature, so not everything is taken on board.
7889	29	42	29	43	Include references / mention of the developments of a global Circular Economy and transition from a Linear to a Circular system e.g: (source adapted from :http://www.easac.eu/fileadmin/Reports/Easac_15_CE_web_corrected.pdf) The case for a circular economy in Europe has been led by several recent studies which identify the following benefits, which could derive from a circular economy: • contributing to EU climate change policy by reducing greenhouse gas emissions; • improved competitiveness by creating savings and reducing raw materials and energy dependency; • improved security of supply and control of rising costs; • employment opportunities; • reducing environmental impact of resource extraction and waste disposal; • opportunities for new businesses going from earning revenue by selling goods to offering services. Underlying the barriers to shifting from a linear to a circular economy is the failure of current pricing systems to fully integrate all costs (including social and environmental costs), which means that pricing systems are failing to transmit the necessary information to inform individual decisions as related to climate changes. A research priority is thus to increase the pace at which these external costs can be introduced. Until this failure is remedied, rules and regulatory instruments may be unavoidable, but need to be carefully designed, taking into account fields of behavioural economics, and providing sufficient flexibility to allow companies to respond in the most efficient ways and to respond to rapid changes in technology and associated effects on product life cycles.The potential impact of a circular economy on international competitiveness is also considered. There is potential for improved competitiveness and new markets, but there are also potential disadvantages from an economic theory perspective where policies for a circular economy are applied only within the European Union. It is thus important to ensure that these policies are also fully embraced in international trade negotiations, and the United Nations policy process involving Sustainable Development Goals. [Geraldine Ann Cusack, Ireland]	Accepted, reference to circular economy is included though this particular literature source is grey literature and was therefore not included.
759	29	44	29	53	I would like to see a paragraph about how "Electrification of manufacturing processes and material substitutions" could be implemented as part of the industrialisation of the developing world. There stranded assets would not be an issue, and the new technology could be the catalyst for change in the industrialised nations when it comes time to replace technology. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The literature is clearer on the need for clean electricity for industrialisation in developing countries. There are very few peer-reviewed studies making this point.
15002	29	45	29	45	technology transfer should be expanded here to include "technology development, deployment, diffusion and transfer" [Farhan Akhtar, United States of America]	Taken into account, but text on tech transfer removed in new 4.3.5.
4875	29	47	29	47	2015) are techincially feasable and would leave [Wilfried Maas, Netherlands]	Taken into account; relevant text has been removed.
1728	29	48			Please, add after the words "materials relatively untouched" the following text: "e.g. in the case of steel production (Tsupari et al. 2015)." Tsupari, E., Kärki, J., Arasto, A., Lilja, J., Kinnunen, K., Sihvonen, M.. 2015. Oxygen blast furnace with CO2 capture and storage at an integrated steel mill. Part II: Economic feasibility in comparison with conventional blast furnace highlighting sensitivities: Elsevier. International Journal of Greenhouse Gas Control, Vol. 32, pp. 189 - 196 doi:10.1016/j.ijggc.2014.11.007 [Ilkka Savolainen, Finland]	Rejected, unfortunately. It's a good comment but we have faced severe space constraints.
562	29	48	29	48	Electrification of manufacturing...would constitute a greater technological challenge… It is unclear why there is any technological challenge at all. There are already electric arc furnaces, dielectric heaters, and electric induction furnaces available. Please see Jacobson et al. (Joule, 1, doi:10.1016/j.joule.2017.07.005, 2017, referenced above). [Mark Jacobson, United States of America]	Reject, though indeed electric solutions are available, they are technologically more advanced. EAFs for iron and steel are mostly for recycling.
2373	29	48	29	53	Thi paragraph refers to stranded assets (SA's). SA's should not be percieved as a barrier to action, infacts Sa's are the beneficial consequence of the transition to a 1.5 world. [David Viner, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account in Section 4.4.1 on "sunset industries". In the context of feasibility, the threat of stranded assets does reduce political will to change.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
15417	29	48	29	51	At the end of the sentence about electrification of industry, a reference to energy savings by the use of appropriate electronic control technics, motor control (Bimal K Bose. Power Electronics and Motor Drives Recent Progress and Perspective. IEEE Transactions On Industrial Electronics, Ieee Service Center, Piscataway, NJ, USA. Vol. 56. Nº - 2. 2009-02-01. Pág. - 581 - 588. ISSN 0278-0046) and efficient electric heating (induction heating, industrial use of microwave heating) should be made. Perhaps this could be done in the frame of a more global reference to smart factories and industry 4.0. and stress the importance of ICT in an energy efficient industry (F. Shrouf ; J. Ordieres ; G. Miragliotta „Smart factories in Industry 4.0: A review of the concept and of energy management approached in production based on the Internet of Things paradigm". IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 2014 . 9-12 Dec. 2014). Electrification should be accompanied of the pertinent control or regulation technologies that will optimise the energy management of the concerned industrial process. [Francisco Javier Hurtado Albir, Germany]	Taken into account/rejected. No peer reviewed literature suggested. However, more emphasis on e.g. energy efficiency in motors is included in the section on industry, and the ICT advances are discussed in section 4.4.4.
7340	29	51	29	51	Delete the text "and developing a circular economy". [Eleni Kaditi, Austria]	Rejected. The text is based on literature references to a circular economy, which is an important concept in 1.5C-consistent industry.
14088	29	52	29	52	Be more specific what the advanced capabilities imply for institutions. [Elvira Poloczanska, Germany]	Taken into account in section 4.4.4.
14347	29	53	29	55	To reduce the challenge and uncertainty, an acceleration of information dissemination and/or public campaigns on the capex-opex asymmetry is necessary so that the public understands the huge savings the circular economy investment could bring in the medium-to long term. [Yana POPKOSTOVA, France]	Taken into account in Section 4.4.1 but literature suggests that uncertainty will remain a feature (see Darron and Satterthwaite)
9282	30	2			Add information from Grafakos et al., 2018 (In Press) [Cynthia Rosenzweig, United States of America]	Noted. Awaiting appearance of paper.
1464	30	2			Climate services are typically useful in cities: for example in Cape town, water insfrastrucutres design now takes CC into account (Singh et al, 2017, The utility of weather and climate information for adaptation decision-making: current uses and future prospects in Africa and India) [Philippe Roudier, France]	Accepted - text revised to include reference to urban climate services.
9283	30	4			Cite: Gencer, E., Folorunsho, R., Linkin, M., Wang, X., Natenzon, C. E., Wajih, S., Mani, N., Esquivel, M., Ali Ibrahim, S., Tsuneki, H., Castro, R., Leone, M., and D. Panjwani (2018). Disasters and risk in cities. In C. Rosenzweig, W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, and S. Ali Ibrahim (eds.), Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network. Cambridge University Press. In Press. [Cynthia Rosenzweig, United States of America]	Rejected. We are unable to cite without a copy of this chapter. Text has been revised to accommodate the general point.
7105	30	4		37	This section 4.3.4.4.1 may be too general to be of any use? Could there be a table or any further categorization of resilience building actions for different risks (as well as regions and sectors ideally)? [Érika Mata, Sweden]	Accepted. Text has been substantially revised.
1668	30	4	30	37	This section is difficult to follow and does not accurately reflect the current state of discourse within urban adaptation planning as it relates to the conflicts and synergies between adaptation, resilience and disaster risk reduction. This section is missing key citations. I'd be happy to speak with the team to discuss. [Jesse Keenan, United States of America]	Accepted. Text has been substantially revised.
19413	30	4	30	37	How does climate resilience relate to disruptive technologies? The disjuncture between the two reflects the tension in the discourses which differ on where societal efforts must be placed - behind enablers such as community engagement and public monitoring of environmental performance or innovations which subvert mainstream processes. [Sumetee Pahwa Gajjar, India]	Accepted. Text has been substantially revised.
9626	30	4	30	40	not consistent for title of 4.3.4.4.2 with title of 4.3.4.4,because 4.3.4.4 for adaptation ,but 4.3.4.4.2 is only mitigation [Jianguo Wu, China]	Accepted. Text has been revised.
11157	30	6	30	8	I have no access to Satterthwaite and Bartlett (2016), but it seems more plausible that mitigation can influence the adaptation "needs", rather than "potential" [Michiel Schaeffer, Netherlands]	Accepted. This section has been rewritten. The sentence is no longer on place and the citation is no longer in use.
7104	30	10		26	I have not had a loot at the book by Satterthwaite and Bartlett, but I wonder if examples from other regions or types of economies are also included? [Érika Mata, Sweden]	Accepted. This section has been rewritten. The sentence is no longer on place and the citation is no longer in use.
1470	30	10	30	21	4.3.4.4.1 Disaster risk reduction and resilience building Asia population is equivalent to about 60% of the total world population. Therefore, some megacities in Asia should also be introduced, e.g.: The risk of higher storm surges, coupled with different sea-level-rise scenarios, highlights how the dykes around Tokyo could fail unless adaptation measures against climate change are attempted (Hoshino et al., 2015). Likewise, present coastal dykes in Jakarta will help to prevent flooding for a while, though their effectiveness will eventually disappear as land subsidence and sea-level rise continues (Takagi et al., 2017). Refereces: Hoshino S., Esteban M., Mikami T., Takagi H., Shibayama T. (2015) Estimation of increase in storm surge damage due to climate change and sea level rise in the Greater Tokyo area, Natural Hazards, Vol. 80, Issue 1, pp. 539–565 , DOI: 10.1007/s11069-015-1983-4 Takagi, H., Fujii, D.; Esteban, M.; Yi, X. Effectiveness and Limitation of Coastal Dykes in Jakarta: The Need for Prioritizing Actions against Land Subsidence. Sustainability 2017, 9, 619. DOI:10.3390/su9040619 [Hiroshi Takagi, Japan]	Noted. DRR will be discussed in SOD
18412	30	15	30	15	Manizles, Rosario not linked to Mendeley [Wilfran Moufouma Okia, France]	Editorial
14348	30	21	30	22	, and effective public information and sensibilisation campaigns that forge public acceptance of the process and render it legitimate. For the effectiveness and efficiency of the process, overlaps between different actions and policies need to be identified and eliminated to streamline the process, increase synergies amongst sectoral policies and avoid duplication and inefficiencies. [Yana POPKOSTOVA, France]	Taken into account - combined with other comment.
14349	30	21	30	22	, and effective public information and sensibilisation campaigns that forge public acceptance of the process and render it legitimate. For the effectiveness and efficiency of the process, overlaps between different actions and policies need to be identified and eliminated to streamline the process, increase synergies amongst sectoral policies and avoid duplication and inefficiencies. [Yana POPKOSTOVA, France]	Taken into account - combined with other comment.
9284	30	23			Add information about role of short term pollutants in urban areas. Cite: Bader et al., 2018 (In Press) [Cynthia Rosenzweig, United States of America]	Rejected. Unable to cite the paper as not in public circulation. Reference to air pollution has been included.
7341	30	24	30	25	Delete the text "to the idea of a lower carbon future". [Eleni Kaditi, Austria]	Accepted. Text revised.
1376	30	28	30	33	In relation to urban adaptation and resilience, this paragraph would benefit form a clear and sharp description of the mentioned "institutional structures", practices that "emphasized knowledge, networks, information, and greater engagement of citizens with the state" is in my humble opinion insuficient and too general, in this respect. [Roger Cremades, Germany]	Accepted. Text revised.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
18032	30	28	30	33	Please, consider adding to the paragraph: Participatory action-research – through iterative cycles between research and practice – may promote incremental and transformative changes in the context of urban climate change adaptation (Campos et el., 2016). To enhance risk assessment and climate adaptation processes, and to support the capacity of communities to prepare for change integrating scientific and local knowledge is essential (Moser and Dilling, 2007; Kettle et al., 2014). Local knowledge on the complex details of community characteristics, such as infrastructure design, governance structures, and vulnerable populations need to be incorporated in the assessments of local risks, and at the same time, local managers need to be assisted with information of climate change impacts and projections for their regions (Amundsen et al., 2010; Picketts et al., 2012; Kettle et al., 2014). Refs. Campos, I., Alves, F. M., Dinis, J., Truninger, M., Vizinho, A. and Penha-Lopes, G. (2016) 'Climate adaptation, transitions, and socially innovative action-research approaches', Ecology and Society, 21(1). doi: 10.5751/ES-08059-210113. Moser, S. C. and Dilling, L. (2007) Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change. Cambridge University Press. Kettle, N. P., Dow, K., Tuler, S., Webler, T., Whitehead, J. and Miller, K. M. (2014) 'Integrating scientific and local knowledge to inform risk-based management approaches for climate adaptation', Climate Risk Management, 4. doi: 10.1016/j.crm.2014.07.001. Amundsen, H., Berglund, F. and Westskog, H. (2010) 'Overcoming Barriers to Climate Change Adaptation—A Question of Multilevel Governance?', Environment and Planning C: Government and Policy. SAGE PublicationsSage UK: London, England, 28(2), pp. 276–289. doi: 10.1068/c0941. Picketts, I. M., Curry, J. and Rapaport, E. (2012) 'Community Adaptation to Climate Change: Environmental Planners' Knowledge and Experiences in British Columbia, Canada', Journal of Environmental Policy & Planning. 14(2), pp. 119–137. doi: 10.1080/1523908X.2012.659847. [Annamaria Lehoczky, Spain]	Accepted. The point about community participation in urban planning has been reiterated and relevant urban citations since AR5 have bene included. Campos, citation added. (as well as processes (Archer et al. 2014; Kettle et al. 2014; Siders 2017). The point about MLG is reflected under "enabling environment". The citations are not, however, explicitly about "urban" which is the focus of this section.
20251	30	29	30	33	Facilitating these meaningful outcomes requires safe arenas where citizens can grapple with the daily expereriences of local climate challenges. [Morien Rees, Norway]	Accepted. Text revised. But this point about trust and social learning is mostly dealt with under "Enabling Environment".
1294	30	35	30	35	The words 'there are' seem to be missing from this sentence. [Colin Raymond, United States of America]	Accepted. Text revised.
14089	30	35	30	37	The message of this sentence is not clear. [Elvira Poloczanska, Germany]	Accepted. Text revised.
1465	30	40			Nothing about migration? [Philippe Roudier, France]	Accepted. Migration is now addressed in a separate section to do it justice.
14262	30	40	30	40	Migration section will be put in? Is this human migration? That's needed in this context! [Jason Donev, Canada]	Taken into account in substantially revised text.
7106	30	40			This section 4.3.4.4.2 - still to be developed - is key from my perspective. E.g. in Sweden, the combination of current long-distance/international migration waves (200k/year expected) and short-distance rural-to-urban migration is challenging national strategies for priorization and building capacity, and in conflict with mitigation strategies. Actors at all levels have to choose - due to capacity and time constraints - between quickly providing new dwellings for over half a million migrants expected to move to the biggest Swedish cities inminently or implementing energy efficient and renovation measures in existing buildings. On the other side, the 1.5C may imply less migration than the 2C, something possitive to stress and quantify? [Érika Mata, Sweden]	Accepted. Migration is now addressed in a separate section to do it justice.
1474	30	40	30	40	The 'Migration' section appears to be missing - this is a crucial element of adaptation and needs significant coverage. For a 1.5 degrees C scenario many areas (e.g. SIDS) will still see enforced migration as a result of climate change impacts (e.g. sea level rise). It would be useful to provide an overview of most at risk areas, the rpotential role of migration as an adaptation strategy, existing plans (e.g. Tuvalau and Kiribati) and the socieconomic impactsa of such planned migration. [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Migration is now addressed in a separate section to do it justice.
19414	30	40	30	40	Section 4.3.4.4.2 Migration as an adaptation strategy is highly contested. Especially, with regards to urban migration and relocation, vulnerability has been found to be entrenched (Gajjar et al, 2018); and in situations where those who migrate do not necessarily possess the agency to improve their lot in their destinations. [Sumetee Pahwa Gajjar, India]	Accepted. Migration is now addressed in a separate section to do it justice.
15040	30	43			Why are cooling SLCFs not addressed here? The reduction of cooling aerosols from coal use is an important forcing on future climate and should be addressed here. [Farhan Akhtar, United States of America]	Reject, we look at response measures only in this section, which is not relevant for cooling substances in the context of feasibility of options for 1.5C
10218	30	43	31	20	The SLCF section is good. It should ackowledge the Kagali agreement on HFCs to bring them into the montreal protocol and discuss the effects of this. If should state that many of these species are coemitted with CO2, so they are not necessarilly additional mitigation options [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accept second part of the comment, text will be added at the start of the section (SLCPs are sometimes co-emitted with CO2 so the options assessed here are not necessarily additional compared to other mitigation options).
14	30	43	32	20	The chapter on "short lived climate pollutants" would benefit from including a discussion of the economic and political benefits of mitigation. Suggested text and references: Global assessments have indicated a potential large net economic benefit from mitigating SLCPs when climate, health and crop benefits are accounted for (Shindlel et al 2012; UNEP/WMO 2012, Victor et al 2012). Recent research confirms that benfits outweight cost for a majority of mitigation options also from a national perspective, but that international cooperation may be vital in realizing these potential benefits (Aakre et al). REFERENCES: Shindell, D. et al. Simultaneously mitigating near-term climate change and improving human health and food security. Science 335, 183-189 (2012); UNEP/WMO. "Integrated assessment of black carbon and tropospheric ozone". (United Nations Environment Programme, Nairobi, Kenya, 2011); Victor, D. G., Kennel, C. F., Ramanathan, V. The climate threat we can beat. What it is and how to deal with it. Foreign Affairs 91, 112-121 (2012); Aakre, S., Kallbekken S., Van Dingenen, R., Victor, D.G., The incentives for small clubs of arctic countries to limit soot and methane emissions. Nature Climate Change (under review, submitted to TSU). [Steffen Kallbekken, Norway]	Taken into account- a column has been added to table 4.2 (in SOD this has become table 4.5) that discusses co-benefits of reducing SLCP emissions.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10634	30	43	32	20	The topic of SLCFs needs and deserves more than 2 pages in this long report! Since length allocations are often made top-down, I know this may not be the fault of the authors that will initially see these comments, so hopefully this can be passed up "higher". Numerous publications - including papers in Science, Nature and PNAS and prominent reports from UNEP and a recent one from an expert committee (http://www.igsd.org/wp-content/uploads/2017/09/Well-Under-2-Degrees-Celsius-Report-2017.pdf) - have shown that it is not feasible to stay well below 2C, let alone remain under 1.5C, without concerted efforts to reduce emissions of SLCFs and their precursors. This is hardly acknowledged here or elsewhere in the FOD report. Why? While it is clear that it is important to be careful that SLCFs do not distract from efforts to reduce CO2 (a point that was made clearly by Schmale et al., 2014, which is cited in this section), the same holds for CDR and SRM, and they get 10x as much space as the SLCFs - in fact, the highly speculative considerations around CH4 removal get nearly as much space (section 4.3.6.8) as the part of the SLCFs discussion focused on CH4 mitigation. There are several improvements that could be made in the section, and I provide a few example comments here, but in the end it would be difficult for any authors to provide an adequate overview of the topic in this limited space. This provides the terrible misimpression that SLCFs are some sideline topic in the efforts to stay under 1.5C, which is not at all the case. While they would become considerably less important as we approach 3C, their mitigation is absolutely essential to acheive 1.5C. I hope those in charge of page allocations will understand this and give the authors the space that they need to deal with this topic adequately. [Mark Lawrence, Germany]	taken into account - much of the comment relates to the role of SLCP mitigation in 1.5C scenarios, which is a chapter 2 topic. For the remainder, our section on CDR will be rebalanced, shortening early-day options.
10635	30	43	32	20	Both terms SLCFs and SLCPs are used intermingled here. Please stick with SLCFs, which is the proper terminology in the context of this report, and just mention once that SLCPs is used in some other contexts, particularly by the CCAC. This also goes for other chapters where SLCPs and SLCFs are both used (e.g., Chapter 2). [Mark Lawrence, Germany]	Taken into account. The ER's understanding of the terms differs. This needs to be addressed in the Glossary.
12285	30	43	32	20	This section may benefit from material in the coming UNEP emission gap report [Jan Fuglestvedt, Norway]	Noted
563	30	44	30	44	The main short-lived climate forcer emissions that cause warming are BC… Please cite Jacobson, M. Z., Strong radiative heating due to the mixing state of black carbon in atmospheric aerosols, Nature, 409, 695-697, 2001, who first concluded BC may be the second-leading cause of global warming after CO2. [Mark Jacobson, United States of America]	Rejected. Though we acknowledge this ground-breaking paper, here, we are trying to assess the literature on assessing the feasibility to reduce emissions of SLCPs since AR5. We are not writing a comprehensive review on SLCPs
5235	30	45	31	9	cf Comment 9. There should be a thorugh definition of Black Carbon, and link with air pollution should be explicited. [Bianka SHOAi-TEHRANI, Japan]	Accept. Term and definition will be included in the glossary
11159	30	45	32	20	This section doesn't make clear why SLCPs are relevant for 1.5°C. Their effects on warming in real 1.5°C pathways must be disentangled. It must be explained that much of methane is reduced alongside CO2 measures without which 1,5°C would be impossible. That potential growth in HFCs must be reduced without which 1.5°C would be impossible, and that - despite all the co-benefits explained at length here - BC is irrelevant in terms of peak warming in real CO2 pathways (Rogelj et al 2014; Rogelj et al 2015). BC reductions are only relevant in baseline CO2 scenarios and in those cases 1.5°C is infeasible anyway [Michiel Schaeffer, Netherlands]	Taken into account. Chapter 2 makes clear why SLCPs are relevant to 1.5C and quantifies this, stating that "Non-CO2 climate forcers reduce carbon budgets by ~1540 GtCO2 per degree of warming attributed to them." As ch 2 shows, there is a large range of non-CO2 forcings (a good portion of which comes from SLCPs) in 1.5C scenarios produced by IAMs, so there is no single 'real' 1.5C pathway. There has also been substantial criticism of the assumptions underlying IAMs regarding some SLCP emissions and the potential for BC reductions in 'real' scenarios remains contentious. The point on co-reductions is already made (page 31, lines 2-4) but this point will be made more clearly.
20797	30	47			The UNEP/WMO assessment on Black Carbon and Troposheric Ozone 2011 as well as Shindell et al 2012 are imprtoant refernces to introduce at the beginning of this section as these led directly to the formation of the CCAC and activtiies to address SLCPs. [Johan Carl Ivar Kuylenstierna, United Kingdom (of Great Britain and Northern Ireland)]	Reject. Understandable suggestions, but Shindell is already cited, UNEP/WMO is considered grey literature.
20850	30	47			The UNEP/WMO assessment on Black Carbon and Troposheric Ozone 2011 as well as Shindell et al 2012 are imprtoant refernces to introduce at the beginning of this section as these led directly to the formation of the CCAC and activtiies to address SLCPs. [Johan Carl Ivar Kuylenstierna, United Kingdom (of Great Britain and Northern Ireland)]	Reject. Understandable suggestions, but Shindell is already cited, UNEP/WMO is considered grey literature.
12281	30	47	30	47	The reference given here to a commentary seems a bit random and narrow; there is a broad and solid literature on this. You could simply refer to AR5 WGI chapter 8 (Myhre et al.) [Jan Fuglestvedt, Norway]	Accept.
16415	30	50	30	51	Having worked with the MAGICC code some years ago exploring the relative effects of various types of pollutants, the results indicated that positive forcing during the 21st century from 21st century emissions are about equal for methane and for tropospheric ozone. Thus, I am wondering why tropospheric ozone is also not listed here. That it is created mostly by co-pollutants from other use of fossil fuels for transportation, etc., it may be that its level will be going down as petroleum use decreases. [Michael MacCracken, United States of America]	Reject. Ozone itself is not directly emitted. The opening sentences to this paragraph mention several ozone precursors, so the precursors to ozone are covered and tropospheric ozone is thus implicitly included. Here we are focusing on the largest warming agents, including methane, one of the main tropospheric ozone precursors.
7531	30	50	30	51	In many cases, it will be impossible to mitigate only the warming SLCFs. In our view, it is therefore the net climate effect of SLCFs reduction that is of interest. We thus recommend to broadening the scope to also include the main cooling SLCFs here. [Øyvind Christophersen, Norway]	Not really the case for HFCs and CH4, which are usually emitted on their own. For BC, this is already pointed out (p31, l2-4).See also response to comment 20409.
20409	30	50	30	51	What is the rationale for focusing on "primary warming agents" ? Are you suggesting that warming agents can be targeted while leaving the cooling agents unmitigated? [Olivier Boucher, France]	Noted. We are not saying, of course, that cooling agents should remain unmitigated, but the focus of this section is to assess the feasibility of mitigation options for substances that contribute to global warming of 1.5C. Cooling agents don't, so we don't assess their mitigation options.
10636	30	53	30	55	Also mention the role of SLCFs in RCP2.6 - this is most relevant for the 1.5C context here (whereas RCP6 and RCP8.5 can just about be left out in this context). Indicating how much SLCF mitigation would be needed to stay below 1.5 - without invoking CDR - would be very illustrative to make the point of how important this is. [Mark Lawrence, Germany]	Accept. We deleted the current sentence as it's only about higher-emission RCPs that are not consistent with 1.5C. In ch 2 we conclude that 1.5°C pathways require deep reductions in CO2, reaching global net zero CO2 emissions around mid-century, together with stringent reductions in non-CO2 climate forcers, primarily SLCPs and nitrous oxide. Non-CO2 climate forcers reduce carbon budgets by ~1540 GtCO2 per degree of warming attributed to them.
10637	31	1			…could increase the CO2 budget - this is a very poor formulation. It gives the mis-impression that we can trade SLCF mitigation for CO2 mitigation and still stay below 1.5C (or even 2C), which Schmale et al. 2014 especially focused on, and several other papers by Shindell and by Ramanathan and colleagues also make clear is not the case. A more appropriate formulation is that SLCF mitigation efforts, along with the efforts to reduce CO2, increase the probability that 1.5C might be acheived. [Mark Lawrence, Germany]	Accept, see response to comment 10636.
11158	31	1	31	2	Good example of misleading statement on SLCPs (see general chapter comment above). Number of 25% in Rogelj et al refers to methane only, not other SLCPs [Michiel Schaeffer, Netherlands]	Accept, see response to comment 10636.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10638	31	2	31	4	We note that BC is rarely emitted alone…; this is correct, but then the section fails to mention the much more important connection: CO2 is rarely emitted alone, and the main co-emittant of fossil fulel CO2 is SO2 (and other precursors and reflective aerosol particles). Thus when CO2 is targeted - as it should be - SO2 and other emissions will be decreased. This can even lead to a near-term warming (as shown in the UNEP reports and accompanying Shindell highlight paper), making the likelihood of overshooting 1.5C even greater, unless BC and CH4 are not explicitly targeted with separate measures. This is really the appropraite framing for the SLCFs discussion. Note that this framing is already made clear in Chapter 2, p. 14, l. 24-31: "SLCFs are often co-emitted with CO2 so in mitigation scenarios many CO2-targeted mitigation measures also reduce SLCF forcing magnitude (Rogelj et al. 2014a; Shindell et al. 2012). Reduction in SO2 emissions largely associated with fossil fuel burning are expected to reduce the cooling effects of both aerosol radiative interactions and aerosol cloud interactions, leading to warming..." [Mark Lawrence, Germany]	Accept. We are not making this point here but in chapter 2, as stated in the comment. Will refer to chapter 2 in the text.
12284	31	5	31	5	I think "front-loaded warming" is not clear to all readers. [Jan Fuglestvedt, Norway]	Accept. Wording will be clarified.
12282	31	6	31	6	Re "comparable contributions": is this based on figure 8.32 and/or 8.33 in WGI? If so, a clear reference could be given here. [Jan Fuglestvedt, Norway]	Accept. Reference will be added (Myhre et al, 2013; figure 8.32 and 8.33).
16416	31	6	31	9	This is a very important statement. Although covered starting on line 26, I would urge mentioning in this paragraph that there are important co-benefits from cutting emissions of most SLCPs. Indeed, I think it would be helpful to add a column regarding these co-benefits to Table 4.2. [Michael MacCracken, United States of America]	Accept. Is added to the table with reference to Haines et al (Submitted)
12283	31	6	31	9	Re "… political lifetime….": This is not, as far as I can see, based on material from AR5 WGI. If this is from WGIII, then a clear reference could be given. [Jan Fuglestvedt, Norway]	Noted, text has been deleted.
20798	31	11			I think it would be fair to include Shindell eta al 2012 here as this set the call rolling on SLCPs [Johan Carl Ivar Kuylenstierna, United Kingdom (of Great Britain and Northern Ireland)]	Reject. Shindell is cited all over the section already.
20851	31	11			I think it would be fair to include Shindell eta al 2012 here as this set the call rolling on SLCPs [Johan Carl Ivar Kuylenstierna, United Kingdom (of Great Britain and Northern Ireland)]	Reject. Shindell is cited all over the section already.
6375	31	11			Table 4.2, ow on methane: why not give the lifetime as stated in the AR5 (12.4 years)? And why does the right-most column ignore the biggest mitigation opportunity, which is increasing productivity and production efficiency to reduce enteric methane (at least per unit of product, and if combined with other policies including demand-side, absolute methane emissions)? Manure methane is only a small part of methane from agriculture and should not be stated first. [Andy Reisinger, New Zealand]	See response to comment 1475
7825	31	11	31	12	“Alternatives to HFCs in air-conditioning and refrigeration” are an important part of a much longer list. If needs to create coolth are addressed with the right steps in the right order—all according to ASHRAE’s Handbook of Fundamentals—then air conditioning, for example, will first cool people (not buildings—i.e., deliver “task comfort” like task lighting), then expand the range of comfort conditions by exploiting all comfort variables, then minimize intrusions of heat and humidity into the space, then use passive cooling, then nonrefrigerative active cooling, and only then efficient and climatically appropriate refrigerative air conditioning (followed by coolth storage, controls, maintenance, etc). Thus the table contemplates an improvement in step 6. But doing the five prior steps first can do the entire job cost-effectively anywhere in the world without refrigerative cooling—e.g. with a Pennington cycle (desiccant, regenerating as low as 37?C) or van Zyl cycle. The pre-refrigerative first five steps has indeed been demonstrated to save ~90–100% of air conditioning energy, with equal or better comfort and lower cost, in climates like Bangkok or the central valley of California (Lovins 1995). [Amory Lovins, United States of America]	Taken into account. We don't have space to make this table exhaustive. Will revise the heading to include "examples of…" rather than giving the suggestion of comprehensiveness.
7679	31	11	31	12	“Alternatives to HFCs in air-conditioning and refrigeration” are an important part of a much longer list. If needs to create coolth are addressed with the right steps in the right order—all according to ASHRAE’s Handbook of Fundamentals—then air conditioning, for example, will first cool people (not buildings—i.e., deliver “task comfort” like task lighting), then expand the range of comfort conditions by exploiting all comfort variables, then minimize intrusions of heat and humidity into the space, then use passive cooling, then nonrefrigerative active cooling, and only then efficient and climatically appropriate refrigerative air conditioning (followed by coolth storage, controls, maintenance, etc). Thus the table contemplates an improvement in step 6. But doing the five prior steps first can do the entire job cost-effectively anywhere in the world without refrigerative cooling—e.g. with a Pennington cycle (desiccant, regenerating as low as 37?C) or van Zyl cycle. The pre-refrigerative first five steps has indeed been demonstrated to save ~90–100% of air conditioning energy, with equal or better comfort and lower cost, in climates like Bangkok or the central valley of California (Lovins 1995). [Amory Lovins, United States of America]	Taken into account. We don't have space to make this table exhaustive. Will revise the heading to include "examples of…" rather than giving the suggestion of comprehensiveness.
10639	31	11	31	13	Ozone needs to be added to the table. Also, better references would be the UNEP reports and Shindell papers. [Mark Lawrence, Germany]	Reject. See response to comment 16415.
1475	31	11	32	20	CH4 as an SLCP is given limited coverage in terms of mitigation potential (mainly just references to AR5). However, more could be discussed on emerging sources (e.g. shale and hydrate exploitation), the potential for figitive emissions and their mitigation. Likewise, trends in increased meat and dairy consumption (and so ruminant CH4 emissions) should be highlighted, with the mitigation potential (e.g. livestock management, feed additives, dietary change literature) noted. [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Accept, will take into account with reference to new literature (see references in Shindell et al 2017)
14263	31	12	31	12	“0,34 GtCO2 eq” should probably be “0.34 GtCO2 eq” [Jason Donev, Canada]	Editorial
1570	31	14	31	14	I suggest to insert here:"Many measures reducing SLCPs have been proposed (UNEP,2011)." Refererence: UNEP 2011. Near-term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers, United Nations Environment Programme (UNEP), Nairobi, Kenya, 78pp [Peter Van Velthoven, Netherlands]	Reject, grey literature of which the insights are also included in more recent, peer-reviewed literature.
10640	31	15			Explain what "front-loaded warming effects" are, most readers will not know this. [Mark Lawrence, Germany]	Accept, see comment 12284.
10641	31	18			Cite Schmale et al. (2014) here, this was a main point of that article (and it was the first to show a scenario with delayed CO2 mitigation designed to clearly make that point). [Mark Lawrence, Germany]	Accept. Done.
20831	31	22			biomass burning: surely this is a source of black carbon, not methane? Also, should field burning be added to the last row of table 4.2? [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Accept. Reducing agricultural biomass burning to be removed, added to Table, now Table 4.5
10642	31	23			This was extensively discussed in … AR5… - the conclusions of that discussion should be summarized here (this is one of the many reasons that this section deserves a longer length allocation). [Mark Lawrence, Germany]	Reject. We have been assigned to update, not summarise, the AR5 here.
16417	31	26	31	27	In that the co-benefits are so important, I would urge further enumerating them here rather than mainly leaving them to references that will make the reader go to an extra effort. [Michael MacCracken, United States of America]	Accept. Although this section is about feasibility of SLCP mitigation measures, a column has been added to table 4.5 on co-benefits.
760	31	26	31	32	Has consideration been given to adding hydrogen to the gasoline to see if it will reduce black carbon? McAlister (The Solar Hydrogen Economy, ISBN0-9728375-0-7) claims that, using hydrogen in small none vehicle engines like lawnmowers, many exhaust emissions are reduced. Mixing hydrogen with gasoline need to be looked into as a mitigating solution for black carbon. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Reject. This is a small part of the problem and in a 1.5C world, it seems unlikely that gasoline-based lawnmowers will continue to exist.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
564	31	26	31	26	Reducing black carbon and co-emissions…has numerous co-benefits, in particular for health. This was also concluded in the 2002 abstract of 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, which stated, "Controlling BC + OM will not only slow global warming but also improve human health." The ozone and particulate matter health effects of fossil fuel and biofuel soot aerosol particles were also quantified in 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]	Reject. The point is true, but recent work uses more up to date epidemiological results, so we will stick to the current references.
10643	31	32	31	35	add references, e.g., Ramanathan et al., Nature Climate Change, 2017 (http://www.nature.com/nclimate/journal/v7/n1/full/nclimate3141.html) [Mark Lawrence, Germany]	Taken into account. This article mainly focuses on the role of wireless sensors and is considered for inclusion in section 4.4.4. It is not a core reference to illustrate the feasibility of modern clean cooking solutions. However, other references will be added on this.
14264	31	33	31	35	Interesting information, should be cited: “Switching from biomass cook stoves to cleaner gas stoves (based on liquefied petroleum gas or natural gas (LPG/PNG) or to electric cooking stoves is technically and economically feasible in most areas, but faces barriers in user preferences, costs and the organisation of supply chains.” [Jason Donev, Canada]	Accept. Reference to Jeuland et al. "The economics of household air pollution." Annu. Rev. Resour. Econ. 7.1 (2015): 81-108.
13522	32	1	32	2	Switching from "field burning" to other agricultural practises is mentioned as a measure to reduce the emissions of black carbon. To make it more clear I suggest to change the expression to "field burning of agricultural residues". I also wonder why field burning of agricultural residues is not mentioned in table 4.2, since it is an important source of black carbon. [Harold Leffertstra, Norway]	First part: reject; it's not just agricultural residues that burn on the fields. Second part: accept, will be added (see response to 20831)
10644	32	3			This should start a new paragraph [Mark Lawrence, Germany]	Accept, and "for HFC" added
10645	32	3	32	9	This paragraph is so vague that it's not really useful - again, grounds for increasing the length allocation for this section. [Mark Lawrence, Germany]	Taken into account. Will try to make it more concrete but we do have to balance word count.
10646	32	4			climate-friendly is not a scientific term and has no place in an IPCC report [Mark Lawrence, Germany]	Accept. Word will be removed and replaced with "with reduced ability to absorb outgoing longwave radiation"
18386	32	5	32	5	TSU needs a copy of the Shah et al. 2015 reference - hard to find [Wilfran Moufouma Okia, France]	Noted.
14265	32	8	32	8	Euros or USD? Be consistent. (Hard to do coordinating different authors!) [Jason Donev, Canada]	Accept. Has been revised to USD2010
10647	32	11	32	13	This paragraph needs to be re-considered and expanded to provide enough information to be sensible and accurate. First, if the section is focusing on warming SLCFs, as indicated in the introduction paragraph on page 30, then it is not correct that there is "a substantial overlap with SLCP mitigation strategies", since the overlap is mainly with cooling SLCFs like SO2 (see above). Further, the statement "SLCP reductions may be acheived later..." makes no sense if there is overlap as ascerted in the previous sentence - this needs some explanation for the reader to understand what the authors mean and what assumptions this is based on (i.e., again, more space is needed). [Mark Lawrence, Germany]	Accept, text will be clarified and better references to: section 2.3 indicates that most very low-carbon emissions pathways include a transition away from 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.
7342	32	11	32	13	Delete the text "Most very low-carbon emissions pathways include a transition away from use of coal and natural gas in the energy sector and oil in transportation, leading to a substantial overlap with SLCP mitigation strategies in such scenarios. However, SLCP reductions may be achieved later in such scenarios". [Eleni Kaditi, Austria]	Reject, this sentence makes a point that is relevant to the reduction of SLCP emissions. However, the statement is not referenced. A reference to section 2.3 will be added.
20852	32	16			Anenburg et al 2012 charactersised the air qulaity benifts on health of SLCP mitigation as well [Johan Carl Ivar Kuylenstierna, United Kingdom (of Great Britain and Northern Ireland)]	Accept. It is a peer-reviewed source so better than Schmale et al, which is a comment.
20832	32	17	32	18	I think the benefits for energy access, gender equality and poverty eradication apply specifically to cleaner cookstoves, not the other SLCP options? [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Accept. This section will be adjusted to focus on feasibility only rather than compatibility with sustainable development (though the two are of course related, so that link will be made clear).
10648	32	18	32	20	The claim that there is an information deficit is not useful without further explanation of what specific knowledge gaps exist and are most relevant (since it is well known that additional knowledge alone is not enough to steer behavior, otherwise e.g. there would not be any more smokers). Further, this is linked with the "absence of international frameworks...being a significant barrier..." - this is an interesting hypothesis that might have some merit, but it is unclear to me how these are really connected and needs to be expounded on (or cut) - again, further grounds for increasing the length allocation for the section. [Mark Lawrence, Germany]	Partly accept. The information deficit should be more clearly characterised as a problem related to institutional feasibility.
10219	32	22	39	8	A good review of carbon capture etc. I found a lack of assessment though, as the section says I think this all needs pulling together. Paragraphs should be not written as she said/he said - but more critical assessment [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - The assessment of CCS has been finalized to be included in the SOD. Furthermore, CCS has been moved to 4.3.2 to focus 4.3.8 on CDR.
11167	32	23			Chapter 2 is clear that the need for NET deployment strongly varies between different socio-economic scenarios and is greatly reduced by stringent near-term mitigation. This is not consistently reflected in this section. [Michiel Schaeffer, Netherlands]	Taken into account - this has been clarified with chapter 2 and we are using consistent language now. Note however that while near-term mitigation indeed reduces the requirement for NETs in the long term, stringent near-term mitigation can well use NETs to achieve the reduction rates required (in this case, most often land-based measures are considered because they are assumed to scale much faster to considerable levels). In any case, this particular paragraph had to be removed to save space.
19624	32	23			Include in references. Christopher Field and Katherine Mach. 2017. Rightsizing carbon dioxide removal. Science 19 May 356: 706-707. Sivan Kartha and Kate Dooley. 2016. The risks of relying on tomorrow's 'negative emissions' to guide today's mitigation action. Stockholm Environment Institute Working Paper No. 2016-18. [Doreen Stabinsky, United States of America]	Noted - Field and Mach is cited earlier in the report, the scope of 4.3.8 is on the bottom-up assessment of individual CDR options. Note however that we do take into account the underlying literature of that commentary. As for Kartha and Dooley, we cannot include non-peer-reviewed working papers at this point.
20203	32	23			4.3.6 Removing carbon dioxide from the atmosphere... [Ton Wildenborg, Netherlands]	Accepted - see reply to comment 13064
13064	32	23	32	23	Removal should be added in the title, changing to "Removal of carbon dioxide for the atmosphere and… [Caserini Stefano, Italy]	Accepted - "removal" added to the title, which furthermore had to be shortened - thereby also addressing comments 13064 and 20203.
19099	32	23	32	45	In the introductory section, it might be good to develop a para or two of text on the role of CCS more widely, not only in the CO2 removal context. Now this gives the impression that in a 1.5 world only removal is of importance. Some text from the following section (for example from lines 36 to 55 might sit better in an overarching section up front. [Ellina Levina, France]	Noted - but as there was duplication with section 4.3.2, the CCS text has been moved there, where the role of CCS is introduced more broadly - as suggested. Section 4.3.8 is now only about removal.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20581	32	23	34	30	Even at current scale, biofuels and bioenergy are resulting in land conversion, deforestation, increased use of fertilizers and chemicals, land grabs and competition with food production and pricing. BECCS on a very large scale would only exacerbate these problems, whereas efforts to restore and protect natural ecosystems, forests and grasslands, incompatible with large scale BECCS, is in fact a well-proven means to sequester carbon and offers multiple ancilliary benefits. Biofuelwatch has long worked to research the impacts of large scale bioenergy. We therefore have an informed basis for recommending that the most realistic appraisal of consequences for large scale BECCS provided in the peer reviewed literature is Smith and Torn 2013 (reference below). They report that sequestering 1 billion tonnes of carbon using a BECCS process involving eucalyptus plantations for feedstock would require: between 6.6 and 15 million hectares of grassland and shrubland to be converted every year – that is 300 – 750 million hectares over 50 years; 10-15 million tonnes of phosphorous and 4.5-15 million tonnes of nitrogen fertilisers a year for those 300-750 million hectares (presuming plantation expansion would stop after 50 years);1.2 – 2.7 trillion cubic metres more water than the original grasslands, which would significantly reduce streamflow, lower water tables and decrease rainfall over much larger areas, thus affecting other ecosystems (and farmlands). And, nitrous oxide emissions from the extra fertiliser use alone would, over the course of a century 'offset' 75-310% of that sequestered CO2, making the entire undertaking largely destructive and ineffective. [Rachel Smolker, United States of America]	Taken into account - The assessment has been finished, the Smith and Torn (2013) reference is part of it (https://github.com/mcc-apsis/NETs-review/blob/master/tables/all_considered_docs.xlsx), the high demand for land has been flagged as a negative side effect. Its impact on SDGs is further assessed in chapter 5. See also the cross-chapter box on land-based CDR in chapter 3 on this (3.11).
20582	32	23	34	30	Further references on BECCS: 1) Smith, L.J. and Torn, M.S. 2013. Ecological limits to terrestrial biological carbon removal.Climate Change 118: 89-103. 2) Vaughan and Gough 2016 "Expert assessment concludes negative emissions scenarios maynot deliver" Enviro Res Letters 11. http://iopscience.iop.org/article/10.1088/1748-9326/11/9/095003/meta 3)) Wiltshire and Barnard 2015. Planetary limits to BECCS negative emissions: http://avoid-net-uk.cc.ic.ac.uk/wp-content/uploads/delightful-downloads/2015/07/Planetary-limits-to-BECCS-negative-emissions-AVOID-2_WPD2a_v1.1.pdf 4) Smith et al. 2015. Biophysical and economic limits to negative CO2 emissions. 2015. Nature Climate Change 6, 42–50. 5) Fuss, S., et al. 2014, Betting on negative emissions, Nat. Clim. Change, 4(10), 850–853. [Rachel Smolker, United States of America]	Taken into account - peer-reviewed literature added if not included already
20584	32	23	34	30	The reliability of longterm CCS should be subjected to far greater scrutiny. Leakage can occur during capture, compression, transport, and injection as well as leakage from storage wells and spaces. A very large proportion of oil and gas wells in the USA for example, have not been plugged, or have cement caps that are cracked or may fail. Those include wells that penetrate many of the formations that are currently used or considered for use for CCS. REF:https://sequestration.mit.edu/pdf/GHGT8_Ide.pdf [Rachel Smolker, United States of America]	Taken into account - the text on CCS from the BECCS paragraph has been moved to 4.3.2, where leakage is discussed.
10557	32	23	35	19	Again, recent research has shown that CCS is not a viable option in the long term due to the strong rebound Jevons' effect, besides of all the technical and economic restrictions (see the work of Acemoglu and other economists) [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account - CCS is more comprehensively assessed in 4.3.2 and the text has been moved there.
10633	32	23	41	49	A review paper on climate engineering is being written by members of the former EuTRACE consortium, aimed to be submitted prior to the SR1.5 deadline of end of October; if it is accepted in time, it may provide useful insights for revising these sections. It will be sent to the chapter lead authors if it is submitted in time. [Mark Lawrence, Germany]	Noted - Thank you for considering to send us your peer-reviewed/submitted manuscript, which we will of course give due consideration.
20583	32	23	34	30	We did not find any discussion of the parasitic energy load requirements associated with carbon capture for BECCS. (it is mentioned for fossil CCS). Capture of CO2 from biomass emissions would be much more challenging even that from fossil fuels due to the low efficiency and low energy density of biomass, which results in much greater CO2 emissions, per unit of energy generated. It is estimated that up to 50% more CO2 is emitted. (See: http://www.pfpi.net/carbon-emissions) This means much more CO2 must, in turn, be captured (and stored) SInce it takes energy to do capture this means much higher overall parasitic energy demand, and much more biomass feedstock would be required. Global CCS Institute estimates that capturing CO2 from a 76 MW biomass power station that would otherwise have a conversion efficiency of 36% would reduce the electricity output to just 49 mW, reducing efficency to just 23%. REF: https://www.globalccsinstitute.com/publications/biomass-ccs-study [Rachel Smolker, United States of America]	Taken into account - the text on CCS from the BECCS paragraph has been moved to 4.3.2, where this issue is discussed. Note that the scenarios we refer to assessed in chapter 2 do take the parasitic load into account. Please note also that the parasitic load issue is discussed (and that was already the case in the FOD) in the DACCS section as well.
20585	32	23	34	30	It is imperative that a clear distinction be made between long term CCS, and use of captured CO2 for enhanced oil recovery (EOR). It is clearly not a strategy for emissions mitigation to capture CO2 and then use it to access oil/gas from depleted wells! There is much obfuscation on this matter, with confusion about the terminology (CCS often referring to EOR). Oil industry estimates that about 30% of CO2 injected at an EOR site will be directly emitted back into the atmosphere. REF: http://www.pembina.org/pub/2458 That could be an underestimate, and does not even include assessment of additional emissions from the combustion of the retrieved oil. Leaving oil/gas below ground in those depleted wells would be highly adviseable! The argument that sale of captured CO2 for EOR is "necessary" to the development of viable CO2 capture industry should be rejected. [Rachel Smolker, United States of America]	Taken into account - We have reinforced the language expressing our concerns about CCUS as a CDR strategy citing MacDowell et al. (2017). Note that CCU (without storage) and CCS do not lead to negative emissions and are therefore assessed in 4.3.2.
11036	32	23	39	12	4.3.6 has to be complemented with non-technical considerations on the policy and politics of CDR, e.g. regulatory schemes or considerations on CBDR (much like the form 4.3.7.1 takes). See, among others, Lomax et al. 2015 (Reframing the policy approach to greenhouse gas removal technologies), Peters/Geden 2017 (Catalysing a political shift from low to negative carbon); Shue 2017 (Climate Dreaming: Negative Emissions, Risk Transfer, and Irreversibility). Furthermore, reflections are needed on what would happen if the CDR volumes "realized" in IAMs would not materialize in the real world and if the widespread use of CDR in IAMs is advisable, given the lack of technological progress and policymakers' (almost complete) silence on CDR [Oliver Geden, Germany]	Taken into account - This is a valid point, even though governance, policies etc are assessed in 4.4/4.5 and not 4.3, but 4.3.8 has still been updated for the SOD with respect to the suggested literature. In fact, a whole paragraph has been added at the end. For part 2 of the question, this is dealt with in chapter 2, which assesses scenarios with limited CDR and discusses whether 1.5°C can then be reached with/out overshoot and with/out CDR.
1533	32	23	39	12	I love that you have this section, but to me there is an important piece missing. I think it is a challenging piece, with little literature, so I can understand the reasons it isn't there. But it is the governance framework for CDR deployment. The IAMs that include substnatial CDR deployment suggest that an important driver could be a high carbon price. But these models also assume a high carbon price to reduce emissions in the energy and AFOLU sectors. One interpretation of modern policy developments is that both countries and the UNFCCC is moving away from a carbon price as the primary policy tool for emissions reduction, and moving towards tools that more closely align with the transisitions literature. But then we are left without a working tool for CDR, including any of the insttutions that we be needed to distribute the needed finance.I think we are left with a huge level of uncertainty as to what could be a workable governance framework for CDR deployment, and this is worth communicating to policy makers. [Anthony Patt, Switzerland]	Accepted - the lack of a governance/policy framework has been noted (with the exception of ocean fertilization, which gets governed via the London Protocol), highlighting the lack of literature as well, see new paragraph at the end of the section.
10631	32	23	41	49	The sections on carbon dioxide removal and solar radiation management need considerable work to accurately portray the current state of knowledge, both on the physical science as well as on the social science side. Several members of my team as well as numerous other colleagues are providing detailed comments on these sections at this review stage, so I will focus my efforts on the second order draft review, and only make two general comments on these sections at this stage. [Mark Lawrence, Germany]	Taken into account - The current state of knowledge has in the meantime been exhaustively assessed by going through all papers from a search of both Web of Science and Scopus. Issues concerning policy, governance etc. are assessed in 4.5, but a paragraph has been added at the end of the section to note the importance of these issues and need for more literature.
11037	32	25	32	25	Some should be quantified here (probably in %) [Oliver Geden, Germany]	Noted - however, this paragraph had to be removed due the need for serious cutting.
2244	32	26	32	28	This is inconsistent with Chapter 2 where it is explained that one significant role of CDR is to compensate for residual emissions. [Kenneth Möllersten, Sweden]	Noted - however, this part of the text is gone due to shortening

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14350	32	28	32	29	This would require an evaluation of the social and economic aspects of CCUS if used at an industrial scale. While reducing GHG emissions is primordial, the process cannot rely on a tool which might open new concerns. [Yana POPKOSTOVA, France]	Taken into account - see reply to comment 20585
7955	32	30	32	33	Chapter 2 mentions only BECCS and AR as included in the pathways? [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Rejected - Although there are only a few studies with direct air capture, chapter 2 does assess them in this report. See also comments 7955 and 4304. In any case, this part of the text is gone due to serious shortening.
7917	32	31	32	35	On clean cooking, the tone is pessimistic. There are number of new financial models for clean cooking in Sub-Saharan Africa that show promise. Also some countries already have done tremendous jobs scaling up clean cooking like LPG - see Brazil, Indonesia. For examples of both, see Westphal et al. 2017. Powering Cities in the Global South: How Energy Access for All Benefits the Economy and the Environment. World Resources Institute [Westphal Michael, United States of America]	Taken into account, however, the reference is grey literature and therefore cannot be used.
4304	32	32			This reference to direct air capture is incorrect. According to the colour code adopted in Chapter 2, page 26, Tabl2 2.5, DACS (in yellow) has not been included in any of the scenarios/pathways reviewed in this report , perhaps because its prohibitive cost compared against BECCS ? [Abanades Carlos, Spain]	Rejected - Although there are only a few studies with direct air capture, chapter 2 does assess them in this report. "yellow" in the table referred to here indicates that it is included in some studies/model versions. See also comments 7955 and 4304. In any case, this part of the text is gone due to serious shortening.
9449	32	32	32	32	Say (DACCS) no (DACS) and add 'carbon' for direct air carbon capture and storage. So it will be easy to grasp that it is associated with CCS. There are different categories of CCS : fossil CCS, industry CCS (terminologies used in Chapter 2, BECCS and DACCS, depending on where the CO2 is captured from. [Isabelle Czernichowski-Lauriol, France]	Accepted and coordinated with chapter 2 (see also comment 19324)
6755	32	33	32	36	Once again the term 'options' is used here to describe a range of proposed CDR concepts in the context of model assumptions, but refering to them all as 'options' could easily lead to misinterpretations out of that context. They are, in many cases, merely proposed concepts. Use of the term 'option' should be restricted to much more specific contexts througout this report in order to avoid giving the false impression that all proposed CDR techniques represent options in policy terms. In the specific case of ocean fertilisation, this is not even a legally or politically acceptable option as decisions have already been taken at an international level to prohbit the technique other than for legitimate scientific research (for details of Resolutions and amendments under the London Convention and Protocol, see http://www.imo.org/en/OurWork/Environment/LCLP/EmergingIssues/geoengineering/Pages/default.aspx). Other proposed marine CDR techniques have yet to be given the detailed scientific and policy critique that would be needed in order to determine whether or not they can ever be considered to be options. [Jennifer Morgan, Netherlands]	Taken into account - In the (new) final paragraphs, text has been added to again highlight that the different options are at different stages of technological readiness, a result that also comes forth from the assessment. We do by no means prescribe the implementation of any options and maintain full transparency about their uncertainties. (see also comment 6756)
9450	32	41	32	41	Replace the sentence by: 'Another strand of options assessed here concerns the utilsation of carbon captured from air or bioenergy plants. Don't mention here CCUS which is much wider, as includes also capture from power and industrial plants as well as storage. [Isabelle Czernichowski-Lauriol, France]	Taken into account - In fact, the mandate for this section is to cover CCUS in addition to CDR. The difference between CCUS from direct air capture or bioenergy and fossil CCS has now been clarified with an additional sentence. (See also comments 4305, 7956, 14130 and 19223). CCU is assessed in section 4.3.2 now.
7343	32	41	32	42	Delete the text "In the absence of carbon pricing, the argument is that". [Eleni Kaditi, Austria]	Rejected - no reason for rejecting this text, as it only notes the current absence of a financial incentive for large-scale CDR.
7956	32	41	32	45	Very thin ice here. There is no sufficient proof yet that the options mentioned result in net negative emissions. One point of debate is whether fossil carbon captured and stored can ever be genuinely net negative. You also picked options as examples that are amongst the ones likely not resulting in negative emissions, due to the lack of permanence of carbon storage. Better example would have been carbonated minerals. The paragraph also somehow contradicts the more balanced argumentation in 4.3.6.7, p.48 l. 8ff, on this topic. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - This paragraph has been removed and a more balanced discussion is offered further below. (see also comments 9450, 14130 and 4305).
19323	32	41	32	45	This is very controversial and questionable, and should not be presented without critical comment. [Marco Mazzotti, Switzerland]	Taken into account - see reply to comments 4305, 9450, 7956; this is an introductory sentence has been deleted and the (critical) discussion follows further down in the main text.
4305	32	41	32	45	This paragraph is mixing/confusing two different CCU options. The text on EOR (which can be considered an option for CO2 geological storage if/whne a net flow of CO2 is permanently stored underground) should not be mixed with text on a CCU referred to fuel production from CO2. In the later, the lifetime of the carbon product is very short and the potential mitigation merit relies on the renewable energy used for utilization (see IPCC SR Ch 7, 2005) [Abanades Carlos, Spain]	Taken into account - This was meant to be a list of CCU options without saying they have the same effectiveness. The assessment shows that neither will likely contribute much to climate change mitigation. The options have been removed and CCUS is discussed as a concept now. (see also comments 9450, 7956, 14130 and 19223).
14130	32	43	32	43	Suggest use synthetic fuel rather than synfuel for non specialist reader [Elvira Poloczanska, Germany]	Noted - but the text has been removed.
9451	32	45	32	45	Add briefly why the technology does not per se lead to negative emissions. [Isabelle Czernichowski-Lauriol, France]	Accepted - though this particular paragraph is gone due to the need for serious cutting, text has been added to the discussion below to clarify this.
11166	32	48			The potential benefits of bioenergy should be considered somewhere (also relevant for chapter 3). E.g. from Creutzig et al. 2014: "uncertainty about projections should not preclude pursuing beneficial bioenergy options" [Michiel Schaeffer, Netherlands]	Noted - the quote is from Creutzig et al. (2015), which had already been included. Note that the bioenergy assessment has been moved to section 4.3.3, along with the suggested reference and a brilliant new one (Robledo et al. 2017).
4877	32	48	32	48	Separate 4.3.6.1 into two sections. A carbon capture and storage (for power and industry) and a Bioenergy with carbon capture and storage one. . With inclusion of the dependencies/synergies between CCS in different sectors/applications [Wilfried Maas, Netherlands]	Taken into account - CCS has been moved to section 4.3.2.
20323	32	48	32	48	With bioenergy being considered a limiting resource, one could mention that technology approaches, that use the CO2 from BECCS together with hydrogen from renewable electricity to produce gaseous or liquid synfuels, allow the bioenergy carbon to be used twice for energy purposes, maximising the energy use from the limited bioenergy resources. [Marine Gorner, France]	Taken into account - this point has been added in footnote #5. See also comment 4877.
11038	32	48	33	30	Land-use implications of BECCS (or terrestrial CDR as a whole) have to be scrutinized in this subchapter, including the IAM assumption that the conversion of pasture would be the major source for land then devoted to delivering biomass for CDR. Real-world experiences should be taken into account when assessing the process of land-use transitions (see Buck 2016: Rapid scale-up of negative emissions technologies: social barriers and social implications) [Oliver Geden, Germany]	Taken into account - Buck 2016 has been added and the language around the land use implications of BECCS strengthened. A deep-dive into the IAM scenarios of chapter 2 is beyond the scope of the bottom-up assessment here, however.
5130	32	48	34	30	The discussion of BECCS would benefit greatly from more discussion of the social feasibility of this approach, particularly in the context of hunger, food security, land rights, etc. Because of the high level of concerns about BECCS, consideration of these issues in the report will ensure that the discussion is not set aside entirely by civil society actors, because of a lack of discussion of these issues. If there are research gaps around these issues, these should be emphasized. [Tonya Rawe, United States of America]	Taken into account - side effects of BECCS deployment are now assessed systematically as well. Note that it is beyond the scope of this section to go into the details of impacts on food security etc, which is done at length in chapter 5.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20113	32	48	34	30	This section discusses the manifold limitations to BECCS (bio-physical limitations to bioenergy potentials, land requirements, impact on food production, ecosystems and biodiversity; energy and water intensity and storage capacity, required infrastructure, uncertainty around feasibility of timely upscaling as a limitation to CCS, as well as limited public acceptance of large-scale BECCS). The section also addresses doubts over the alleged carbon neutrality of bioenergy and the increase in competition for resources like land and water. These risks and negative impacts must not be understated, and cannot leave mitigation pathways as produced by IAMs in Chapter 2 unaffected, which, in turn, rely on BECCS in great measure. Chapter 4 authors must make sure that Chapter 2 authors produce mitigation pathways that are attentive to the serious concerns voiced here. [Lili Fuhr, Germany]	Rejected - Chapter 2 does not produce their own pathways. They can only assess what is in the literature. See also comments 11038, 20113, 2792.
20633	32	48	34	30	It seems that BECCS is over-emphasized in relation to other options. The diversity of mitigation options need to be covered and trade-offs clearly identified in a balanced discussion. [Hans Poertner, Germany]	Taken into account - The BECCS paragraph has been shortened significantly by outsourcing bioenergy to 4.3.3 and CCS to 4.3.2. By including an overview graphic now, the whole text of 4.3.8 could be reduced in comparison to 4.3.1-4.3.7.
2248	32	48	34	30	The section does not address the challenge embedded in large-scale deployment of BECCS in 2030 (12 years from now). Early opportunities for BECCS have been identified by: 8. Möllersten K, Yan J, Moreira JR (2003). Potential market niches for biomass energy with CO2 capture and storage - Opportunities for energy supply with negative CO2 emissions. Biomass and Bioenergy 25 (3):273-285, as noted in previous IPCC reports (SR CCS and AR4). [Kenneth Möllersten, Sweden]	Taken into account - the assessment has been completed only after the FOD. As the upscaling challenge is not typical for BECCS only, there is now a general paragraph at the end of the section discussing these issues for the wider set of CDR options.
20432	32	48	34	30	The Section on BECCS seems out of balance with the rest of the options. The long length of the section is one reason. Another reason is BECCS is essentially a combination of technologies and the component technologies are addressed elsewhere. The last reason is that other combinations, or suites of approaches, are not addressed. At a minimum, it should be said that BECCS is one combination of technology, but there are various combinations of technologies and approaches that could potentially be used to address climate change but BECCS just happens to have more early stage literature published while others combinations are yet to be explored and published. [Jeremy Webb, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - a very valid point. The individual technologies CCS and bioenergy have been moved to sections 4.3.2 and 4.3.3 and we now make clear that we here only assess the combination, see also comments 20432, 938, 20633. The amount of literature is now reflected in a new Figure that synthesizes the information for all CDR options.
2792	32	48	34	30	Why do you resist saying that BECCS is only a notional backstop technology that enables the IAM models to achieve a 1.5oC pathway? All of the models overshoot and this technology arrives on the scene after 2050 to save the day! In addition to all of the doubts raised in this section, BECCS would need large subsidies to cover the cost of the CCS and because the electricity generated would be more expensive than from solar and wind. The CCS comments here are a little weaker than on page 20. Most of the BECCS plants would be needed for less than 40 years thus making the technology more costly. Revenue from enhanced oil recovery is no longer available because oil has been effectively phased out. [Erik Haites, Canada]	Rejected - the mandate of this section is for an assessment, not to state opinions. The elements mentioned in the comment have been fairly assessed, resulting in a critical view. It is furthermore wrong that BECCS suddenly appears after 2050, see pathways in chapter 2, which show that BECCS (or better: a portfolio of CDR options!) will need to start being deployed in the first half of the century (though not visible when only consulting visualizations of net emissions). Footnote #1 has been added to avoid this misunderstanding in the SOD.
1084	32	48	34	33	A general comment: I do not recall seeing a deep dive into Global Warming Potential and its relevance for the assumption Bio-energy emissions are neutral. Under an accounting perpctive it is if the right timeframes are used to estimate impacts as related with specific sources. However the domino effect of emissions while in the athmosphere are to be consideted as well and those are not neutral at all. Currently this is matter for intense debate e.g. in the EU. [naikoa aguilar-amuchastegui, United States of America]	Taken into account - there are more reasons why bioenergy might not be carbon-neutral and we can't provide a deep-dive into all of them. We have added the disagreement about Global Warming Potential of biogenic CO2 emissions to the examples of why bioenergy may not be carbon-neutral in the main text. Note that the bioenergy assessment has been passed to the AFOLU section, 4.3.3 to discuss this issue more generally. See also comment 1085.
938	32	49	32	49	BCCS receives a huge section in the paper, but on the larger scale is a small component of the climate solution. I think the attention given to the subject is disproportionate and its focus should be dimished. [Elizabeth Aldrich, United States of America]	Taken into account - the individual technologies CCS and bioenergy have been moved to sections 4.3.2 and 4.3.3 and we now make clear that we here only assess the combination, see also comments 20432, 938, 20633. The amount of literature is now reflected in a new Figure that synthesized the information for all CDR options.
7918	32	49	34	30	The 1.5°C pathways assessed in Chapter 2 remove about 5Gt CO2 per year by mid-century. However, currently we have 14 sites with 1 Mt CO2 per year. So, we need to scale this up by a 1,000! How feasible is this? The section does not really address feasibility, but Section 4.3 begins by emphasizing feasibility. This is a different issue from one of potential. If BECCS unit costs vary widely in the literature, ranging between US$ 60–250 per ton of CO2, how feasible is it that BEECS will scale up in the near term, given that carbon prices currently are much lower than this? [Westphal Michael, United States of America]	Taken into account - the feasibility assessment had not been finished prior to the FOD deadline. We now include the full assessment, including references (see Nemet el al. submitted to ERL) on the upscaling challenge (see also comments 2248, 7918). See new paragraph at the end of the section.
2245	32	51	32	51	What is a "long time"? [Kenneth Möllersten, Sweden]	Accepted - has been reformulated.
2246	32	51	32	54	The contribution in pathways prior to 2050 is omitted (chapter 2 explains that there are substantial negative emissions as soon as 2030). [Kenneth Möllersten, Sweden]	Accepted - it is mentioned now, see also footnote #1.
7344	32	54	32	55	Delete the text "Note that bioenergy (Section 4.3) can play an even larger role when BECCS use is constrained, as biofuels are then needed at". [Eleni Kaditi, Austria]	Noted - this part of the text no longer exists, as we had to shorten the BECCS subsection.
7957	32	54	33	1	However, limiting BECCS in favour of biofuels without CCS does nothing to help with the land demand issues. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted - pointing this out was the purpose of the sentence. However, it has been removed due to space constraints and to avoid further misunderstandings.
7681	32	55	33	1	Not with available and cost-effective vehicle efficiency, mobility or freight system efficiency, and hydrogen options, as described in my previous comments. [Amory Lovins, United States of America]	Noted - this part of the text no longer exists, as we had to shorten the BECCS subsection. See also comments 7344 and 7957.
7827	32	55	33	1	Not with available and cost-effective vehicle efficiency, mobility or freight system efficiency, and hydrogen options, as described in my previous comments. [Amory Lovins, United States of America]	Noted - this part of the text no longer exists, as we had to shorten the BECCS subsection. See also comments 7344 and 7957.
936	33		33		I don't understand why CCS had its own section in the electric power sector and then has a large section later in the paper. I would keep all of the CCS information in the same place. [Elizabeth Aldrich, United States of America]	Accepted - CCS is now only assessed in 4.3.2
9121	33	1	33	1	There is a paper Liu et al. (under review) which shows macro economic cost under 1.5 degree sceanrio can be reduced if BECCS is more acceralated. I think the contenxt is relevant to BECCS and 1.5 degree. Here I put the link of the draft. Jing-Yu Liu*, Shinichiro Fujimori, Kiyoshi Takahashi, Tomoko Hasegawa, Xuanming Su and Toshihiko Masui, Socio-economic factors and future challenges of 1.5°C goal, Carbon Management. https://fxp.nies.go.jp/public/CuzwwApNCAhAprkB0lFe_4qmDd4KobxdWMDHe71uisMw [Shinichiro Fujimori, Japan]	Accepted - has been added along with Muratori et al. 2016 on the same topic.
7345	33	1	33	1	Delete the text "larger scale to decarbonize the transport sector". [Eleni Kaditi, Austria]	Noted - this part of the text no longer exists, as we had to shorten the BECCS subsection.
10858	33	3	33	10	the following reference may be also helpful for this paragraph: DOI 10.1007/s13412-017-0445-6 [Christian Breyer, Finland]	Accepted - reference has been incorporated
565	33	3	33	3	This section on bioenergy and BECCS says nothing about the potential air pollution impact of bioenergy or the fact that photosynthesis is only 1% efficient whereas solar panels are 20% efficient, so bioenergy results in 20x more land area than solar for generating the same energy (or solar obtains 20x more energy for the same land). [Mark Jacobson, United States of America]	Noted - Bioenergy is now assessed in section 4.3.3 along with the side effects (main reference Robledo-Abad et al. 2016, which covers over 1000 articles on bioenergy side effects), see also comment 5128. Land footprints are now given in Box 3.11.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14266	33	3	33	3	The 100 EJ for biofuels needs to be put into some sort of context here (I know how much energy the world uses, this is about 20% of current demand, but the normal reader of this section may not). Also, is this consistent with chapter 2? [Jason Donev, Canada]	Noted - the bioenergy paragraph has been moved to 4.3.3. Please note that many IAMs used in chapter 2 partially assume higher than 100 EJ availability, as stated after the references in this sentence (now gone from 4.3.8).
20410	33	3	33	4	I don't know the literature but would think that "large agreement" requires more than two studies. [Olivier Boucher, France]	Yes- this is why we cite an assessment article of many studies (Creutzig et al. 2015) because we cannot cite dozens of references directly here (more than 3000 articles have been assessed for section 4.3.8). Note that the bioenergy assessment has been moved to 4.3.3 for the SOD along with this assessment article.
5128	33	7	33	10	The sustainability limitations to bioenergy also extend to livelihoods and land rights, particularly in light of insecure tenure in many places where land (for bioenergy) would likely be cheaper and easier to secure. This point may be implicit in the mention of food production for a growing population, but it is in other ways deeper than that, given the context (of inequality) in which many small-scale food producers seek their livelihood. [Tonya Rawe, United States of America]	Noted - Bioenergy is now assessed in section 4.3.3 along with the side effects (main reference Robledo-Abad et al. 2016, which covers over 1000 articles on bioenergy side effects), see also comment 565. A new reference has been added, which develops a human-rights-based approach to BECCS deployment.
13065	33	12	33	18	It is needed a better logistic analysis: not all the biomass production is close to a CO2 storage and not all the CO2 storages are close to the final user [Caserini Stefano, Italy]	Noted - this is why more geographically explicit studies of BECCS potentials are identified as a key knowledge gap, see also section 4.5.1.
11165	33	12	33	23	Do we have estimates for how much marginal land / residues could be used? And how this would affect the amount of pasture land / cropland needed for bioenergy (under different socio-economic scenarios?). These pieces of information are important for policy makers. [Michiel Schaeffer, Netherlands]	Taken into account - added text to discuss availability of marginal land with new references (see footnote #2), see also comments 11164 and 11165. Effects in different socio-economic scenarios is beyond the scope of this section, however, and falls within the scope of chapter 2.
4668	33	14			Change "ha per ton of C-eq. per year" by "ha tCeq-1 yr-1" [Radim Tolasz, Czech Republic]	Accepted
4669	33	15			Change "C-eq. per year" by "Ceq yr-1" (2x) [Radim Tolasz, Czech Republic]	Accepted
7958	33	18	33	18	What are these assumptions, especially the ones responsible for the significant increase? [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted - however this text no longer exist, as we had to shorten the BECCS part of the section.
10354	33	20	33	34	The issue of areas required for the BECCS is quite controversial, and it should be reflected in a more trasparent manner. For example assumptions made in the different IAMs for the different scenarios. And as itdicated for chapter 2, the limitations of the IAMs in terms of the where thos areas should be (not only how many Has). [Maria Jose Sanz Sanchez, Spain]	Taken into account - have added literature on the uncertainty about land availability. Note that land availability is additionally flagged as a key knowledge gap in section 4.5.1. See also comment 5129. Note that it is beyond the scope of this section to make the assumptions of the IAMs transparent.
5129	33	20	33	28	The consideration of land use required for BECCS at scale should be put in a larger context of the current amount of land under cultivation for food (and the ecosystem health of this land), the amount of land that is not held with secure tenure (land governance frameworks) -- and where that land is/the livelihood/rights/poverty context in that geographic area, and pressures on land (for further cultivation and for conservation -- recognizing the potential for restoration of land as a climate mitigation option). There is a fair amount of discussion about the need to focus on sustainable intensification/yield increases per ha, and to avoid any further extensification (sustainable or not). Moving past global estimates of BECCS, land required, etc.,to consider where this land is supposed to be found is important to ensure consideration of all aspects of feasibility, given locally specific context. [Tonya Rawe, United States of America]	Taken into account - the context with respect to arable land is given. However, we cannot go into this much detail as required by the comment, as we had to cut the BECCS section substantially and the discussion is therefore more high-level now. See also comment 10354.
7959	33	24	33	26	The Energy Technologies Institute (ETI) has done extensive work on this for the UK (Insights into the UK bioenergy sector, The evidence for deploying BECCS in the UK). [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted - but could not find anything peer-reviewed on this.
14267	33	27	33	27	Could the 720 km3 of water be put into context? I know that's 'a lot', but compared to what? [Jason Donev, Canada]	Taken into account - the units have actually been amended and the water footprint has been set into context with respect to total global freshwater withdrawals (3928 km^3 according to the United Nations World Water Development Report 2017).
6756	33	30	33	32	For similar reasons to that of comment 17 above, including concepts such as ocean liming and DACs in an unqualified way as 'options' in calculations of CDR potential is oversimplistic and could result in substantial misinterpretation around the state of knowledge on the readiness, effectiveness and acceptability of such concepts. Again, what may be legitimate modeling assumptions are presented as real potentials. [Jennifer Morgan, Netherlands]	Rejected - Pertinent knowledge gaps and issues of governance etc. are highlighted as an impediment for the realization of the cited potentials.
2247	33	30	33	34	Is this potentials for storage? [Kenneth Möllersten, Sweden]	No, these are "Combined 2050 bioenergy and CCS potentials", i.e. BECCS potentials, and most often the constraint is not on the storage side, but on the bioenergy side.
6662	33	31	33	31	Please check: a BECCS potential of 18 Gt CO2 per year does not seem inline with a bioenergy potential of 100 EJ per year as cited on page 33, line 3. (E.g. burning 100 EJ of wood would only release around 10 Gt of CO2) [Astrid Schulz, Germany]	Noted - Please note that this is not a consistent modeling study, but an assessment. The 100 EJ refer to what most papers agree would qualify as a sustainable potential to exploit. Still, disregarding sustainability constraints, there are papers finding much higher BECCS potentials. Note that the bioenergy assessment has moved to 4.3.3 in the SOD.
11065	33	33	30	34	In additon, there are well-formulated arguments that the biomass potentials may turn out to be not realizable, see Kartha & Dooley (2016): "The risks of relying on tomorrow's negative emissions for guiding today's climate action" [Jakob Wachsmuth, Germany]	Taken into account - the issue of availability of land and other problems that might constrain the bioenergy potentials are discussed. Note that the bioenergy paragraph has been moved to section 4.3.3. Note that the suggested reference is not peer-reviewed.
13066	33	36	33	37	Bui et al is under review… it cannot consider this source since is under review, but it seems strange to me that the technological advance could be considered "large", since there are still very few projects operating, compared to what is needed [Caserini Stefano, Italy]	Rejected - Articles under peer-review before November 1st 2017 can be considered. Reference moved to 4.3.2.
4857	33	36	33	37	see Bui et al.) for an extensive assessment: there is now Capture, Transport and Injection of CO2 at rates exceeding 1 Mt CO2 per year at individual sites [Wilfried Maas, Netherlands]	Noted - Bui et al. (under review) had already been cited. The CCS assessment has been moved to section 4.3.2 along with this reference and examples are given.
7960	33	36	33	38	One project that should be highlighted here is the Illinois Industrial CCS (IL-ICCS) project, as it is BECCS on the same scale as the milestone Fossil-CCS projects. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - it is now mentioned as an example (footnote #4), see also comments 4857, 6757, 9452, 761, 19100.
3619	33	36	33	47	The description of CCS technology potential seems quite optimistic here and authors should ensure aligns with the seemingly less optimistic portrayal of CCS on page 20 [Stewart Fast, Canada]	Noted - the CCS paragraph has been removed and the assessment is now exclusively done (in a harmonized way) in section 4.3.2.
20204	33	36	33	47	The following special volume is of interest for this section: International Journal of Greenhouse Gas Control Volume 40, Pages 1-458 (September 2015) Special Issue commemorating the 10th year anniversary of the publication of the Intergovernmental Panel on Climate Change Special Report on CO2 Capture and Storage Edited by J. Gale, J.C. Abanades, S. Bachu and C. Jenkins [Ton Wildenborg, Netherlands]	Noted - but CCS has been moved to section 4.3.2.
11163	33	36	34	4	This section on BECCS looks closely at CCS, but CCS is relevant to other NETs (i.e. DAC) so a separate CCS section on e.g. "CCS for combination with bioenergy or DAC" might be more appropriate (with clarification that CCS alone is not a NET). [Michiel Schaeffer, Netherlands]	Accepted - there is a separate CCS section in 4.3.2 now and all material has been moved there.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
566	33	36	33	36	The section on CCS says nothing about the fact that CCS requires 25% more energy to run the CCS equipment, thus 25% more mining and transport of coal or gas, thus 25% more air pollution, since CCS equipment doesn't reduce any emissions from mining or transport or any emissions aside from CO2 from the smokestack. Since mining and transport are around 1/3 of the emissions, coal-CCS, for example, results in 50 times more CO2 than wind per unit energy and 150 x more air pollution (see, for example, 40. 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). [Mark Jacobson, United States of America]	Noted -These parameters are taken into account in the modeling referred to here and the CCS assessment has been moved to section 4.3.2, where it is discussed in more detail, see also comment 6757.
6757	33	36	33	39	I would double check these facts as they don't appear to be accurate. According to this, there are 8 such projects: https://www.globalccsinstitute.com/projects/large-scale-ccs-projects. What's more, I don't think Boundary Dam is actually injecting that much due to a range of problems that have the project offline a great deal. It only achieved about 800,000 tons of injected CO2 in 2016. http://leaderpost.com/business/energy/ccs-plant-hits-target-of-capturing-800000-tonnes-of-co2-in-one-year Also, it's important to break these stats down further. Of the 8 projects listed, only 3 are dedicated geological storage. The rest of are EOR. Also, it would be more balanced to mention some of the problems encountered at some of the injection sites to-date. For example, the In Salah injection project was shut down after they fractured the cap rock by overpressurizing the formation: http://www.sciencedirect.com/science/article/pii/S1876610213007947. [Jennifer Morgan, Netherlands]	Noted - however, this text is gone from this section due to (a) the CCS assessment having moved to 4.3.2 and (b) severe shortening of the BECCS paragraph for space saving and balancing reasons.
19100	33	38	33	38	17 projects currently in operation. [Ellina Levina, France]	Noted -see reply to comment 9452
9452	33	38	33	38	There are more than 14 currently operating industrial scale projects. See latest reference, Global CCS Institute 2016 (or 2017 which is about to be released) [Isabelle Czernichowski-Lauriol, France]	Noted - but CCS has been moved to section 4.3.2.
761	33	38	33	38	How does this statement, that there are "14 currently operating industrial scale projects" cited from (Global CCS Institute 2015), compare or agree with the statement on page 2-38 line 43 that there are "two large-scale industrial CCS projects outside of oil and gas processing are in operation (Global CCS Institute 2016)" [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - the CCS assessment has been moved completely to 4.3.2 and the text consolidated.
14268	33	39	33	39	the Global CCS institute is cited. Based on their website 'about us' page: https://www.globalccsinstitute.com/institute I'm quite concerned that they are not a credible source. Advocacy/lobbying groups like the Global CCS institute are not appropriate sources of information for peer reviewed papers. In general this paper has been far too optimistic about CCS and this section seems to continue the overly optimistic trends of CCS. I agree that we can sequester a lot of carbon dioxide, but this ignores the cost issue, and that's non-trivial! [Jason Donev, Canada]	Noted - but CCS has been moved to section 4.3.2.
13067	33	40	33	41	The amount of evidence on this point is quite limited, thus I suggest avoiding clear statement about the actual ability to manage the risk of leakage, that is in large part site-dependent [Caserini Stefano, Italy]	Noted - the assessment of CCS has been moved to 4.3.2, where there is more discussion on leakage.
20205	33	49			…can also be timely exploited... [Ton Wildenborg, Netherlands]	Accepted - but note that the CCS part has been moved to 4.3.2.
20209	33	49	34	4	Make reference to the main causes making CCS deployment lagging behind to date, which are the lack of incentivizing measures and political support. [Ton Wildenborg, Netherlands]	Accepted - but note that the CCS part has been moved to 4.3.2.
20206	33	50			..targets in 1.5 degrees or WB2D pathways. [Ton Wildenborg, Netherlands]	Accepted - but note that the CCS part has been moved to 4.3.2.
18413	33	50	33	50	Move "Scott et al." into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Accepted
20207	33	53			…not only the timely availability... [Ton Wildenborg, Netherlands]	Noted - see reply to comment 20205
6090	33	53	33	55	A recent report by IEAGHG highlights that the required infrastructure is achievable based upon analogies with other industries. IEAGHG Report 2017-TR6 "CCS Industry Build-out Rates - Comparison with Industry Analogues" (June 2017) [Tim Dixon, United Kingdom (of Great Britain and Northern Ireland)]	Noted - but the CCS material has been moved to section 4.3.2, where the upscaling challenge is now discussed in more detail.
20208	33	55			upscaling in the 1.5 degrees ofr WB2D pathways. [Ton Wildenborg, Netherlands]	Accepted - with CCS assessment now in section 4.3.2
6758	34	2	34	16	Compare these costs to wind and solar. [Jennifer Morgan, Netherlands]	Taken into account - comparisons between all mitigation options' feasibility criteria will be made in the synthesis section
4876	34	5	34	5	up a large CCS and BECCS infrastructure [Wilfried Maas, Netherlands]	Accepted
9453	34	5	34	5	add 'CCS' as such : 'for ramping up a large CCS or BECCS infrastructure…' [Isabelle Czernichowski-Lauriol, France]	Accepted
4856	34	5	34	6	Furthermore,economic incentives for ramping up a large CCS&BECCS infrastructure are weak in the absence of carbon pricing or other policies that could support an accelerated uptake of these technologies. [Wilfried Maas, Netherlands]	Accepted - though the sentence had to be shortened due to space constraints.
14269	34	7	34	49	"In their ex-post assessment of DAC energy requirements based on previous bottom-up technology studies (Socolow et al. 2011), Smith et al. (2016) estimate that energy consumption could be up to 45 GJ per ton C-eq. This translates into an average of 156 EJ per year by 2100 corresponding to an average 2°C pathway. Water requirements are estimated to average 10–300 km3 per ton C-eq. per year." This has switched to C-eq instead of CO2-eq, which is different by a factor of ~3. [Jason Donev, Canada]	Taken into account - units have been checked and numbers amended.
14270	34	7	34	49	"In their ex-post assessment of DAC energy requirements based on previous bottom-up technology studies (Socolow et al. 2011), Smith et al. (2016) estimate that energy consumption could be up to 45 GJ per ton C-eq. This translates into an average of 156 EJ per year by 2100 corresponding to an average 2°C pathway. Water requirements are estimated to average 10–300 km3 per ton C-eq. per year." – We only get ~45 GJ per ton of gasoline, this seems to be a very poor energy return on investment. That needs to be addressed! The parasitic load seems comparable to the amount of energy we get! If this is for methane (natural gas, there may still be reasons to do this). [Jason Donev, Canada]	Noted - there is current research to bring down the parasitic load, which has been emphasized now.
14271	34	7	34	49	"In their ex-post assessment of DAC energy requirements based on previous bottom-up technology studies (Socolow et al. 2011), Smith et al. (2016) estimate that energy consumption could be up to 45 GJ per ton C-eq. This translates into an average of 156 EJ per year by 2100 corresponding to an average 2°C pathway. Water requirements are estimated to average 10–300 km3 per ton C-eq. per year." – This is an unbelievably large amount of water for 1 ton of carbon sequestration! Is this freshwater? That's 10 billion tonnes of water for 1 tonne of CO2? Is this right? I had trouble finding the original Socolow article (the Smith 2016 article didn't include water but seemed to be related to other statements made here). [Jason Donev, Canada]	Taken into account - units have been checked and numbers amended. It was not per t C, but per year, so in fact about 3 km^3 per Gt C. This has been corrected.
4670	34	9			Change "per ton of CO2" by "tCO2-1" [Radim Tolasz, Czech Republic]	Accepted
4671	34	10	34	11	Change "per ton of CO2" by "tCO2-1" [Radim Tolasz, Czech Republic]	Accepted
4672	34	11	34	12	Change "per ton of CO2" by "tCO2-1" [Radim Tolasz, Czech Republic]	Accepted
6091	34	18	34	28	This paragraph is using many old references . The other chapters try to use new material published since AR5, and there is more recent work in many of these areas. For example the International Journal of Greenhouse Gas Control 40 (2015) A 'Special Issue' to review developments in knowledge since the IPCC Special Report on CCS (2005). Papers from this journal Special Issue have been used earlier in this chapter. [Tim Dixon, United Kingdom (of Great Britain and Northern Ireland)]	Noted - the CCS paragraph has been removed and the assessment including public acceptance is now exclusively done in section 4.3.2. Thanks for pointing us to this literature.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
18791	34	18	34	30	References concerning impacts of BECCS on land-use and food should also include Searchinger, T. and R. Heimlich. 2015."Avoiding Bioenergy Competition for Food Crops and Land." Working Paper, Installment 9 of Creating a Sustainable Food Future. Washington, DC: World Resources Institute. Available online at http://www.worldresourcesreport.org [David Waskow, United States of America]	Taken into account - in the main text we cite the peer-reviewed Searchinger paper. Searchinger and Heimlich are addressed in Box 4.3.
18824	34	18	34	30	References concerning impacts of BECCS on land-use and food should also include Searchinger, T. and R. Heimlich. 2015."Avoiding Bioenergy Competition for Food Crops and Land." Working Paper, Installment 9 of Creating a Sustainable Food Future. Washington, DC: World Resources Institute. Available online at http://www.worldresourcesreport.org [David Waskow, United States of America]	Taken into account - in the main text we cite the peer-reviewed Searchinger paper. Searchinger and Heimlich are addressed in Box 4.3.
6759	34	18	34	30	They fail to mention the water impact of BECCS and how that can have a range of impacts, especially in light of climate change. See Smith et al. 2016. This also impacts the feasibility of CCS operation. We should not lose sight of the fact that existing land and water resources are already stressed in many parts of the world and are only becoming more stressed. See, e.g. Alexandratos, N. and Bruinsma, J. (2012). World Agriculture towards 2030/2050: The 2012 Revision. ESA Working Paper 12-03. Food and Agriculture Organization of the United Nations, Rome. http://www.fao.org/docrep/016/ap106e/ap106e.pdf. One uncertainty is, for example, the water requirements of different bioenergy crops in a warmer world. See, e.g. Nature Comment (2016), https://www.nature.com/news/emissions-reduction-scrutinize-co2-removal-methods-1.19318. [Jennifer Morgan, Netherlands]	Noted - however, the water footprint has already been discussed on the previous page. The assessment by Smith et al. (2016) has been included.
7961	34	19	34	19	Suggest changing "CCS is problematic" to "CCS is perceived problematic by some" or similar. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - note that the CCS assessment has moved to 4.3.2.
7346	34	19	34	20	Delete the text "First, CCS is problematic (Benson et al. 2012) as there is concern that it is a strategy in favour of prolonging the profitability of the fossil fuel industry (Shackley et al. 2009; Upham and Roberts 2011; Wallquist et al. 2012)". [Eleni Kaditi, Austria]	The CCS assessment has been moved to 4.3.2, though we see no reason to disregard these references.
14515	34	20	34	20	Why this is necessarily bad? We need to engage the fossil fuel industry in the transition process because they are the first to be affected, they are the quickest to be able to react and they have a know-how and institutional weight and remit which would help the transition process if they are engaged early on positively. Facilitating the fossil fuel industries' adaptation and business model transition, be it through increased use of CCS would not stall the energy transition, the uptake of RES technologies or the integration of RES energy in the system - these processes are irreversible but we should avoid having important social casualties and adversarial economic side-effects by not facilitating the adaptation of the fossil fuel giant to a carbon-constrained environment. [Yana POPKOSTOVA, France]	Noted - this is a concern that the cited surveys reported as a result of their studies. It is not the opinion of the authors, but is listed to show what people worry about (if perceived unwarranted or not). Note however that the text is gone because (a) the CCS assessment had to move to 4.3.2, and (b) the BECCS section needed to be severely cut due to space constraints.
16418	34	21	34	28	It seems to me it ought to also be said that the first priority for use of biofuels should probably be for aircraft and other uses for which there is no alternative. For electricity generation, there are quite economical alternative approaches and spending both a lot of money and using biofuels to sustain fossil fuel use is going to significantly impede the overall strategy to limit overall warming. [Michael MacCracken, United States of America]	Noted - the bioenergy paragraph has been moved to 4.3.3, where biofuels are discussed in more detail.
20210	34	22			….issues, in particular in populated onshore regions... [Ton Wildenborg, Netherlands]	Accepted
7962	34	22	34	24	I find the discussion about the food price crisis unbalanced/incomplete. As it is written now, it could imply bioenergy was the sole cause for the crisis. There have been several contributing factors, e.g. droughts in previous years, rising oil prices, dietary changes in Asian emerging middle class, falling stockpiles, financial speculation. A World Bank paper in 2008 firstly attributed the major cause to biofuels. However, other reports, as by the OEDC and FAO, and a later World Bank paper in 2010 by Baffes and Haniotis provided a more balanced picture, admitting the effect of biofuels had not been as large as previously thought and that financial speculation played a key role. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted - this is not an analysis of the food price crisis, but about public perception, which unfortunately does not take the full breadth of aspects into account when forming an opinion. Later, we have added a new reference (Muratori et al. 2016) to show that systems effects can also lead to lower food prices in climate change mitigation scenarios. More detail is in addition given in 4.3.3, to where the bioenergy assessment has been moved and in chapter 5, which assesses SD implications of bioenergy deployment.
11164	34	24	34	30	The discussion on indirect land-use change does not apply to marginal land / crop residues used for bioenergy - this should be clearly stated. [Michiel Schaeffer, Netherlands]	Taken into account - more text on marginal land has been added in this respect, see footnote #2.
7682	34	25	34	30	Repeating my comment above on p on pp 4–23–4-25: Prof. John DeCicco (U. Michigan) found in Climatic Change (2016) 138:667–680, DOI 10.1007/s10584-016-1764-4, that much of the literature on biomass energy production's carbon balance reflects a confusion between stocks and flows. Such systems decarbonize only if the increase the ecosystem's net carbon uptake; most do not. [Amory Lovins, United States of America]	Noted - however, bioenergy is discussed here as an option that can at most (and even that is doubted!) be carbon neutral, the carbon removal then comes from adding CCS. Ecosystems enhancement is assessed separately, see also 4.3.3 and afforestation and reforestation section in 4.3.8 including the new assessment by Griscom et al. (2017).
1085	34	25	34	30	This paragraph comes to reinforce the previous one on GWP but from the prespective of leakage. I would say any AFOLU mitigation work will need to deal with this matter. Displacement of emmitting activities will very much generate leakage. This is also potentially the case of BECCS! [naikoa aguilar-amuchastegui, United States of America]	Taken into account - see reply to comment 1084.
7828	34	25	34	30	Repeating my comment above on p on pp 4–23–4-25: Prof. John DeCicco (U. Michigan) found in Climatic Change (2016) 138:667–680, DOI 10.1007/s10584-016-1764-4, that much of the literature on biomass energy production's carbon balance reflects a confusion between stocks and flows. Such systems decarbonize only if the increase the ecosystem's net carbon uptake; most do not. [Amory Lovins, United States of America]	Noted - however, bioenergy is discussed here as an option that can at most (and even that is doubted!) be carbon neutral, the carbon removal then comes from adding CCS. Ecosystems enhancement is assessed separately, see also 4.3.3 and afforestation and reforestation section in 4.3.8 including the new assessment by Griscom et al. (2017).
1729	34	28			Please, add after the reference Popp et al. the reference Pingoud et al 2016. Pingoud, K., Ekholm, T., Soimakallio, S., Helin, T. 2016. Carbon balance indicator for forest bioenergy scenarios. GCB Bioenergy, Vol 8, pp. 171-182. doi: 10.1111/gcbb.12253 [Ilkka Savolainen, Finland]	Noted - Popp et al. has been cited as a global estimate of indirect land use change, whereas the suggested reference is about net emissions of forest bioenergy scenarios in Finland. The reference has therefore been transferred to the lead author of 4.3.3, where the actual bioenergy assessment is located.
14363	34	28	34	28	There is an ongoing scientific and political effort to assess what is the acceptable level of carbon budget borrowing we could allow to consider bioenergy as a renewable source. [Yana POPKOSTOVA, France]	Noted - this paragraph is meant to cover the concerns about the carbon neutrality of bioenergy. Note that the bioenergy assessment has been moved to 4.3.3.
7963	34	28	34	30	Specific ones or in general? If specific policies and their shortcomings can be clearly identified, then please name. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - the Renewable Energy Directive is now explicitly named as the example here.
1730	34	30			After the reference Frank et al, please, add the reference Koponen et al. 2013. Koponen K., Soimakallio, S., Tsupari, E., Thun, R., Antikainen, R. 2013. GHG emission performance of various liquid transportation biofuels in Finland in accordance with the EU sustainability criteria. Applied Energy 102, 440–448 [Ilkka Savolainen, Finland]	Noted - however, this sentence is about the effectiveness of sustainability criteria in avoiding indirect land use change, whereas the suggested reference is about the ability of Finnish biofuels to meet the standards.
19324	34	33	34	33	I suggest calling it DACCS: Direct Air Capture with Carbon dioxide Storage [Marco Mazzotti, Switzerland]	Accepted - see reply to comment 9449
11000	34	33	34	33	Need to be clear that DAC is not an option in most/many models [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - the end of the DACCS section points out that DACCS is only being incorporated into IAMs now and that there are only few studies (Chen and Tavoni 2013, Strefler et al., submitted) that do so already.
1295	34	33	35	19	This section should also mention recent successful trials of CO2 injection into subterranean basaltic reservoirs in Iceland. [Colin Raymond, United States of America]	Noted - however, the CCS part has been moved to section 4.3.2.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20114	34	33	35	19	The section clearly states that DAC is inefficient, energy intensive and suffers from the same barriers, deficiencies and uncertainties as any CCS-based techology - it should be made clear that it's not a viable response to climate change. Given the above, Chapter 4 authors should definitely not call for incorporation of DAC(S) into IAM scenarios! [Lili Fuhr, Germany]	Noted - however, (1) it is beyond the mandate of 4.3.8 to prescribe what is "viable" - we have to assess all dimensions of feasibility for a fair assessment; (2) DACCS is already being incorporated into IAMs, which is what is stated here (with references) in this paragraph starting with "Current research....".
2793	34	33	35	19	Agreed that DACS capture is more costly than capture from CO2 rich emissions streams, such as fossil-fired generating stations. But under a 1.5oC pathway, the number of emissions ich sources shrinks rapidly, ultimately leaving DACS as the only potentially large scale option. [Erik Haites, Canada]	Noted - the large potential of DACCS in comparison with other CDR options is now visualized in Figure 4.3.8, Panel A. However, costs have to be assessed as well.
6761	34	34	34	38	Again DAC is presented here as 'another option', as if it is already an established, deployable technology with associated infrastructure. This grossly misrepresents its current state of development. The claim that captured CO2 could be disposed of in carbonate minerals uses for support reference to a single paper from 1995 which has been much critiqued. Furthermore, claiming that DACs has particular advantages and 'can' capture CO2 independently from certain other restrictions and 'can' therefore also offset emissions from aviation is stretching assumptions about its future development, efficiency and application to the extreme (see e.g. Wilcox et al. (2017) [https://doi.org/10.1088/1748-9326/aa6de5]). Such unqualified statements in support of a largely conceptual 'technology' which carries a range of significant downsides could well encourage unwise policy decisions. [Jennifer Morgan, Netherlands]	Taken into account - Wilcox et al. (2016) has been added. Note that we are not making claims here or are prescribing deployment of particular options; our mandate is to assess different criteria for all options including DAC (and there are now two demonstration plants up and running). We cannot exclude options that have a less favourable assessment because this is part of the assessment. The outcome is that it is still way more expensive than other CDR options and shares the disadvantages associated with storage, which is probably what is hinted at here with "downside".
11066	34	34	39	43	A few checks of the literature suggest that the high agreement may be due to the fact most articles refer to the same primary source, in some cases via a chain of articles. [Jakob Wachsmuth, Germany]	Taken into account - A systematic assessment has been finalized after the FOD, which has resulted in better quality of this subsection. However, this particular part of the text does no longer exist due to a major shortening of the CDR section.
4306	34	35			Reference to air capture should include, to be balanced, key ref to studies highlighting the technical and economic challenges (respect to BECSS when discussing about negative emissions or respect to CCS). Example of such reference is a PNAS articile of House et al 2011 (http://www.pnas.org/content/108/51/20428). [Abanades Carlos, Spain]	Taken into account - A systematic assessment has been finalized after the FOD, which has resulted in better quality of this part, the estimate House et al. 2011 is included in Figure 4.3.8.
2249	34	38	34	38	CO2 is mixed in the atmosphere. A negative emission offsets CO2 from a mixture of emission sources of unspecified origin. [Kenneth Möllersten, Sweden]	Noted - however, this part of the text is now gone due to major shortening of this section.
4858	34	41	34	42	and thus still requires at least three times more energy than flue gas capture and very large equipment sizes (Pritchard et al. 2015) |Check consistency| [Wilfried Maas, Netherlands]	Taken into account - text has substantially changed after the assessment was finalized post-FOD. This particular part had to be shortened, unfortunately.
20411	34	41	34	43	Sentence is unclear. It could be useful to provide the energy cost per mol CO2 captured. [Olivier Boucher, France]	Taken into account - exact cost ranges have been added, though in $/ton CO2 to preserve comparability with the other options.
18414	34	47	34	47	Move "Smith et al." into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
4859	34	47	34	48	Smith et al. (2016) estimate that energy consumption could be up to 45 GJ per ton C-eq. That would be a factor 10 higher than the ~4GJ/ton for published MEA , so in line 41 at least three times more than [Wilfried Maas, Netherlands]	Noted - units checked and text amended. It is still high, however. Unfortunately, it seems like the comment is incomplete, so we were not able to check the other number that this comment apparently wanted to refer to.
7989	34	48			It is indicated that DACS would require 45 GJ/t CO2. This is about 5 times more than the energy (LHV) that is produced from the burning of carbon that would produce 1 t CO2. This is thus at least 10 times more then the electrical or thermal energy that has been obtained from the burning of the carbon producing 1 t CO2. Thus, DACS requires about 10 times more energy then what we have obtained from carbon burning. There are surely more interesting actions to be engaged which such an amount of energy... This kind of analysis shows that the different proposed techniques should (must) be analysed at the light of their efficiency in comparison with other techniques. This kind of analysis is necessary for a realistic assesment of the different pathways and would strengthen and given more interest to the document. [Jean Marie Seiler, France]	Taken into account - Units checked, text amended, and current research trying to reduce the parasitic load highlighted.
4673	34	48			Change "GJ per ton C-eq." by "GJ tCeq-1" [Radim Tolasz, Czech Republic]	Accepted
4674	34	48			Change "EJ per year" by "EJ yr-1" [Radim Tolasz, Czech Republic]	Accepted
1544	34	49			Is this really km3 ?? This seems huge [Noé Lecocq, Belgium]	Taken into account - units checked and text amended
4675	34	49			Change "km3 per ton C-eq." by "km3 tCeq-1" [Radim Tolasz, Czech Republic]	Accepted
20412	34	49	34	49	The unit must be incorrect. [Olivier Boucher, France]	Taken into account - units checked and text amended
13068	34	49	34	50	A reference is needed. Why there is the need of such big quantity of water for DAC? Please check carefully, this is a mistake: 10 - 300 km3 per Gton C-eq. is probably 10 - 300 m3 per Gton C-eq. [Caserini Stefano, Italy]	Taken into account - units checked and text amended
13523	34	49	34	50	The water requirements mentioned here, 10-300 km3 per ton C-eq. per year seem outrageous. Cheque for errors. The unit "ton C-eq" seems a bit unusual [Harold Leffertstra, Norway]	Taken into account - units checked and text amended
18415	34	52	34	52	Move "Broehm et al." into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Accepted
4676	35	1			Change "per ton of CO2" by "tCO2-1" (2x) [Radim Tolasz, Czech Republic]	Accepted
18416	35	1	35	1	Move "Socolow" into grey shaded Mendeley field with "2011" [Wilfran Moufouma Okia, France]	Accepted
4677	35	5			Change "per ton of CO2" by "tCO2-1" (2x) [Radim Tolasz, Czech Republic]	Accepted
4678	35	6			Change "per ton of CO2" by "tCO2-1" (2x) [Radim Tolasz, Czech Republic]	Accepted
14853	35	9	35	9	and less cost- and potential- efficient. [Yana POPKOSTOVA, France]	Do not understand the suggestion.
6663	35	11	35	14	It should be mentioned that there is a competition for CO2 captured from either bioenergy or DAC between storing it longterm or using it in power-to-gas schemes, methanisation and synthetic hydrocarbons, which are meant to be "carbon neutral". (See e.g. table 2.5 in Chapter 5: power-to-gas etc. is often used in mitigation scenarios). You can either store the captured CO2 longterm, or use it in a synthetic hydrocarbon, but not both. [Astrid Schulz, Germany]	Noted - however, power-to-gas does not result in carbon removal and thus goes beyond the scope of this section. For an assessment of CCU (without storage), see section 4.3.2.
2250	35	13	35	14	The major reason is that DACCS is less area intensive (compared to BECCS it does not need large areas for biomass production). [Kenneth Möllersten, Sweden]	Noted - that is the message of the paragraph.
14854	35	14	35	14	OECD indicated that "achieving lower concentrations targets (450ppt) depends significantly on the use of BECCS". [Yana POPKOSTOVA, France]	Noted - This comment might be linked to the wrong page/line? We do not see the controversy here?
20634	35	16		19	The aspect of CO2 recycling has been poorly developed. [Hans Poertner, Germany]	Taken into account - CCU (without storage), also called CO2 recycling, is now assessed in 4.3.2. The discussion here is only on the prospect of generating negative emissions.
6762	35	17	35	19	Given the huge uncertainties surrounding DACs as a concept, incorporating it more widely into models could be highly premature [Jennifer Morgan, Netherlands]	Noted - but the point here is that it is already being done, see reference to Chen and Tavoni (2013) and Strefler et al. (submitted).

Comment No	From Page	From Line	To Page	To Line	Comment	Response
939	35	21	35	21	I am again confused as to why aforestation and reforestation is mentioned in a separate section. Why does the REDD+ information exist in a separate section. I would consolidate this land use section into one. [Elizabeth Aldrich, United States of America]	Rejected - REDD+ is a UNFCCC mechanism, 4.3 assess mitigation options. Of these, reduced emissions from avoided deforestation are assessed in section 4.3.3 (along with ecosystem restoration) and all land-based options that remove carbon from the atmosphere (i.e. also afforestation) are assessed in the CDR section (4.3.8).
762	35	21	35	21	Perhaps there is a need to define for a layman the meaning of Afforestation [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - definition has been added for afforestation and reforestation.
20588	35	21	36	14	A comparison between afforestation and reforestation and BECCS/DAC is entirely inappropriate. They may all fall within the very broad category of CDR, but one involves natural ecosytems and the other involves questionable and unproven technofixes. In particular portraying forests as “problematic” with many “caveats” re their long term carbon storage capacity due to their vulnerability to weather, climate and fires, seems especially egregious. THe capacity for forests to grow is well proven and does not require reliance on mythical accounting for “carbon neutral” biomass, nor does it require construction of massive infrastructure, nor does it rely on assumptions about the long term reliability of geological storage. That forests require ongoing management in order to deliver their carbon beneifts is presented as a downfall - but note that BECCS or fossil CCS would also require long term monitoring for leakage and security of geological storage. Last, this portrayal of forests as an inferior method of CDR utterly sidesteps the many fundamental life supporting functions that forests provide in addition to storing carbon - such as, for example, providing oxygen and regulating rainfall and hydrology. Those are not provided by BECCS or DAC, but are essential to, for example, delivering on the SDGs. This treatment of forest issues is so woefully lacking it is difficult to even begin to provide review comments.. [Rachel Smolker, United States of America]	Rejected - afforestation is nowhere in this paragraph judged to be "inferior" to BECCS. All CDR options have been assessed with respect to certain criteria and afforestation performs better on the co-benefits and worse on the permanence according to the literature. Note that in this section the mandate is to look at everything that withdraws CO2 from the atmosphere. Avoided deforestation is part of the AFOLU section, 4.3.3.
20115	35	21	36	14	Large-scale afforestation with monoculture plantations is detrimental to biodiversity, ecosystem integrity and resilience, land and land-use rights of local and indigenous communities, and is excessively land and water intensive. Monoculture plantations are moreover easily inflammable. In general, biosequestration is unqualified to ensure the level of permanence with which emissions need to be reduced. Chapter 4 authors should focus on means to stop deforestation and allow for reforestation in sustainable and careful ways. In general, careful ecosystem restoration should be prioritised, rather than land-based geoengineering technologies. [Lili Fuhr, Germany]	Noted - Afforestation has been kept as a CDR option. The side effects of afforestation and reforestation had already been discussed, but the assessment has now been completed for the SOD and more literature could be added. Permanence is also a criterion of the assessment. Avoided deforestation does not remove CO2 from the atmosphere and is therefore assessed in the AFOLU section, 4.3.3.
4679	35	22			Change "Gt CO2-eq per year" by "Gt CO2eq yr-1" [Radim Tolasz, Czech Republic]	Accepted
13528	35	22	35	23	In this sentence the potential for mitigation in the forest sector is estimated to be hhvis 9,5 Gt CO2-eq and up to 13,8 Gt CO2-equivalent at USD 50 per ton of CO2. The reason for 2 different cost estimates is not given. [Harold Leffertstra, Norway]	Taken into account - the full assessment of potentials and costs was only finished after the FOD and the text (incl. numbers) has now been amended. Note that the text has changed substantially.
2632	35	22	35	31	again, link back to effects on local livelihoods rather than as an abstract concept to reduce emissions? [Zoha Shawoo, United Kingdom (of Great Britain and Northern Ireland)]	Partially taken into account - impact on local livelihoods is considered as a side effect. The task of the section is, however, to assess AR as a CDR option.
4680	35	23			Change "Gt CO2-eq per year" by "Gt CO2eq yr-1" [Radim Tolasz, Czech Republic]	Accepted
2251	35	23	35	23	The same price mentioned twice. [Kenneth Möllersten, Sweden]	Accepted
1086	35	25	35	27	I have serious issues with this sentence. It totally dismissess the service of standing forests provide in stiocking and sequestering carbon. Yes, afforestation and reforestation will enhance such service BUT forest standing sequestration needs be accounted for and be included in any 1.5 scenario. Recent leterature has demosntrated how these dimissed forests have mitigated the emissions of the entire transport sector of latinamerican countries. Stating standing forests do not lead to additional removal of CO2 in the atmosphere is a very bold thing to say. [naikoa aguilar-amuchastegui, United States of America]	Noted - We agree that the preservation of sinks is important and they are taken into account in the carbon budgets. However, additional removal of CO2 is needed to reach 1.5°C, which is what is assessed in 4.3.8 along with potential co-benefits. Forests and avoided deforestation are very important in climate change mitigation as well and are assessed in detail in the AFOLU section, 4.3.3.
1087	35	29	35	31	The authots seem to not know the russia far east current deforestation dynamics and their impact to permafrost. [naikoa aguilar-amuchastegui, United States of America]	Noted - please note that we speak about "relative" potentials here and compare with the tropics. Please refer to 4.3.3 for the assessment of avoided deforestation. Due to space constraints, we cannot offer a full regional assessment.
9343	35	30	35	30	There are missing words "there are" in the phrase "that (there are) significant overlaps between" [Siir KILKIS, Turkey]	Editorial
18417	35	33	35	33	Move "Houghton et al." into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Accepted
7829	35	33	35	42	Repeating my comment on p 4-24 line 5: “…[T]he Bornean sugar palm Arenga pinnata has ~5–10x the net primary productivity of sugarcane (contrary to old textbooks that ignore what a C4 plant with the highest known optical leaf efficiency can do). This tree, widely cultivated in Kalimantan and Sulvawesi for its extraordinary sugar yield and >50 other benefits, is the keystone species for Dr. ing. Willie Smits’s integrated ecological and economic restoration of devastated Indonesian (and other tropical) rainforests. His technical papers are mainly in Bihasa but are starting to gain proper attention in English. Being familiar with his work and walked tens of sq km of his key projects, I’m convinced he has demonstrated a fundamentally important innovation for restoring rainforests and their cultures, and for incentivizing their inhabitants to protect and sustain them. The Indonesian government has asked Dr. Smits to apply his system, already demonstrated in six significant sites, on about a million ha. A McKinsey due diligence funded by the Norwegian government in 2016–17 found a 35% IRR for his restoration method if the wages are 3x those paid to Kalimantan oil-palm workers and if only one of the 50+ benefits (ethanol production). Dr Smits’s latest innovations hold major promise of equally competitive long-chain hydrocarbon production, and his global GIS overlays suggest sufficient global tropical potential to roughly displace the world’s current oil extraction. Though you may not feel that this work is yet ripe for full description, my personal experience of Dr. Smits’s remarkable work over many years suggests that you could and should refer (perhaps in the context of p 4-24 line 27 on co-benefits) to emerging promising methods of economic/ecological integration to restore tropical rainforests (even after they’re thoroughly logged and burned) with economics superior to those of the activities now destroying those forests. These methods’ carbon uptake is well demonstrated, as is their application to restoring burned or burning Kalimantan peat swamps. [Amory Lovins, United States of America]	Taken into account - We have added new literature to cover restoration techniques in more detail (Griscom et al. 2017, who review 20 conservation, restoration, and improved land management actions that increase carbon storage), although we cannot cover individual projects here. See also box on land-based CDR in chapter 3 (Box 3.11).
18418	35	35	35	35	Dinerstein et al., 2014 not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted
4681	35	37			Change "Gt CO2 per year" by "Gt CO2 yr-1" [Radim Tolasz, Czech Republic]	Accepted
18419	35	37	35	37	Move "Smith et al." into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
1088	35	37	35	42	This section seems ti imply a one or the other situation. Is that the case? Can't both approaches complement each other? [naikoa aguilar-amuchastegui, United States of America]	Not relevant anymore, as the comparison has been removed. However, it was never the intention to say that avoiding deforestation and afforestation are mutually exclusive.
4682	35	39	35	40	Change "per ton of CO2-eq" by "tCO2eq-1" [Radim Tolasz, Czech Republic]	Accepted
14272	35	41	35	41	Context for the 16.8 kt N per year? I don’t know what that means functionally, and for this report that number should be put in context. [Jason Donev, Canada]	Noted - however, this information is now presented in a box on land-based CDR in chapter 3 (Box 3.11). We have added a cross-reference to this.
4683	35	41	35	42	Change "kt N per year" by "ktN yr-1" [Radim Tolasz, Czech Republic]	Accepted
13529	35	41	35	42	I"Nutrient need" or "nutrient input" or "nutrient requirement" might be better then "nutrient impact" [Harold Leffertstra, Norway]	Rejected - we indeed mean the impact on nutrients, not the nutrients required.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1089	35	44	35	55	This paragraph makes several correct points yet it misses some aspects due the fact it is looking at emissions reductions as a whole without looking at the different origins. Here is a good opportunity to explain the need for reducing dynamic and non-dynamic carbon emission. BECCS and particularly CCS should target non-dynamic carbon e.g. from oil. Forests should be aimed at dealing with emissions from dynamic systems such as themselves and AFOLU related emissions. Hence the need to explain complementarity [naikoa aguilar-amuchastegui, United States of America]	Taken into account - the intention is not to imply that different mitigation options are mutually exclusive. A sentence has been added to clarify this at the end of the paragraph. Unfortunately, space constraints keep us from going more deeply into the details of what is called here dynamic vs. non-dynamic emissions.
21178	36	3	36	7	re "low agreement". Thisstatement doesn't do justice to the literture. generally reforestation and other ecosystem restoration is beneficial for biodiversity. For afforestation dependson number of factors. Afforstation under unfccc defiantion that is actually reforestationis often positive. afforestation of grassy biomes is not. [David Cooper, Canada]	Taken into account - we now specify under which conditions the impact on biodiversity would not be favourable, e.g. if performed through plantations of monocultures.
1545	36	4	36	5	For avoided deforestation there is probably more confidence in biodiversity and ecosystem benefits (see : https://earthobservatory.nasa.gov/Features/Deforestation/). Maybe make the distinction between avoided deforestation and afforestation, and give more details to illustrate why there is low agreement on biodiversity and ecosystem benefits (which is somewhat counter-intuitive). [Noé Lecocq, Belgium]	Taken into account - this section now deals only with afforestation and 4.3.3 assesses avoided deforestation now.
1090	36	4	36	7	As in many things, the devil resides in the details. Yet this statement is somehow categorical but lacks of the large enough lit references or detail. Particularly because it seems to argue we should drop and abandon these approaches an do only BECCS? [naikoa aguilar-amuchastegui, United States of America]	Noted - the assessment has been finalized after the FOD and side effects (tradeoffs and co-benefits) are now assessed more systematically, see also Fig. 4.3.8. Note however that nowhere it is said that BECCS is to be preferred over afforestation. We are assessing all options along the same dimensions without prescribing anything.
20620	36	4	63	6	The sentence seems to state that deforestation,afforestation and reforestation not necessarily have a positive effect on ecosystems and biodiversity. For afforestation and reforestation that seems to be reasonable since these options often are carried out as monoculture plantations. Deforestation however is normally linked to losses of biodiversity and weakening of ecosytems, especially when it is carries out in natural forests. Avoiding deforestation should therefor be positive for ecosystems and biodiversity. I urge to check the content and meaning of the statement. [Harold Leffertstra, Norway]	Noted - agreed that the sentence was not well formulated and gave the wrong impression; avoided deforestation is no longer discussed together with afforestation and reforestation now, but is assessed in more detail in section 4.3.3. In 4.3.8 we furthermore emphasize now that adverse impacts emanate from the implementation of afforestation (e.g. through monocultures).
11161	36	9	36	14	The reforestation section considers land sparing from diet shifts, which would also be relevant for BECCS and other land-based NETs. Such consideration of drivers of land-use change should be considered in a more balanced way, across all relevant land-based mitigation types (i.e. not just for reforestation). [Michiel Schaeffer, Netherlands]	Agree - though no literature could be found for the other land-based options, a remark has been added here in this respect.
18420	36	10	36	10	Move "Roos et al." into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted
7964	36	10	36	11	For the US, Peters 2016 did an assessment. A more general assessment was also done by the World Resources Institute in 2016. For food waste reduction, see FAO 2013, HLPE 2014 and Wirsenius 2010. However, freeing land resources is a benefit for all land based CDRs, so shouldn't be mentioned in isolation here for AR. [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - though no literature could be found for the other land-based options, a remark has been added here with respect to this. Röös et al. has been identified as an example only, as we cannot go into much detail here and have to rely on peer-reviewed articles, with a focus on post-AR5 literature. See also comment 11161.
1128	36	17			Maybe I overlooked it, but I could not find a discussion on the “4 per 1000” initiative as a way to "recarbonize the Earth’s soils", e.g., see http://4p1000.org/understand [Rob Swart, Netherlands]	Taken into account - a footnote has been added to this remarkable initiative, however space restrictions keep us from discussing individual projects at length, especially within the main text.
567	36	17	36	17	Please discuss the air pollution impacts of biochar. [Mark Jacobson, United States of America]	Noted - however, biochar is here only assessed as a soil amendment to create negative emissions, not for use. A definition has been added to avoid this confusion.
763	36	17	36	17	Perhaps there is a need to define for a layman the meaning of biochar [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - definition added
20586	36	17	36	47	Biochar production on large scale would require biomass feedstocks on large scale, not unlike the case for BECCS. This demand for feedstock appears to have been overlooked in the text entirely. Assuming that there would be available "residues and wastes" to produce the massive quantities of biochar that would be required to influence global climate is misguided. Dedicated feedstock production would be necessary. The impacts on land, water, biodiversity and human rights all apply. There is scant adequate data, and many unfounded claims made about biochar and many conflicting results. See: “Biochar: A Critical Review of Science and Policy”. 2011. http://www.biofuelwatch.org.uk/2011/a-critical-review-of-biochar-science-and-policy/). There are serious doubts not only about sustainability of production on large scale, but also about the effectiveness of biochar as a means to sequester carbon in soils, and other impacts on soils and crop growth (See for example: Viger, M, Hancock, F M. and Taylor, G. 2015. More plant growth but less plant defence? First global gene expression data for plants grown in soil amended with biochar. Clobal Change Biology, Bioenergy. Vol 7. 658-672). [Rachel Smolker, United States of America]	Noted - a systematic assessment of the peer-reviewed literature has been undertaken on all options by now and is included in the FOD. A reference on the need for a human-rights-based approach has been included at the end of the section where governance and ethics are now discussed.
20587	36	17	36	47	We also point out that biochar production, though it is referred to as a “negative emission” technology, does not usually involve production of any useable energy. The underlying technology involves pyrolysis and gasification, which are combustion technologies fraught with difficulties when scaled up to commercial level. (See: http://www.biofuelwatch.org.uk/docs/Biomass-gasification-and-pyrolysis-ES.pdf). There appears little real potential for generating energy while producing biochar (in addition to inherent tradeoffs). Second we point out that addition of biochar to soils not only reduces albedo due to dark coloration, but also is known to stimulate the oxidation of preexisting carbon in the soil, a phenomenon referred to as priming. Furthermore, most assessments of the longevity of biochar in soils are short term at best. Many rely on studies of charcoal from natural wildfire events, and those studies indicate that the ultimate fate of black carbon in soils is essentially unknown (it often disappears, either via erosion, transport by water and air or by breakdown and oxidation into the atmosphere). (See: Michael I. Bird,1 Jonathan G. Wynn,2 Gustavo Saiz,3 Christopher M. Wurster,1 and Anna McBeath 2015. The Pyrogenic Carbon Cycle. Annuall Review of Earth and Planetary Sciences Vol 43: 273-298) There are many many unknowns about not only the sustainability of biochar production on large scale, but also its' impacts on soils - in some cases it has been shown to inhibit rather than enhance crop growth for example though likely under-reported. Many conflicting results may reflect the great diversity of both soils, and processes and materials used in the production of biochar which lends differing properties. Claims made about biochar should be carefully scrutinzed, convincing and adequate data should be required to back up those claims, and until there is solid grounds for inclusion as a viable approach, biochar should remain outside the scope of a serious evaluation of urgent and timely responses to climate change. [Rachel Smolker, United States of America]	Noted - a systematic assessment of the peer-reviewed literature has been undertaken on all options by now and is included in the FOD, including negative impacts e.g. on albedo. See also comment 50586. With respect to energy, it has been clarified that this is only a low amount in the form of a side product: the energy generated is indeed a co-product: Because pyrolysis is exothermic, the heat required for the production of the biochar is self-sustaining – the “waste” heat thus generated can be used for heat energy while making the biochar for application to the soil. Since the combustion is not complete, the energy generated is not as great as that produced by total combustion (as in bioenergy), but the process nevertheless generates some energy while making the biochar.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
19415	36	17	37	22	These technologies would require similar processes of public engagement and contextual testing. The report should word strongly that authors are sharing scientists' work on CO2 removal - and not necessarily recommending them, due to ethical considerations. [Sumetee Pahwa Gajjar, India]	Noted - all options are assessed along the same dimensions and no prescriptions have been made. As a matter of fact, the literature on public acceptance of BECCS is much larger than for soil carbon storage.
10357	36	18	36	47	More should be added on where addition of Biochar is suitable. Here again the concept of negative emisionss in included but it is not clear. [Maria Jose Sanz Sanchez, Spain]	Taken into account - a definition of how biochar can achieve negative emissions has been added, however, space restrictions prohibit a regional assessment here.
20643	36	21	36	22	The meaning of the sentence is less clear. When biochar is used for sequestering carbon it will extract CO2 from the atmosphere. When used to replace fossil fuel it will not extract CO2 from the atmosphere, but prevent that fossil carbon is turned into CO2 and emitted into the atmosphere. This difference is stated in line 25-26 [Harold Leffertstra, Norway]	Don't understand the suggestion/question: it is clearly stated that the displacement of fossil fuels through biochar is not considered here, as this does not lead to negative emissions.
18421	36	22	36	22	Move "Smith et al." into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
18422	36	25	36	25	Move "Woolf et al." into grey shaded Mendeley field with "2010" [Wilfran Moufouma Okia, France]	Accepted
18423	36	26	36	26	Move "McGlashan et al." into grey shaded Mendeley field with "2012" [Wilfran Moufouma Okia, France]	Accepted
4684	36	27			Change "Gt CO2 per year" by "Gt CO2 yr-1" [Radim Tolasz, Czech Republic]	Accepted
18424	36	27	36	27	Move "Caldecott et al." into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Accepted
13069	36	31	36	32	a problem of resuspension should be mentioned… i.e. see See Genesio et al. (2016) Black carbon aerosol from biochar threats its negative emission potential. Global Change Biology. 22, 2313–2314, [Caserini Stefano, Italy]	Taken into account - biochar is here only assessed as a soil amendment to create negative emissions, not for use. A definition has been added to avoid this confusion.
18425	36	33	36	33	Move "Smith" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
20644	36	33	36	34	Could the full biochar potential be precised as a figure, ...Gt CO2 and the cost expressed in USD/tonn CO2. It will make it easier to compare with other mitigation measures [Harold Leffertstra, Norway]	Accepted - a figure comparing the potential, cost and side effects of all options has been added and the numbers are now in the main text as well.
20833	36	33	36	47	Biochar: there is no mention of the land requirements or environmental impact of producing the biomass needed for conversion into biochar? [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - the full assessment was only finished after the FOD and the results for side effects are now more systematically covered. Also, there is more information in the box on land-based CDR in chapter 3 now (Box 3.11). Even in the FOD there was a discussion of the land requirements (and related impacts on albedo), however.
4685	36	35			Change "per year" by "yr-1" (2x) [Radim Tolasz, Czech Republic]	Accepted
4686	36	36			Change "per year" by "yr-1" (2x) [Radim Tolasz, Czech Republic]	Accepted
20645	36	38	36	39	Does the sentence mean that full deployment of biochar would generate 65 EJ and extract CO2 from the atmosphere? Please clearfy [Harold Leffertstra, Norway]	Taken into account - clarified that the energy generated is indeed a co-product: Because pyrolysis is exothermic, the heat required for the production of the biochar is self-sustaining – the "waste" heat thus generated can be used for heat energy while making the biochar for application to the soil. Since the combustion is not complete, the energy generated is not as great as that produced by total combustion (as in bioenergy), but the process nevertheless generates some energy while making the biochar.
14273	36	45	36	45	Odd citation format: "biochar (Caldecott, B.; Lomax, G.; Workman 2015)" [Jason Donev, Canada]	Accepted
19622	36	46	36	47	Disadvantages should also include those cited earlier with respect to labile nature of soil C at higher T. (chapter 4 page 23 line 36-37) [Doreen Stabinsky, United States of America]	Taken into account . The sentence has been reformulated.
14131	36	50	36	50	In the marine community, OA is used for ocean acidification. Please use another acronym [Elvira Poloczanska, Germany]	Accepted
13070	36	50	37	22	Ocean liming (addition of calcium oxide powder in the seawater) should be better considered and explained in depth, since could results in a net sequestration of very large quantities of atmospheric CO2 into the ocean. This options is widely discussed in literature, and should be better analyzed, [Caserini Stefano, Italy]	Taken into account - a systematic assessment of all CDR options including ocean alkalinization has been finished after the FOD and included in the SOD.
20117	36	50	37	22	Chapter 4 authors should look into literature on, and highlight, the problematic amount of resources that strategies of EW would imply, the resource- and energy intensity of the establishment of required large-scale EW infrastructure, the water consumption as well as the human rights violations that are already a grave concern in the extractive industries of all sorts. [Lili Fuhr, Germany]	Noted - high energy and resource requirements have been covered further down the page. In the SOD a more systematic assessment of side effects has been included. See also Box on land-based CDR in chapter 3 (Box 3.11). A reference on the need for a human-rights-based approach has been included at the end of the section where governance and ethics are now discussed.
18383	36	52	36	52	The bibliographic entry for IPCC, 2014 should have the title as just "Climate Change 2014: Impacts, Adaptation, and Vulnerability" if intending to refer to both Parts A and B of the AR5 WGII report. Right now if just refers to Part B. [Wilfran Moufouma Okia, France]	Accepted
6763	36	53	37	4	While the analysis provided by Renforth and Henderson (2017) does indeed provide some estimates for sequestration potential for ocean alkalinity management poposals, those authors also provide vital qualifications and warnings about the poor state of knowledge regarding impacts and potential downsides of such approaches. These qualifications are absent from the current text of section 4.3.6.5 on alkalinity management, focusing only on calculations of potential sequestration and economic cost. Reference should be made to the substantive concerns raised in the article cited. [Jennifer Morgan, Netherlands]	Taken into account - a systematic assessment of all CDR options including ocean-based and their side effects has been finished after the FOD and included in the SOD.
14274	36	55	37	3	"thereby naturally sequestering about half a billion tons of CO2 each year." We've just switched units, we've been talking about Gt CO2, but this is tonnes of CO2, misleading! Also 'hundreds of billions or tonnes: in line 2 &3 on page 37. [Jason Donev, Canada]	Noted - but the text is gone due to a major shortening of the text. PS: a billion tons is a gigaton
3977	37	1	37	22	The negative effects of ocean alkalization on ocean biogeochemical functioning are not mentioned, e.g. González, M. F., and T. Ilyina (2016), Impacts of artificial ocean alkalinization on the carbon cycle and climate in Earth system simulations, Geophys. Res. Lett., 43, 6493–6502, doi:10.1002/2016GL068576. [Stephanie Henson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - a systematic assessment of all CDR options including ocean-based and their side effects has been finished after the FOD and included in the SOD. See also comment 6763.
18426	37	3	37	3	Move "Renforth and Henderson" into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted
18427	37	4	37	4	Move "Hartmann et al." into grey shaded Mendeley field with "2013" [Wilfran Moufouma Okia, France]	Accepted
6764	37	5	37	7	Once again, the language used in this sentence to describe 'co-benefits' is definitive, unqualified and almost niaive in its assumptions [Jennifer Morgan, Netherlands]	Noted - however, not only tradeoffs, but also cobenefits have to be assessed if there is peer-reviewed literature.
14132	37	6	37	7	Does this refer to freshwaters and land-based agriculture or does this refer to freshwater and marine aquaculture? [Elvira Poloczanska, Germany]	Noted - but the text is gone due to a major shortening of the text.
6765	37	7	37	12	same as comment 22 - in fact, this whole paragraph relies far too heavily on highly optimistic assumptions about benefits and co-benefits that have been claimed by proponents of, e.g. olivine spreading, resulting in their interpretation as specific 'advantages' over other techniques and approaches. [Jennifer Morgan, Netherlands]	Noted - this section does not make any assumptions, but assesses the existing literature and - at most - discusses their assumptions. However, the assessment has been finished after the FOD, so the SOD is naturally more balanced.
18428	37	8	37	8	Move "Taylor et al." into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
13071	37	9	37	10	Negative impacts mean that there will be more or less acidification? Please clarify that according to Taylor enhanced weathering scenarios over less than a third of tropical land could cause significant drawdown of atmospheric CO2 and ameliorate ocean acidification by 2100. [Caserini Stefano, Italy]	Noted - but the text is gone due to a major shortening of the text.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14133	37	9	37	10	The double negative is misleading, suggest clarify by “positive impacts namely reduction of ocean acidification” or some such wording [Elvira Poloczanska, Germany]	Noted - but the text is gone due to a major shortening of the text.
14134	37	9	37	10	Unanticipated ecosystem impacts are not discussed [Elvira Poloczanska, Germany]	Taken into account - a systematic assessment of all CDR options including ocean-based and their side effects has been finished after the FOD and included in the SOD. See Figure 4.3.8, where ecosystem impacts are explicitly included now. See also comment 6763.
20646	37	9	37	10	Consider to change the sentence to "....with significant decreased ocean acidification, [Harold Leffertstra, Norway]	Noted - but the text is gone due to a major shortening of the text.
14275	37	9	37	9	“negative impacts on ocean acidification” this phrase is unclear. Is this preventing ocean acidification (I doubt it), or having a negative impact on the ocean’s pH? I think I see what's meant, but a minor edit would clarify this a lot. [Jason Donev, Canada]	Noted - but the text is gone due to a major shortening of the text.
13072	37	12	37	13	how much? How does it mean "prohibitive"? Consider that for other DACS has been assessed a cost up to 1000 $/tCO2. So I believe it is better to report the overall cost, instead of value judgement [Caserini Stefano, Italy]	Noted - but text has been removed, as a figure comparing all costs, potentials and side effects has been added.
7965	37	12	37	13	Not only costs but also energy requirements and their related emissions. How net negative are these pathways once you take those into account, e.g. the grinding of large amounts of rock material? [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted - the energy requirements are given further down in the same paragraph. A qualification has been added with respect to the need for carbon-free energy for the energy-intensive processes such as the grinding, see also footnote #11.
20834	37	13	37	15	As well as economic costs and the effect of dust, the large upscaling of quarrying, mining and transport activity needed for large scale enhanced weathering would entail significant environmental costs, including loss of habitat as well as the costs, pollution and GHG emissions associated with the additional energy usage required. [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Noted - A more systematic assessment of the side effects of all CDR options has been included in the SOD, see especially synthesis figure 4.3.8, where these side effects are flagged as prevalent in the literature.
4687	37	17			Change "Gt CO2 per year" by "Gt CO2 yr-1" [Radim Tolasz, Czech Republic]	Accepted
18429	37	17	37	17	Smith et al., 2016 not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted
4688	37	19			Change "EJ of energy per year" by "EJ yr-1" [Radim Tolasz, Czech Republic]	Accepted
4689	37	20			Change "Gt CO2 per year" by "Gt CO2 yr-1" [Radim Tolasz, Czech Republic]	Accepted
18430	37	20	37	20	Move "NAS" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Accepted
20669	37	21	37	21	Add "per ton CO2"after USD 20-1,000 [Harold Leffertstra, Norway]	Noted - but text has been removed, as a figure comparing all costs, potentials and side effects has been added.
18431	37	22	37	22	Double bracket [Wilfran Moufouma Okia, France]	Accepted
20106	37	25	29	52	Ocean fertilization as a marine geoengineering technology is internationally banned under the London Protocol of the London Convention! An intergovernmental body attending to this technology and coming to the conclusion its deployment should be prohibited should be reason enough for the IPCC not to consider it as a response strategy to climate change. From the downsides, risks and negative impacts of this technology that are already refered to in this section, the unambiguous conclusion must be drawn that this cannot be considered a credible response strategy. Chapter 4 authors must be a lot clearer on this. [Lili Fuhr, Germany]	Rejected - Concerning ocean fertilization, the London Protocol indeed calls for more research before commercial-scale deployment of ocean fertilization techniques (we have added a sentence on this in the SOD); recent amendments include permits for sub seabed storage of carbon dioxide streams and a new permit system for ocean fertilization - a thorough assessment of ocean fertilization in SR1.5 can help informing such processes, while the amendments have not entered into force, yet. In general, excluding options from the assessment is not possible because the IPCC cannot be prescriptive or give authors' opinions. Note again that section 4.3.8 is meant to comprehensively assess the selected CDR options along the same dimensions.
11001	37	25	37	25	Flag some of the legal/ethical dimensions of untested options - isnt ocean fertilisation prohibited under the London Convention? [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - a final paragraph on ethics has been added to section 4.3.8, as also relevant for other CDR options. (Concerning ocean fertilization, the London Protocol indeed calls for more research before commercial-scale deployment of ocean fertilization techniques (a sentence pointing this out has been added); recent amendments include permits for sub seabed storage of carbon dioxide streams and a new permit system for ocean fertilization - a thorough assessment in SR1.5 can help informing such processes, while the amendments have not entered into force, yet).
6664	37	25	37	52	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]	Taken into account - a final paragraph on ethics has been added to section 4.3.8, as also relevant for other CDR options and ocean fertilization is flagged as an example. Note however that the London Protocol indeed calls for more research before commercial-scale deployment of ocean fertilization techniques, but recent amendments include a new permit system for ocean fertilization - a thorough assessment of ocean fertilization in SR1.5 can therefore help informing such processes, while the amendments have not entered into force, yet.
20129	37	25	38	52	On ocean fertilization: "During the 1990s, researchers postulated that for every tonne of iron added to seawater, tens of thousands of tonnes of carbon (and hence CO2) could be fixed by the resulting blooms of phytoplankton. This quantity has been whittled down over the years with the realization that most of the CO2 absorbed by such blooms - stimulated either by adding iron or other nutrients to seawater, or by enhancing upwelling through mechanical means - would be released back into the atmosphere when the phytoplankton decomposed. Moreover, a large-scale increase in plankton productivity in one region (across the Southern Ocean, say) could reduce the yields of fisheries elsewhere by depleting other nutrients, or increase the likelihood of mid-water deoxygenation. Such risks have resulted in the near-universal rejection of ocean fertilization as a climate intervention, through bodies such as the Convention on Biological Diversity (CBD)" Williamson 2016 Scrutinize CO2 removal methods. Nature 530(7589):153-155. [Lili Fuhr, Germany]	Noted - Rather than a commentary, we prefer to cite Williamson (2012) and we have already in the FOD pointed out the low confidence in actual removal potentials.
21179	37	26	37	29	this may not be "anotyher option". Techncially unproven and generally prohibitedunder the London Convention. [David Cooper, Canada]	Rejected - Concerning ocean fertilization, the London Protocol indeed calls for more research before commercial-scale deployment of ocean fertilization techniques, but recent amendments include a new permit system for ocean fertilization - a thorough assessment of ocean fertilization in SR1.5 can help informing such processes, while the amendments have not entered into force, yet. In general, excluding options from the assessment is not possible because the IPCC cannot be prescriptive or give authors' opinions. Note again that section 4.3.8 is meant to comprehensively assess all CDR options along the same dimensions. Whether there is insufficient evidence will then be an outcome of the assessment, but cannot just be decided ex ante.
20635	37	26		52	The aspect of deep water hypoxia caused by large scale ocean fertilization has not been considered [Hans Poertner, Germany]	Taken into account - the assessment of all CDR options has only been finished after the FOD, so the SOD now has a more systematic base - also for the side effects. Both surface anoxia and deep water hypoxia are now discussed.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6766	37	26	37	27	See comments above - ocean fertilisation should not be presented as 'an option' in terms of response to climate change - it has very largely been discredited as such and is not allowed in any deployment sense under the terms of the London Convention and Protocol Resolution (set to become legally binding in the coming years). [Jennifer Morgan, Netherlands]	Rejected - Concerning ocean fertilization, the London Protocol indeed calls for more research before commercial-scale deployment of ocean fertilization techniques, but recent amendments include a new permit system for ocean fertilization - a thorough assessment of ocean fertilization in SR1.5 can help informing such processes, while the amendments have not entered into force, yet. In general, excluding options from the assessment is not possible because the IPCC cannot be prescriptive or give authors' opinions. Note again that section 4.3.8 is meant to comprehensively assess all CDR options along the same dimensions. Whether there is insufficient evidence will then be an outcome of the assessment, but cannot just be decided ex ante.
6767	37	27	37	31	It is not true that the low confidence in the amount of carbon that could be stored through ocean fertilisation arises because only small-scale field experiments and theoretical modelling have been conducted so far. The low confidence has come as a result of the field testing that has been done, i.e. it is a factor of the complexity and variability of the system under study, and not the lack of such study (see e.g. Boyd et al. 2007 [DOI: 10.1126/science.1131669], Williamson et al. 2012 https://doi.org/10.1016/j.psep.2012.10.007]). This is clear from many authoritative published assessments on ocean fertilisation. [Jennifer Morgan, Netherlands]	Noted - we already cite Williamson et al. (2012), who state that "On the basis of small-scale field experiments carried out to date and associated modelling, the maximum benefits of ocean fertilization as a negative emissions technique are likely to be modest..." In addition, ".. arrangements for the international governance of further field-based research on ocean fertilization are currently being developed, primarily under the London Convention/London Protocol.", so it is not clear what large-scale field testing is referred to here that supposedly took place before these references were published.
18432	37	29	37	29	Williamson al., 2012 not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted
6768	37	29	37	29	Williamson et al. (2012) does not currently appear in the reference list. Assuming that it is Williamson, et al. (2012). Impacts of Climate-Related Geoengineering on Biological 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 (http://www.cbd.int/doc/publications/cbd-ts-66-en.pdf), it is important also to bear in mind that the CBD has since published an update to that original analysis, which would also be worth more indepth analysis and inclusion in Chapter 4 (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, 158 pages. https://www.cbd.int/doc/publications/cbd-ts-84-en.pdf) [Jennifer Morgan, Netherlands]	Taken into account - This is not about biodiversity, but the reference is: Phillip Williamson, Douglas W.R. Wallace, Cliff S. Law, Philip W. Boyd, Yves Collos, Peter Croot, Ken Denman, Ulf Riebesell, Shigenobu Takeda, Chris Vivian, Ocean fertilization for geoengineering: A review of effectiveness, environmental impacts and emerging governance, In Process Safety and Environmental Protection, Volume 90, Issue 6, 2012, Pages 475-488, ISSN 0957-5820. It has been incorporated in the reference list, thanks for spotting.
17234	37	31	36	32	It is better to delete the part of the sentence: "who 32 also makes this point for mineralization techniques" [Himangana Gupta, India]	Accepted
18433	37	31	37	31	McLaren 2012 doesn't need brackets [Wilfran Moufouma Okia, France]	Accepted
4690	37	32			Add explanation to OF [Radim Tolasz, Czech Republic]	Accepted - the explanation at the beginning of the section has been expanded.
11162	37	32	37	33	There is broad agreement that OF as a negative emissions technique is likely to play a modest role in offsetting current or future climate forcing - what is this based on? Only one paper (from 2012) is cited. Ocean fertilization is a highly controversial option, and this section should put greater emphasis on the associated risks. Its classification as a CDR technique could be questionned given these risks and the uncertainty over whether carbon is actually removed. In addition, it must be discussed here that OF is problematic under the United Nations Convention on Biological Diversity (CBD) and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) [Michiel Schaeffer, Netherlands]	Taken into account - Though the 2012 article is a review of the whole ocean fertilization literature, the assessment that has been finished after the FOD now takes into account all ocean fertilization papers in the literature, even if not explicitly listed in the main text (see synthesis figure 4.3.8).
18434	37	33	37	33	Williamson al., 2012 not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted
18435	37	34	37	34	Williamson al., 2012 not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted
20711	37	40	40	21	Areplace "interior waters"with "deep waters" [Harold Leffertstra, Norway]	Accepted
18436	37	45	37	45	Williamson al., 2012 not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted
6769	37	45	37	46	This is an accurate reference to a statement made in that paper, but is somewhat outdated as international governance of field-based research on ocean fertilisation is already a reality, as noted above (and as reflected by Williamson & Bodle 2016, among others) [Jennifer Morgan, Netherlands]	Accepted - ocean fertilization example has been added to new governance paragraph in this section.
18437	37	48	37	48	Move "NAS" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Accepted
14276	37	48	37	48	Graphically showing the discussed potentials would be quite helpful. [Jason Donev, Canada]	Accepted - a figure comparing the potential, cost and side effects of all options has been added
4691	37	49			Change "Gt CO2 per year" by "Gt CO2 yr-1" [Radim Tolasz, Czech Republic]	Accepted
18438	37	50	37	50	Move "Bopp" into grey shaded Mendeley field with "2006" [Wilfran Moufouma Okia, France]	Accepted
18439	37	50	37	50	Move "Harrison" into grey shaded Mendeley field with "2013" [Wilfran Moufouma Okia, France]	Accepted
18440	37	50	37	50	Move "McLaren" into grey shaded Mendeley field with "2012" [Wilfran Moufouma Okia, France]	Accepted
4692	37	50	37	51	Change "Gt CO2 per year" by "Gt CO2 yr-1" [Radim Tolasz, Czech Republic]	Accepted
4693	37	51			Change "Gt CO2 per year" by "Gt CO2 yr-1" [Radim Tolasz, Czech Republic]	Accepted
4694	37	52			Change "Gt CO2 per year" by "Gt CO2 yr-1" [Radim Tolasz, Czech Republic]	Accepted
4307	38				Section 4.3.6.7. Very good and brief assesment of CCU. Do not change this, even if you get comments from advocates of CCU promoting it as a climate change mitigation tool (which is not). [Abanades Carlos, Spain]	Noted - thanks!
7990	38				It is indicated that "carbon dioxyde has a large potential as synthetic feedstock for chemical material". CO2 has a very low formation enthalpy (-393 kJ/mole) in comparison with chemical compounds of interest (plastics, CH4, CO, fuels, etc… formation enthalpy ~-50 to -100 kJ/mole per atom carbon. Polypropylene carbonate has a formation enthalpy of ~ - 140 kJ/mole per atom of carbon). This means that the formation enthalpy difference must be compensated by a very important energy input to produce synthetic feedstocks from CO2. When process losses are accounted for, the necessary energy input is generally much greater (factor 4 to 10) than the energy that has been gained from the carbon combustion... This is generally valid for all CO2 chemical conversion processes and hampers seriously the interest of all these chemical processes. As in the case of DACS, this energy input should best be directly used .... to replace fossile fuels combustion and avoid CO2 production ... [Jean Marie Seiler, France]	Noted - but CCU is now being assessed in 4.3.2.
20636	38	1		18	A more detailed discussion is needed of these various aspects as some of these technologies are already in use. [Hans Poertner, Germany]	Noted - but CCU is now being assessed in 4.3.2.
940	38	1	38	1	Again CCS has its own section. Why is this not combined with the other CCS sections? [Elizabeth Aldrich, United States of America]	Accepted - CCS is now only assessed in 4.3.2 now.
9454	38	1	38	1	Replace the title by 'Carbon capture and utilization'. Don't speak here about storage. [Isabelle Czernichowski-Lauriol, France]	Taken into account - CCU and CCS do not result in negative emissions and are now assessed in 4.3.2. Only if the CO2 is more permanently stored in longer-lived products do we speak of CCUS, which remains therefore in this section. We hope this clarifies things.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
19325	38	1	38	18	It has to be said here that using CO2 as chemical building block requires a large amount of energy input to reduce the carbon (carbonates are the ONLY exception). Such energy must come for renewables and is huge (because of the second law of thermodynamics); no catalyst can do anything to avoid such huge penalty. If the renewable energy needed to reduce CO2 were used to substitute carbon-basedd electricity the CO2 emission mitigation effect would be much stronger. [Marco Mazzotti, Switzerland]	Noted - this is one of the main reasons that leads to a rather pessimistic outlook for the role of CCU in mitigation, see e.g. MacDowell et al. (2017) referenced here.
19326	38	1	38	18	The seventh chapter of the SRCCS (2005) should be cited here because the arguments reported there about CO2 utilization are still valid (but forgotten by many people). [Marco Mazzotti, Switzerland]	Noted - comment transferred to 4.3.2, where CCU and CCS are now assessed.
6092	38	1	38	18	This is a contentious topic and this paragraph succeeds in being well balanced, focussing on mitigation, and with recent references. [Tim Dixon, United Kingdom (of Great Britain and Northern Ireland)]	Noted - thanks!
2794	38	1	38	18	This section considers CO2 capture and utilization (CCU) solely as a potential negative emissions option. It could be a zero emissions option and help meet the pathway by displacing fossil based emissions. And if adopted prior to 2050 could reduce the need for CCS and subsequent BECCS. Captured CO2 (from ambient air or emissions streams using renewable electricity) and H2 (by electrolysis or other techniques using renewable electricity) can be used to produce zero emissions liquid fuels and petrochemical feedstocks that displace fossil based liquid fuels and feedstocks thus helping to meet the 1.5oC target. Peng Wang et al. Lattice Defect-Enhanced Hydrogen Production in Nanostructured Hematite-Based Photoelectrochemical Device, ACS Applied Materials and Interfaces, 2012 dx.doi.org/am300395p (more recent literature probably available). Michele Aresta et al., State of the art and perspectives in catalytic processes for CO2 conversion into chemicals and fuels ..., Journal of Catalysis, 343 (2016) pp. 2-45; Global Roadmap for Implementing CO2 Utilization, 2016 https://www.google.ca/search?q=Global+Roadmap+for+Implementing+CO2+Utilization&ie=utf-8&oe=utf-8&gws_rd=cr&dcr=0&ei=95u6WffeHuLn0gLiilPYAQ; and http://www.advancedsciencenews.com/achieving-gty-co2-utilization-negative-co2-emissions/. [Erik Haites, Canada]	Noted - but beyond the scope of this section. CCU and CCS do not result in negative emissions and are now assessed in 4.3.2. Only if the CO2 is more permanently stored in longer-lived products do we speak of CCUS, which remains therefore in this section. We hope this clarifies things.
20211	38	1	38	18	Fundamental to utilisation in the context of climate mitigation is that it leads to reduction of the GHG concentration in the atmosphere. Not all utilisation option lead to emission reduction per se. A recent report (2017) published by ZEP on CO2 utilisation might be useful here. [Ton Wildenborg, Netherlands]	Taken into account - we focus only on carbon removal here and stress that CCUS does not necessarily have to lead to negative emissions, indeed. Unfortunately, we cannot include non-peer-reviewed literature, but we cite van Assen et al. to make this point.
9457	38	2	38	18	This paragraph is good but does not apply specifically to this chapter 'Carbon dioxide from the atmosphere". It concerns CO2 utilisation whether the CO2 comes from power plants, industrial plants, bioenergy plants, or air. Therefore CO2 use could be mentioned also elesewhere in the report. And there is no need to make a special paragraph on page 38 as the contribution of the use of CO2 from air or bioenergy plants is very low compared to the mitigation needs. [Isabelle Czernichowski-Lauriol, France]	Accepted - We focus only on removal now and CCU has been moved to 4.3.2.
7966	38	2	38	2	Chemicals and materials? Otherwise just "chemicals". [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted - but this part of the text is gone after major shortening of the CDR section.
20324	38	2	38	3	Carbon dioxide is toxic in high concentrations [Marine Gorner, France]	Not sure what the suggestion is.
11160	38	5	38	5	It should be made clear that Enhanced Oil Recovery leads to further emissions [Michiel Schaeffer, Netherlands]	Noted - but this part of the text is gone after major shortening of the CDR section.
7967	38	8	38	18	This is an important discussion. A critical discussion of CO2-EOR is also in IEAGHG 2016-06 "Emissions accounting for CO2-EOR". [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted - but this part of the text is gone after major shortening of the CDR section.
18441	38	8	38	8	Move "Assen et al." into grey shaded Mendeley field with "2013" [Wilfran Moufouma Okia, France]	Accepted
9455	38	9	38	9	Say 'CCU', not 'CCUS' [Isabelle Czernichowski-Lauriol, France]	Rejected - CCU only recycles CO2 and is assessed in 4.3.2. CCUS stores the CO2 in a longer-lived product, so that it is in principle removed from the atmosphere (though our assessment is rather pessimistic with respect to this CDR potential).
9456	38	12	38	12	Say 'CCU', not 'CCUS' [Isabelle Czernichowski-Lauriol, France]	Rejected - CCU only recycles CO2 and is assessed in 4.3.2. CCUS stores the CO2 in a longer-lived product, so that it is in principle removed from the atmosphere (though our assessment is rather pessimistic with respect to this CDR potential).
18442	38	13	38	13	Move "MacDowell et al." into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted
14277	38	19	38	19	Enhanced oil recovery has been promoting oil extraction, thereby increasing the amount of oil that we can afford to get out of the ground. Something should be said to address that issue somehow. [Jason Donev, Canada]	Noted - but the text is gone due to major shortening of the CDR section
18443	38	29	38	29	Move "Boucher and Folberth" into grey shaded Mendeley field with "2010" [Wilfran Moufouma Okia, France]	Accepted
13073	38	30	38	32	It is true that all the DAC technologies are not currently economically or energetically suitable for the large scale air capture; the point is whether or not in the future the costs could be reduced, through R&D and learning by doing. Something should be added on this point [Caserini Stefano, Italy]	Accepted
18444	38	37	38	37	Double bracket [Wilfran Moufouma Okia, France]	Accepted
11168	38	42			Blue carbon is not a scientific term. Perhaps a more scientific term could be used. This section should place greater emphasis on the risk of reversal / the uncertainties in storage and the risks associated with using "blue carbon" to offset other emissions. Mitigation in coastal ecosystems should be a co-benefit of adaptation / biodiversity conservation, not the driver. [Michiel Schaeffer, Netherlands]	Taken into account - subsection renamed and risk of reversal emphasized. Blue carbon used with quotation marks wherever unavoidable.
13405	38	42	39	9	I advise against using BC as acronym for Blue Carbon, as it is used for Black Carbon aerosols in earlier section 4.3.5. [Helene Muri, Norway]	Accepted
20116	38	42	39	9	Sea grasses, mangroves, and salt marshes, or any other terrestrial or coastal sink, must not serve as offset capacity. In a post-Paris world, there is no room for offsets. International NGOs have long called for a strict and consistent separation in the way emission sources and sinks are accounted in emission inventories. Ecosystems - terrestrial and coastal alike - must be carefully restored, but as global commons without a price tag per unit of CO2 placed on them, and without being abused for offsetting fossil emissions. [Lili Fuhr, Germany]	Noted - this is about "enhancing" sinks, i.e. storing carbon in addition to existing sinks as with afforestation.
21180	38	42	39	9	suggest tomove theis blue carbon section up to follow section on afforestation and reforestation which should be expansed tocover all ecosusytem restoration [David Cooper, Canada]	Taken into account - it's a logical suggestion, but we eventually decided to keep afforestation separately, as the potentials of other NCS can overlap and do not necessarily all have to lead to negative emissions. The latter part is then assessed in 4.3.3. The blue carbon text has been shortened and integrated into a section called "other and emerging CDR options". New literature on ecosystem restoration/NCS has also been added (Griscom et al. 2017).
14278	38	43	38	44	“under the label of, which” is there a missing word before the comma? [Jason Donev, Canada]	Noted - however, this part of the text is gone due to shortening
20835	38	44			insert 'blue carbon' after 'of'? [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Noted - however, this part of the text is gone due to shortening
7683	38	44	38	44	Should presumably read “of ‘blue carbon’, which…”. [Amory Lovins, United States of America]	Noted - however, this part of the text is gone due to shortening
14090	38	44	38	44	of?? ‘blue carbon’ missing from sentence [Elvira Poloczanska, Germany]	Noted - however, this part of the text is gone due to shortening
14135	38	44	38	44	an algae in coastal and open ocean [Elvira Poloczanska, Germany]	Noted - however, this part of the text is gone due to shortening
7830	38	44	38	44	Should presumably read “of ‘blue carbon’, which…”. [Amory Lovins, United States of America]	Noted - however, this part of the text is gone due to shortening
18445	38	45	38	45	Move "Macreadie et al." into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
17235	38	46	38	46	BC' is generally used more for black carbon. This could create confusion, especially where the list of abbreviations will be given [Himangana Gupta, India]	Accepted
18446	38	51	38	51	Move "Johannessen and Macdonald" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
18447	38	55	38	55	Move "Johannessen and Macdonald" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
9344	38	55	38	55	There is a missing word "of" in the phrase "to the meeting (of) the 1.5°C target" [Siir KILKIS, Turkey]	Taken into account - has been fixed by keeping "of" and deleting "the", as the sentence needed to change during a major shortening of this section.
4308	39				As a non-expert, I find section 4.3.7 very interesting to read. But the lenght dedicated to this subsection highlights a big problem in the structure and coverage of key topics in the whole chapter. Example: this Solar Radiation Management subsection desrves almost 3 pages and 3 subsections, while MAJOR RENEWABLE TECHNOLOGIES (wind, solar PV, concentrated solar power, geothermal, tidal etc) are treated in half a page or less, and crosscutting big topics like Energy Storage (from thermal to electric, from short term to seasonal, from small devices to network balancing large scale energy storage systems) get very little attention. In a report on how to get to 1.5ºC this simply looks odd, and it is highly missleading: we may be putting the spot light on the wrong issues/tools ¡¡¡. [Abanades Carlos, Spain]	Taken into account, text shortened in order to make chapter more balanced
6206	39		41		This discussion of SRM ought to be made more specifically focused on the 1.5C temperature question. At the moment it repeats the various discussions in different parts of AR5, with a bit of updating for more recent literature and debates. It seems to me there is an opportunity here to be quite specific about which SRM/CDR technologies might be brough into play within the timeframes to avoid 1.5C, and with what sorts of risks associated with them. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, SRM implications in context of 1.5 covered in the SRM Box, here we have revised text to clarify scenarios of implementation related to 1.5
18448	39	5	39	5	Move "Johannessen and Macdonald" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
17391	39	7	39	9	Virtually no assessment work has been done on the impact on Blue Carbon release from the practice of dredging for shipping channels, adaptation sea defences and port development. The estimates of material dredged are between 250-400 million tonnes per yr worldwide and could become higher once increased sea defence work and restoration of shipping channels is required from larger/more violent wather conditions. Much of the near shore and riverine dredging is potentially high in degraded organic matter. [Gavin Allwright, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - there are a number of CDR options, for which the evidence base was low, as is the case for the side effects of blue carbon. It has therefore been moved to a section entitled "other and emerging CDR options", just explaining the concepts and highlighting the need for further research.
18449	39	8	39	8	Move "Jones" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
14279	39	12	39	12	A figure would probably be more helpful than a table, but both could work. [Jason Donev, Canada]	Accepted
18450	39	14	39	14	Move "Robock et al." into grey shaded Mendeley field with "2009" [Wilfran Moufouma Okia, France]	Accepted
1129	39	15			Personally, I find the attention to SRM (including the blue box at the end 12 out of 100 pages) way to much. Emissions reductions in the energy sector seem to get less space! [Rob Swart, Netherlands]	Taken into account, it was shorten
18451	39	15	39	15	Move "The Royal Society" into grey shaded Mendeley field with "2009" [Wilfran Moufouma Okia, France]	editorial
4360	39	15	39	34	Include in this section some of the ideas discussed in the work developed by Parson (2017) (PNAS) - Climate policymakers and assessments must get serious about climate engineering [Gabriel de Oliveira, Brazil]	Taken into account. Suggestions of this paper we have already took into account
12288	39	15	41	49	I think a brief discussion about what can be inferred from the Paris Agreement would be needed here. I also suggest that this includes a brief discussion of whether SRM can be used in the definition of "balance" (see discussion in Fuglestvedt et al., 2017 (see references in chapter 1). [Jan Fuglestvedt, Norway]	Noted, we had to cut text significantly, and due to the space limitation we cannot add proposed discussion and reference to the text
13406	39	15	41	49	It is not clear why the focus is on SAI and MCB in Section 4.3.7, whilst on SG and SAI in Section 3.7.3. I would suggest to assess SG, SAI and MCB in both sections. [Helene Muri, Norway]	Taken into account, Section 3.7.3. moved to SRM Box, where we discuss all measures. 4.3.7. focuses mostly on SAI
20142	39	15	41	49	McLaren 2016 [Lili Fuhr, Germany]	Noted. Already cited in 4.3.9
20144	39	15	41	49	Chapter 4 authors should be particularly aware of their moral and scientific responsibility and draw appropriate conclusions from the various risks associated with SRM already referenced in the chapter that make any serious consideration of SRM technologies undefensible and untenable. [Lili Fuhr, Germany]	Noted
20151	39	15	41	49	Braun et al. 2017 Public perception of climate engineering and carbon capture and storage in Germany: survey evidence, in: Climate Policy, http://dx.doi.org/10.1080/14693062.2017.1304888 - show how SRM is "widely rejected" among the German public. [Lili Fuhr, Germany]	Accepted, paper cited
1213	39	15	41	49	Too much space dedicated to SRM. The details are interesting and important but better dealt with in one single, comprehensive, x-chapter box. We can discuss this again at LAM 3. [Petra Tschakert, Australia]	Taken into account, it was shorten
20157	39	15	41	49	See Tilmes, S., and Coauthors, 2013: The hydrological impact of geoengineering in the Geoengineering Model Intercomparison Project (GeoMIP). J. Geophys. Res. Atmos., 118, 11,036-11,058, doi:10.1002/jgrd.50868. [Lili Fuhr, Germany]	Noted, it is part of the SRM Box and cited there
21181	39	15	41	49	for a comprehensive discussion of regulatory frameworks for SRM see: Bodle, R., with Homan, G., Schiele, S., and E. Tedsen (2012). The Regulatory Framework for Climate-Related Geoengineering Relevant to the Convention on Biological Diversity. Part II 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. ;and: 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; [David Cooper, Canada]	Accepted, we refer to the CBD in the text, and cited proposed literature
21182	39	15	41	49	note that the convention on biological Diversity has adopted decisions on geoengineering,including SRM.see decision XI/20 (https://www.cbd.int/decision/cop/default.shtml?id=13181) and Decsision X/10,and decision XI/33,para 8(w) which invites parties: to "Ensure, ... in the absence of science based, global, transparent and effective control and regulatory mechanisms for geo-engineering, and in accordance with the precautionary approach and Article 14 of the Convention, that no climate-related geo-engineering activities76 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 environment" [David Cooper, Canada]	Taken into account, existence of these decisions mentioned in the text

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20159	39	15	41	49	Robock, Alan, 2008: 20 reasons why geoengineering may be a bad idea. Bull. Atomic Scientists, 64, No. 2, 14-18, 59, doi:10.2968/064002006: 1. Effects on regional climate, 2. Continued ocean acidification, 3. Ozone depletion, 4. Effects on plants, 5. More acid deposition, 6. Effects on cirrus clouds, 7. Whitening of the sky, 8. Less sun for solar power, 9. Environmental impacts of implementation, 10. Rapid warming if deployment stops, 11. There's no going back, 12. Human error, 13. Undermining emissions mitigation, 14. Cost - especially when accounting for social and environmental costs and damages, 15. Commercial control of technologies, 16. Military use of the technology, 17. Conflicts with current treaties (ENMOD), 18. Control of the thermostat - impossibility of democratic governance and controllability, 19. Questions of moral authority, 20. Unexpected consequences. Chapter 4 authors should make sure these fundamental problems are adequately covered and reflected in their treatment of SRM. [Lili Fuhr, Germany]	Taken into account. Some of them addressed in the SRM Box, others are not discussed in peer-reviewed literature
10220	39	15	41	59	The SRM section is good.Note it should not call for more research at end.It is rather review like though at would benefitr from a cleaer assessment [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	accepted, text revised
6187	39	20	39	20	The citation "Visioni et al., 2016" refers to the manuscript in discussion on ACPD during 2016. The paper has then been accepted on ACP in 2017, so that the correct citation should be: Visioni et al., 2017. Complete reference follows: Visioni, D., G. Pitari, and V. Aquila, 2017: Sulfate geoengineering: a review of the factors controlling the needed injection of sulfur dioxide. Atmos. Chem. Phys., 17, 3879-3889, doi: https://doi.org/10.5194/acp-17-3879-2017. [Giovanni Pitari, Italy]	Accepted, reference corrected
16419	39	20	39	21	What Robock and others have mainly raised are questions to be investigated. What they have not generally done, and what needs to be done, is to consider these issues and risks in terms of an assessment of GHG without SRM versus GHG with SRM and not just list questions about risks and concerns about SRM all on its own. In addition, most of the risks and concerns have been raised in the context of invoking SRM to a large degree and quite suddenly in the future (such as going from 2 times CO2 climate to one times CO2 climate). This is very different that the potential SRM implementation that might done in a comprehensive response of effort would be to use SRM to shave off the overshoot of some temperature level (say 1.5 C, or better yet 0.5 C), which would involve a gradual phasing up of SRM and then continuing it as needed until mitigation and CDR allow it to be phased out (so there would be an exit strategy). There are not really many papers considering such implementation strategies, but this would clearly be the preferred approach to a sudden intervention. That this strategy might be workable and effective is suggested by the apparent contribution to slowing global warming that was played by small volcanic eruptions, as indicated in the recent analyses of Santer et al.--except for the very persistent efforts of interested scientists, virtually no one noticed the cooling influence that was exerted. If implemented to shave off potential overshoot warming, the idea would be to phase SRM up each year only to the extent to offset the warming from the preceding year's emissions, and so adjustments coud easily be made. Also, using such an incremental application would also allow ongoing iteration and phasing down in the event of volcanic eeuptions, which would overcome a number of the risks and concerns raised by Robock et al. and other investigators, who seem to be thinking about situations with weak mitigation efforts followed by sudden large SRM implementation to offset unacceptable impacts (an emergency response approach that would, in actuality, come to late to avoid important impacts). So, I would very much urge a modification of the discussion here focusing only on potential implementation to shave off relatively modest overshoot warming and to bring overall warming back down to 0.5 C. [Michael MacCracken, United States of America]	Taken into account, clarifications about different implementation schemes added to the section
6188	39	21	39	21	Another study on possible side effects of sulfate geoengineering was under discussion in ACPD and recently accepted on ACP: it focuses on the SAI impact on methane transport and lifetime. Citation: Visioni et al., 2017b. Complete reference follows: Visioni, D., G. Pitari, V. Aquila, S. Tilmes, I. Cionni, G. Di Genova, and E. Mancini, 2017: Sulfate geoengineering impact on methane transport and lifetime: results from the Geoengineering Model Intercomparison Project (GeoMIP). Atmos. Chem. Phys., 17, 11209-11226, doi: https://doi.org/10.5194/acp-17-11209-2017. [Giovanni Pitari, Italy]	Accepted, reference added
16420	39	21	39	23	With respect to potential implications, all SRM studies indicate that climate perturbations are reduced as compared to situations without SRM. Again, the assessment to be done is whether GHG with SRM will be resulting in smaller departures from an appropriate baseline (say mid to late 20th century climate) as compared to the GHG perturbation alone. Of course, a perfect return to preindustrial will not result (and, such a lower situation is likely not optimal given ecosystem adjustments over the last two centuries)--the issue to be asked is whether SRM will return the range of the climate to roughly its earlier state, and all simulatioons are showing this is the case virtually everywhere. I would note also that while stratospheric aerosol injection may make the most sense for dealing with large temperature adjustments, cloud brightening and cirrus thinning may well make much more sense if one is only slicing a relatively small amount (e.g., 1-2 C) off of the temperature, and these and other approaches have the potential to be somewhat regionally tailored and by not modifying the solar radiation coming in that drives the monsoons, are unlikely to cause the worst o f the impacts that Robock et al. and others are typically most concerned about. Thus, I would suggest a rewriting of this sentence, starting with an explanation of this alternative approach to implementation (this matters, one cannot generalize and just say "If SRM is employed") and to indicate that relevant SRM simulations all indicate that this can reduce the magnitude of changes in the climate, and so generally reduce adverse impacts. [Michael MacCracken, United States of America]	Taken into account, text changed
15418	39	23	39	23	In opinion of the reviewer this sentence should be added: "Geoengineering would also change urban and agricultural landscapes, because of the use of reflective roofing material and growing high-albedo crops". [Francisco Javier Hurtado Albir, Germany]	Noted, but it is the topic of SRM Box and discussed there
16421	39	25	35	26	Well, Chapter 3, at least, does not provide a full explanation, and does not provide any discussion of the gradual implementation approach to offset the overshoot. Such an implementation, especially if tailored regionally, has just not received much research attention, even though it would seem to make the most sense, both scientifically and politically. In this gradual implementation, iteration is possible, and all that would happen if it did not work out would be a return to the overshoot level. If instead there were little or no mitigation and no 1.5 C or lower target, so perhaps eventually a need for a strong implementation of SRM, then the types of questions that are currently raised here would arise, but that is not what this report is about--it is about doing as much mitigation as possible and so the question becomes whether a bit of additional SRM (later phased out as CDR is phased up) makes sense? [Michael MacCracken, United States of America]	Noted, this approach described in SRM Box. Also please note that we rewrite all SRM Box and section 4.3.9 significantly in order to discuss SRM in terms of 1.5C and in context of "peak shaving scenario"
6770	39	25	39	28	It will be important to strengthen the links considerably between the treatment of SRM in Chapters 3 and 4, as the two currenyl give markedly different and often conflicting perspectives. If section 4.3.7 attempts to assess the feasibility of two SRM options, it must be acknowledged that this cannot be done credibly by considering governance, economic and ethical viewpoints only, divorced from the issues of practicality, controlability, regional variance and adverse impacts that are addressed in Chapter 3. Doing so has so far resulted in an unreasonably optimistic assessment of feasibility in Chapter 4. [Jennifer Morgan, Netherlands]	Taken into account, Section 3.7.3. moved to SRM Box, where we discuss all measures. 4.3.9. focuses mostly on SAI. We referred to the Box where side effects described

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16422	39	27	39	29	This specification of the two options is inadequate as it does not say how these potential approaches might be used: is the consideration for using these approaches as a substitute for aggressive mitigation with the intent of taking the global average temperature back to its 19th century baseline (as virtually all discussion and simulations to date seems to indicate) or to gradually phase in SRM to limit or moderate the overshooting of a particular temperature level such as 1.5 C and then to aim to phase SRM out as CDR takes over and helps return the global average temperature to 0.5 C. How a technology is used really can matter--and not indicating how SRM might be used here is an important omission. [Michael MacCracken, United States of America]	Taken into account, clarifications about different implementation schemes added to the section
1602	39	28	39	28	Change "aerosols" to "aerosol" [Alan Robock, United States of America]	editorial, text revised
15691	39	28	39	29	The statement that SAI and MCB would be "effective" is not proven anywhere, thus there is no basis. Delete that sentence. [Elenita Daño, Philippines]	Taken into accounted, it was rewritten "This section assesses the feasibility….. focusing on Stratospheric Aerosol Injection (SAI) unless otherwise indicated, as most available literature is about SAI. "
15443	39	28	39	29	The statement that SAI and MCB would be "effective" is not proven anywhere, thus there is no basis. Delete that sentence. [Elenita Daño, Philippines]	Taken into accounted, it was rewritten "This section assesses the feasibility….. focusing on Stratospheric Aerosol Injection (SAI) unless otherwise indicated, as most available literature is about SAI. "
13407	39	29			effective? In terms of what? Offsetting radiative forcing? Offsetting global temperatures? [Helene Muri, Norway]	Taken into accounted, it was rewritten "This section assesses the feasibility….. focusing on Stratospheric Aerosol Injection (SAI) unless otherwise indicated, as most available literature is about SAI. "
1603	39	29	39	29	SAI and MCB at the moment appear to be the technologies that could become most effective Actually, only SAI could possibly be effective. Current research presents many questions about MCB. [Alan Robock, United States of America]	Taken into accounted, it was rewritten "This section assesses the feasibility….. focusing on Stratospheric Aerosol Injection (SAI) unless otherwise indicated, as most available literature is about SAI. "
19703	39	30	39	33	Overall comment to integrate a rights based approach and to mainstream gender considerations. Also to capture the cobenefits of climate action in terms of benefits to rights e.g. rigt to health, right to shelter, right to decent work [Tara Shine, Ireland]	Noted
13408	39	31	39	34	I suggest cutting this text. It seems out of place. The justification as to why you define CDR as part of mitigation should come at the start of Section 4.3. Though I do not agree with that definition. CDR is not emission reductions. The methods remove CO2 after emissions are done. [Helene Muri, Norway]	Noted. According to the glossary: mitigation is "a human intervention to reduce the sources or enhance the sinks of greenhouse gases". CDR enhance the sinks. This paragraph was moved to the beginning of this section
11002	39	31	39	34	This conceptual distinction needs made earlier [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, moved to the beginning of section
11039	39	33	39	34	Simply assuming CDR as (a form of) mitigation goes against standard definitions of geoengineering. While there are many good reasons not to put CDR under this umbrella term any longer (see, for example, Heyward 2013: Situating and Abandoning Geoengineering: A Typology of Five Responses to Dangerous Climate Change), such a move demands a thorough explanation [Oliver Geden, Germany]	Noted. According to the glossary: mitigation is "a human intervention to reduce the sources or enhance the sinks of greenhouse gases". CDR enhance the sinks. This paragraph was moved to the beginning of this section
10632	39	34			…we consider CDR as mitigation. This statement should be carefully reconsidered, and better justified! It has far-reaching implications for how CDR will be thought of. If the IPCC team really agrees on this statement, then it should be explained, analysed, justified, and placed prominently in the report. Currently it is "hidden" in the section on SRM, but could easily be cited and mis-used. No mention of this standpoint is made in the section on CDR (nor elsewhere, as far as I could find, though I might have overlooked it in the earlier chapters). In fact, in Chapter 1, it is stated (p. 33, l. 15-16): "Extreme measures could be undertaken to avoid climate change. These include carbon dioxide removal (CDR)...", which does not make it sound like CDR is viewed as mitigation by these chapter authors. Given the substantial difference between installing solar and wind power for primary energy use (mitigation) versus compensating fossil fuel CO2 emissions by using solar and wind power to drive direct air capture devices or using other approaches to remove post facto remove CO2 from the air (CDR), I - and probably most of the community working on this - would argue that CDR and mitigation should not be considered as the same. [Mark Lawrence, Germany]	Accepted. Consistency with chapter 1 will be added. According to the glossary: mitigation is "a human intervention to reduce the sources or enhance the sinks of greenhouse gases". CDR enhance the sinks. This paragraph was moved to the beginning of this section.
16423	39	34	39	34	Another potential type of application of SRM approaches is to seek to reduce the intensity of particular adverse impacts, such as the amplification of Arctic warming or the very warm ocean waters that are increasing the likelihood of extreme intensification of tropical cyclones in the Atlantic basin and in the western Pacific upwind of the Philippines, etc. Such potential uses have been raised by a number of researchers, including myself (see, for example, MacCracken, M.C., 2016: The rationale for accelerating regionally focused climate intervention research, Earth's Future 4, 649-657, doi:10.1002/2016EF000450) and in papers by Stephen Salter, and in that their intended influence is to reduce specific impacts, such implementations might well be considered as a form of adaptation in that their global influence is small (other examples of such efforts are seeking to reduce loss of ice from mountain glaciers, etc.). This report does not seem to even consider this type of focused application of potential SRM and related technologies/capabilities--there perhaps needs to be a separate name for such efforts based on their intent. [Michael MacCracken, United States of America]	Noted; we accept the point but we have to be selective as to what literature to include to stay within the agreed page limit of the section
1604	39	34	39	34	we consider CDR as mitigation. This is different from the previous IPCC geoengineering report and AR5. You should be consistent with past practice. [Alan Robock, United States of America]	Noted. According to the glossary: :mitigation is "a human intervention to reduce the sources or enhance the sinks of greenhouse gases". CDR enhance the sinks. This paragraph was moved to the beginning of this section
19327	39	34	39	34	SRM is neither adaptation nor mitigation. why? It should be explained? [Marco Mazzotti, Switzerland]	Noted. SRM do not fit to adaptation and mitigation description in the glossary
11007	39	37	40	9	the Draft's sole paragraph outlining different governance models only cites one piece, Sandler 2017 (Review of International Organizations), which is a game theory piece arguing for attention to security concerns with a fairly limited discussion of this governance options more broadly. Although an important contribution to the literature, priviliging this piece in your discussion of SRM governance design is insufficienct. One piece currently under review at Climate Policy (Nicholson, Jinnah, and Gillespie) both offers a thorough review of the CE governance literature that you might find helpful and, importantly, offers a comparative and comprehensive analysis on various governance frameworks. Specifically, it overlays the literature on governance design with that of CE governance, ultiimately arguing for a polycentric governance framework for this issue. [Michael Thompson, United States of America]	Taken into account. This paragraph extended with new literature and rewritten

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11101	39	38	40	9	The text is right to note that governance of SRM presents challenges that are quite distinct from those that apply to mitigation and adaptation. However, the content that follows gives the impression that institutional solutions are both obvious and clearly delimited. In contrast, research on governance of solar geoengineering, with regard to both field experiments and possible deployment, is only just now getting underway and there is little agreement as to which architectures would be most viable and effective. Only one comprehensive research governance proposal (Hubert and Reichwein 2015) has been advanced, while proposals for governance of SRM deployment have been fragmentary and incomplete. The text suggests that there are three possible governance arrangements for SRM—multilateral, unilateral, and minilateral—but this underplays the scope and variety of governance mechanisms that scholars have put forward (e.g., Lloyd and Oppenheimer 2014; Weitzman 2015). The text also indicates that unilateralism is the most serious governance issue confronting SRM, yet the severity of this problem has been disputed (Horton 2011; Parson and Ernst 2013) and many observers consider the potential for SRM to undermine mitigation efforts (the so-called "moral hazard" problem) to be the most challenging governance problem associated with solar geoengineering (Hale 2012; Lin 2013). [Anna-Maria Hubert and David Reichwein, An Exploration of a Code of Conduct for Responsible Scientific Research Involving Geoengineering, IASS (2015); Ian D. Lloyd and Michael Oppenheimer, "On the Design of an International Governance Framework for Geoengineering," Global Environmental Politics 14 (2014): 45-63; Martin L. Weitzman, "A Voting Architecture for the Governance of Free-Driver Externalities, with Application to Geoengineering," Scandinavian Journal of Economics 4 (2015): 1049-1068; Joshua B. Horton, "Geoengineering and the Myth of Unilateralism: Pressures and Prospects for International Cooperation," Stanford Journal of Law, Science, and Policy 4 (2011): 56-69; Edward A. Parson and Lia N. Ernst, "International Governance of Climate Engineering," Theoretical Inquiries in Law 14 (2013): 307-337; Benjamin Hale, "The World That Would Have Been: Moral Hazard Arguments Against Geoengineering," in Reflecting Sunlight: The Ethics of Solar Radiation Management, ed. Christopher Preston (Lanham, MD: Rowman and Littlefield, 2012): 113-131; Albert C. Lin, "Does Geoengineering Present a Moral Hazard?," Ecology Law Quarterly 40 (2013): 673-712] [Joshua Horton, United States of America]	Taken into account, text revised. Ideas of proposed papers (Lloyd and Oppenheimer 2014; Weitzman 2015) included. It was mentioned that there is little agreement in studies of SRM governance
16425	39	39	39	39	Regarding the phrase "If risks of negative effects and trade-off are ignored" is without context. This would better if "If risk of negative effects and trade-offs is less than the risks posed by the increased GHG concentrations in the absence of SRM," or something similar. The issue is comparative risks and outcome--context simply has to be given. [Michael MacCracken, United States of America]	accepted, text changed
16424	39	40	39	40	Change "cheap" to "inexpensive" or "low cost" [Michael MacCracken, United States of America]	accepted, text changed
20413	39	40	39	40	How cheap? Isn't this a myth that SRM is cheap? Is it still cheap if the long-term commitment to SRM is considered? [Olivier Boucher, France]	Accepted, clarifications added.
12286	39	40	39	40	I suggest adding more recent references than one from 2006. [Jan Fuglestvedt, Norway]	Accepted, new reference added
16426	39	40	39	41	Any unilateral actor, were that to happen would certainly be considering the likelihood of negative effects and tradeoffs, just doing so in a different framing, so the sentence needs modification. I'd also note that per the IPCC RF paradigm, cooling anywhere will contribute to at least a bit of cooling everywhere, and so it is not at all clear that the impacts on others would be adverse. [Michael MacCracken, United States of America]	Taken into account, text revised
11863	39	41	39	42	While unilateral deployment is technically feasible for a number of states, it faces serious geopolitical feasibilty constraints, which should be acknowledged along with the concerns about unilateral and minilateral deployment. See: Joshua B Horton, "Geoengineering and the Myth of Unilateralism: Pressures and Prospects for International Cooperation," Stanford Journal of Law, Science & Policy IV (2011): 56. [David Morrow, United States of America]	Taken into account, reference added
16427	39	42	39	43	Regarding the need for governance of field experiments, I know of no proposed field experiments that have been postulated to have a significant effect on other parties--indeed, the proposed experiments are all considerably smaller than the influences of analogous situations going on without objection. There has been no proposal for a stratospheric experiment that puts in anywhere near as much material as aircraft flights are injecting all the time, much less the amounts of injected material from small volcanic eruptions, the effects of which have not or have only barely been detected; similarly with regard to proposed cloud experiments, all are far smaller than what is going on all the time as a result of the many thousands of freighter plying the oceans. This whole issue arises, in my opinion, due to either an overall antipathy to the idea of SRM or to potential implementation of SRM in a sudden large burst, which is not the implementation strategy that would be appropriate for what is considered in this report. For the situation this report is talking about, a slow, iterative application is what makes sense--unfortunately, this type of application has simply not been much discussed in the various reports in the literature. I am not suggesting there is not need for special consideration and an expert panel, etc., but that the discussion in the literature has not been about what merits consideration in the situation covered in this report is not, in my view, a reason to jump to the conclusions and supposed requirements for other types of applications. [Michael MacCracken, United States of America]	Taken into account, clarifications about different implementation schemes added to the beginning of the section
15692	39	43	39	47	Governace of geoengineering MUST be in place before any outdoor experimentation proceeds. Field experiments could lead to dangerous technological "lock-in". See Oldham et al, http://rsta.royalsocietypublishing.org/content/372/2031/20140065 [Elenita Daño, Philippines]	Taken into account, text revised. Due to space limitations this sentence was deleted
15444	39	43	39	47	Governace of geoengineering MUST be in place before any outdoor experimentation proceeds. Field experiments could lead to dangerous technological "lock-in". See Oldham et al, http://rsta.royalsocietypublishing.org/content/372/2031/20140065 [Elenita Daño, Philippines]	Taken into account, text revised. Due to space limitations this sentence was deleted
1605	39	44	39	44	Add to reference list Robock (2012): Robock, Alan, 2012: Is geoengineering research ethical? Peace and Security, 4, 226-229. [Alan Robock, United States of America]	Noted, but due to the space limitation we cannot add reference to the text. We have to be very selective
15693	39	46	39	49	There are no proofs nowhere, that "Regional" SRM from MCB or cirrus clouds couldbe done or even exist. Delete this paragraph [Elenita Daño, Philippines]	Taken into account, text rewritten
15445	39	46	39	49	There are no proofs nowhere, that "Regional" SRM from MCB or cirrus clouds couldbe done or even exist. Delete this paragraph [Elenita Daño, Philippines]	Taken into account, text rewritten
1916	39	46	39	49	An interesting recent paper on public research in soloar radiation management to refere to might be Quaas, M. F., Quaas, J., Rickels, W., & Boucher, O. (2017). Are there reasons against open-ended research into solar radiation management? A model of intergenerational decision-making under uncertainty. Journal of Environmental Economics and Management, 84, 1-17. [Jasper Meya, Germany]	Taken into account, cited in Social acceptability and ethics
764	39	46	39	49	It is not clear if SRM can be successfully employed locally and at what scale. Perhaps this needs to be written about, to avoid not employing SRM locally for fear of effecting outside the target region when it may be a very viable tool for regional cooling especially over icecaps, sea ice and glaciers [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Noted, Due to space limitations this sentence was deleted
16428	39	46	39	49	You might also consider citing the two following papers of mine, the first focusing on the rationale for a variety of potential regional interventions and the latter a study of the responses to a regional intervention in the polar regions. (1) MacCracken, M.C., 2016: The rationale for accelerating regionally focused climate intervention research, Earth's Future 4, 649-657, doi:10.1002/2016EF000450. (2) MacCracken, M. C., H-J. Shin, K. Caldeira, and G. Ban-Weiss, 2013: Climate response to solar insolation reductions in high latitudes, Earth Systems Dynamics, 4, 301-315, 2013; www.earth-syst-dynam.net/4/301/2013/; doi:10.5194/esd-4-301-2013. [Michael MacCracken, United States of America]	Noted, but due to the space limitation we cannot add references to the text. We have to be very selective. We deleted paragraph which discussed regional interventions

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6771	39	46	39	49	Again it is too unqualified a conclusion to state that 'regional radiation management has potential' since such activites can be operated at a local scale. It is also simplistic to say that 'it is desirable to avoid any substantial climate effects of regional SRM outside the target region'. While it is the case that Quaas et al. (2016) provide a useful overview of the proposals and their projected impacts, both intended and unintended, those authors also conclude their paper by saying that "RM, as an option to engineer the climate, is highly controversial and suffers from a number of ethical and regulatory concerns. To the extent that regional RM is feasible, some concerns may have to be reassessed. However, it is unclear to what extent a limited-area application might be possible that is both locally effective and harmless outside the targeted region." If reference is to be made to this paper, it would therefore be important to reflect these conclusions, rathret than presenting the concept in a less qualified context. [Jennifer Morgan, Netherlands]	Noted, but due to the space limitations we deleted paragraph which discussed regional interventions
3857	39	47	30	9	the Draft's sole paragraph outlining different governance models only cites one piece, Sandler 2017 (Review of International Organizations), which is a game theory piece arguing for attention to security concerns with a fairly limited discussion of this governance options more broadly. Although an important contribution to the literature, priviliging this piece in your discussion of SRM governance design is insufficienct. One piece currently under review at Climate Policy (Nicholson, Jinnah, and Gillespie) both offers a thorough review of the CE governance literature that you might find helpful and, importantly, offers a comparative and comprehensive analysis on various governance frameworks. Specifically, it overlays the literature on governance design with that of CE governance, ultiimately arguing for a polycentric governance framework for this issue. [Sikina Jinnah, United States of America]	Taken into account. Proposed paper cited
3859	39	47	30	9	the Draft's sole paragraph outlining different governance models only cites one piece, Sandler 2017 (Review of International Organizations), which is a game theory piece arguing for attention to security concerns with a fairly limited discussion of this governance options more broadly. Although an important contribution to the literature, priviliging this piece in your discussion of SRM governance design is insufficienct. One piece currently under review at Climate Policy (Nicholson, Jinnah, and Gillespie) both offers a thorough review of the CE governance literature that you might find helpful and, importantly, offers a comparative and comprehensive analysis on various governance frameworks. Specifically, it overlays the literature on governance design with that of CE governance, ultiimately arguing for a polycentric governance framework for this issue. [Sikina Jinnah, United States of America]	Taken into account. Proposed paper cited
16429	39	51	40	3	With respect to potential winners and losers, it really does need to be noted that without SRM, the consequences for virtually all situations would be very large and negative. What SRM, of many types of interventions, would do is to take conditions back toward the unperturbed state such that it would be unlikely for any country to have very large and negative as for the GHG alone situation. Yes, not all countries would get back precisely to unperturbed situation, but virtually all countries would be winners with respect to not undertaking SRM, they would just not all be corrected to the same extent, so there would be some conceivable winners and losers, but with a much smaller magnitude than with respect to no SRM at all. In the statement here, there is no indication of what the reference is to, and that is essential. Being reasonably familiar with the field, my sense is this criticism of winners and losers is not with respect to the GHG perturbation and for cases of very large changes. Also, for the relatively limited magnitude of SRM likely for the pathways considered in this report, so slicing off the temperature in excess of some level at 1.5 C or below, this effect would be small. Not making clear what the presumable use of SRM would be, its magnitude, etc. and what the comparison is being made with respect to area all shortcomings of the discussion here. [Michael MacCracken, United States of America]	Noted. Describing a method (for example SAI) we are assessing it alone with its possible effects. The same is done of BECCS and other methods.
20491	39	54	40	1	Note the contrast between the assertion here that “it is likely” that there will be SRM winners and losers and the claim in Chapter 3 p120 line 33 that winners and losers are “inevitable”. This phrasing is preferable. Also note that the supporting references for the claim here are entirely different to those of the Chapter 3 claim. Also note that, in these references, Robock 2017, like Hegerl and Solomon 2009 in the previous case, is a personal commentary. Izrael et al 2014 looks specifically at SRM in the context of stabilizing the climate under an RCP8.5 scenario and finds that, in general, there is a lot more winning than losing: “Comparison of regional features of temperature and precipitation fields with and without stabilization of global temperature shows that the use of SRM could reduce or, at least, would not increase the value of regional anomalies in most regions in contrast to the case of uncontrolled growth of global temperature… it would be possible to find a compromise between growth of temperature and intensity of precipitation both on global and regional levels.” Heyen et al 2015 argues specifically against the assumption that “change is bad”, saying that it is not possible to make strong statements about winners and losers without an understanding of the different preferences of different actors and more sophisticated damage functions. I would suggest replacing “it is likely” with “it is quite possible”. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, text revised. Personal commentaries do not discussed in the main body of the text even if they appear in scientific journals.
7811	40	2	40	2	There is no valid materials-availability concern, just the usual need for responsible mining practices. Lithium has proven abundant in quite a few countries. There are no valid rare-earth concerns either (Lovins, “Clean energy and rare earths: Why not to worry,” Bull. atom. Scient., 24 May 2017, http://thebulletin.org/clean-energy-and-rare-earths-why-not-worry10785). And new rechargeable alkaline battery chemistries using Ionic Materials' solid polymer electrolyte, notably MnO2/Al, have 1–3 Li-ion energy densities with ~5% the materials cost, mower manufacturing cost, and no offsetting liabilities; the same electrolyte permits other chemistries containing nothing rare, toxic, or flammable. [Amory Lovins, United States of America]	Accepted. The whole section on airlines, shipping and storage has been rewritten in 4.3.2.’
7665	40	2	40	2	There is no valid materials-availability concern, just the usual need for responsible mining practices. Lithium has proven abundant in quite a few countries. There are no valid rare-earth concerns either (Lovins, “Clean energy and rare earths: Why not to worry,” Bull. atom. Scient., 24 May 2017, http://thebulletin.org/clean-energy-and-rare-earths-why-not-worry10785). And new rechargeable alkaline battery chemistries using Ionic Materials' solid polymer electrolyte, notably MnO2/Al, have 1–3 Li-ion energy densities with ~5% the materials cost, mower manufacturing cost, and no offsetting liabilities; the same electrolyte permits other chemistries containing nothing rare, toxic, or flammable. [Amory Lovins, United States of America]	Accepted. The whole section on airlines, shipping and storage has been rewritten in 4.3.2.’
15699	40	4	40	9	It is striking that no reference has been made at all to the decision of the Conference of Parties of the Convention on Biological Diversity (CBD) in 2008 for a moratorium on ocean fertilization (later complemenetd by a set of Guidlines adopted by the London Convention/Protocol) and adoption of a de facto moratorium on all climate-related geoengineering in 2010. These decisions (also cited in Bodansky 2013) constitute the foundation and starting point of any discussion on global governance of geoengineeirng. [Elenita Daño, Philippines]	Accepted. Reference to the decision of the Conference of Parties of the Convention on Biological Diversity (CBD) was added
15451	40	4	40	9	It is striking that no reference has been made at all to the decision of the Conference of Parties of the Convention on Biological Diversity (CBD) in 2008 for a moratorium on ocean fertilization (later complemenetd by a set of Guidlines adopted by the London Convention/Protocol) and adoption of a de facto moratorium on all climate-related geoengineering in 2010. These decisions (also cited in Bodansky 2013) constitute the foundation and starting point of any discussion on global governance of geoengineeirng. [Elenita Daño, Philippines]	Accepted. Reference to the decision of the Conference of Parties of the Convention on Biological Diversity (CBD) was added

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6772	40	4	40	9	The United Nations per se is not the only example of a globally-relevant international body that could take on governance of such activities - the UN has many agencies and other bodies that could have the authority for such governance and regulation, and that need not take long periods of time. As an example, the Parties to the London Convention and London Protocol, hosted by IMO as a UN body, agreed on the policy approach relating to ocean fertilization within 18 months of the statement of concern by scientists, on a framework for assessment within 2 furter years and on amendments to legal text within 3 more. it has yet to enter into legal force, but the decisions have had force in policy and political terms since the initial policy was agreed. The London Protocol amendments are also prepared so as to make possible the regulation of other marine geoengineering activities in the future, without the need for further change to the Protocol itself but only to its Annexes. This therefore provides both a mechanism and a model for quite rapid adaptive governance. [Jennifer Morgan, Netherlands]	taken into account, text mentioned other governance possibilities. London Convention and London Protocol are for CDR, but not SRM
16430	40	6	40	6	Indeed, international agreements can be very time consuming, likely so time consuming that the only possible use of SRM would be late in the warming pathway when very adverse lead to proposals for very SRM large interventions. While this is the typical scenario being studied, it really is not at all optimal scientifically compared to a scenario with gradual onset and phaseout as CDR is phased up. And suggestions that one await establishment of an international governance structure be in place before any outside-the-lab experiments would likely rule out SRM at any time given the difficulty of making this happen--and no field experiments have been proposed that are anywhere close to having a large effect compared to natural or human analogs to the proposed approaches that are going on continuously. In my view, there are enough mechanisms in place for reviewing the research and initial research should focus on moving toward testing and early implementation to limit large regional impacts (see MacCracken, M.C., 2016: The rationale for accelerating regionally focused climate intervention research, Earth's Future 4, 649-657, doi:10.1002/2016EF000450) before moving toward potential global intervention to limit temperature overshoots rather than waiting until the temperature increase iand resulting impacts are so large that SRM is the only possible response. [Michael MacCracken, United States of America]	Taken into account partly. Proposed paper cited within a text of the section. Since IPCC research based on peer-reviewed literature, we can't include personal ideas of reviewer which are not supported by such literature
1606	40	7	40	7	the pivotal country What does this mean? [Alan Robock, United States of America]	Taken into account. The pivotal country - is a country which is a core of government structure. This sentence was significantly rewritten
6773	40	7	40	9	This includes a verbatim quote from the paper cited, and should be indicated as such. More importantly, that cited paper includes a further direct condition that is not included in Chapter 4, i.e. that under such a coalition structure, "Major economic powers should also be included if they do not fall into the other two categories of countries.". This is then quite a different prospect from that currently indicated. Sandler (2017) also points to some of the particular difficulties in governance of atmospheric modification which arise from the primary objective of avoiding unilateral action, points that are also relevant to Chapter 4. [Jennifer Morgan, Netherlands]	Taken into account. This text was significantly rewritten
11169	40	12			Should this section on the economics and cost of SRM include the risks/costs of a halt in deployment (and associated rapid warming)? Also, this section does not discuss how deployment costs would add up over time, and the risk of not being able to secure such annual expenditure. [Michiel Schaeffer, Netherlands]	Taken into account There is no literature assessing costs of a halt in deployment. Issues of maintenance mentioned in the text
11102	40	12	40	55	In the section "Economics and Cost," the authors first emphasize large cost ranges before focusing on a $10 billion cost estimate, noting "that it is important to recognize that costs could increase rapidly as cooling exceeds 2 W m-2." Costs are indeed uncertain, though it is relatively well established that the high leverage of stratospheric aerosols would lower costs. In particular, e.g. Keith, Wagner, and Zabel (2017) conclude that "Narrow calculations of costs make solar geoengineering, in particular using stratospheric aerosols, appear 'too cheap'." They triple a prior engineering estimate of aircraft lofting costs (McClellan, Keith, and Apt 2012), and use monitoring costs equal to the totality of the current annual US Global Change Research Program budget, rounded up to US$3 billion per year (USGCRP 2016), and still find approximate costs of less than $0.5/tCO2e averted -- and that estimates costs /tCO2e. Direct costs in terms of W m-2 might, if anything, be 'too cheap', a fact that has led others to argue that solar geoengineering engenders a "free driver" effect (Wagner and Weitzman 2012). In addition, direct costs per output (e.g. W m-2) might well decrease as overall cooling from SRM increases, because of large economies of scale, e.g. for monitoring costs. [Keith, David W., Gernot Wagner, and Claire L. Zabel. "Solar geoengineering reduces atmospheric carbon burden." Nature Climate Change 7: 617–619 (1 September 2017); McClellan, J., Keith, D. W. & Apt, J. Environ. Res. Lett. 7, 034019 (2012); Our Changing Planet: the US Global Change Research Program for Fiscal Year 2017 (USGCRP, 2016); Wagner, Gernot and Martin L. Weitzman. "Playing God." Foreign Policy, 24 October 2012] [Joshua Horton, United States of America]	Taken into account. This text was significantly rewritten. Keith, Wagner, and Zabel (2017) - is a COMMENTARY and we can't assess it in main body alongside with research articles.
13410	40	13			You are also not taking into accound R&D costs, nor maintenance costs or monitoring costs. This could be mentioned here. [Helene Muri, Norway]	Accepted, clarifications added.
9689	40	13	40	21	The authors should not treat all the cost esimates equally. Moriyama et al. (2016) critically reviewed previous estimates, but found flaws in a vast majority of past estimates. McClellan et al. (2012) even used a misleading number for cooling efficiency (but not the lifting cost). [Masahiro Sugiyama, Japan]	Taken into account, this paragraph was shortened and simplified
20414	40	13	40	25	I think that these cost estimates need to be looked at more critically. Who believes MCB can be achieved at the global scale for 38 million USD annually ? That must be about the IPCC budget with in-kind contributions from the countries included… [Olivier Boucher, France]	Taken into account. Due to low evidence (one study) this paragraph deleted
16431	40	13	40	21	Again, these costs are for relatively large SRM implementations after warming (and impacts) have become so large that there are demands to do something and somehow it is thought that a sudden 2 W/m2 is needed will not have its own quite significant impacts from the rapid intervention. For the pathways described in this report where the overshoot is envisioned as gradually growing and then being brought under control by various mitigation actions, using SRM to shave off overshoot warming (so gradually phasing SRM up and then down), the costs would likely be significantly less than indicated here. It is really a shame that this section has not laid out the peak-shaving type of intervention, particularly because it could be iteratively implemented with learning along the way, instead of the large and sudden intervention type of intervention considered in much of the literature, especially that cited here. [Michael MacCracken, United States of America]	Taken into account, clarifications about intervention type added. Since there are no studies which assessed costs of "moderate SRM", we can't refer to those
1607	40	14	40	14	change "have varied over the years and between" to "have been quite consistent between" [Alan Robock, United States of America]	Accepted, text revised
18452	40	16	40	16	Move "McClellan et al." into grey shaded Mendeley field with "2012" [Wilfran Moufouma Okia, France]	Editorial
1608	40	16	40	16	$0.225-30 billion What does this mean? $0.225 to $30 billion? $0.225 billion to $30 billion? If the latter, write it as "$225,000,000 to $30,000,000,000" [Alan Robock, United States of America]	Noted, this paragraph was shortened and simplified
18453	40	17	40	17	Move "Ryaboshapko and Revokatova" into grey shaded Mendeley field with "2012" [Wilfran Moufouma Okia, France]	Editorial
18454	40	19	40	19	Move "Moriyama et al." into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Editorial
16432	40	23	40	25	Is this latter operational cost per vessel carrying out MCB? Otherwise, please indicate how large or modest an effort is involved with the proposed $38M annual cost. [Michael MacCracken, United States of America]	Noted, but we deleted this paragraph because only 1 study exists

Comment No	From Page	From Line	To Page	To Line	Comment	Response
13409	40	23	40	25	These operational costs depend of course on the magnitude of radiative forcing you are aiming to achieve with the MCB. Also these estimates are based on the used of very specific marine vessels. There are now discussions on the possible use of aircrafts, though this is not yet published. This cost analysis could be put into context of the 1.5C target, by e.g. assume you want to cool from the different RCPs down to 1.5C, and by taking the assumption from Salter 2008. 1 ship cost 1-2 mill GBP, and 1500 ships would be needed for a raditative forcing of -3.7 W m^-2. It might be worth mentioning that one might expect substantial maintenance costs, since the spray filters are likely to get clogged up, and the ship lifetimes are relatively short. [Helene Muri, Norway]	Taken into account. Due to low evidence (one study) this paragraph deleted
1609	40	24	40	24	change "need" to "needs" [Alan Robock, United States of America]	editorial
6774	40	24	40	25	As the preceding sentence notes, this analysis arised from only one paper, published almost 10 years ago and by a strong proponent of the technology with a direct commercial interest. Unqualified reference to the annual running costs in the second sentence of this paragraph is therefore inappropriate. [Jennifer Morgan, Netherlands]	Noted, but due to low evidence (one peer-reviewed study) this paragraph deleted
16437	40	24	40	27	These issues were also the subject of consideration at the Asilomar conference. Reference is: Asilomar Scientific Organizing Committee [M. MacCracken (chair), S. Barrett, R. Barry, P. Crutzen, S. Hamburg, R. Lampitt, D. Liverman, T. Lovejoy, G. McBean, E. Parson, S. Seidel, J. Shepherd, R. Somerville, and T. M. L. Wigley], 2010: The Asilomar Conference Recommendations on Principles for Research into Climate Engineering Technologies: Conference Report, Climate Institute, Washington DC, 37 pp. [Michael MacCracken, United States of America]	Noted, but due to low evidence (one peer-reviewed study) this paragraph deleted
16433	40	27	40	30	With respect to the true economic cost, this should really involve the savings from having reduced GHG impacts and not be focused on the remaining negative influences (so the costs of SRM not being perfect). Again, the correct assessment to be done is a comparison of the impacts of elevated GHG without SRM and the the impacts of elevated GHG with SRM, and there are no indications that in making such a comparison that elevated GHG with SRM would have anywhere near the overall negative impacts of elevated GHG alone--and it were even close, then one would not be doing SRM. It is true that during any research phase there could be a situation where testing may lead to relatively minor negative consequences (though no such experiment has yet been suggested) while the field experiment is so small there would not be global benefits, and this may make for a difficult decision, but this is roughly equivalent to suggesting one would not be doing any potentially negative medical testing on people in search of a medicine that would provide very large benefits. Society has learned how to move forward in such situations, and given the very severe prospective impacts of elevated GHG levels, taking some risk of slightly negative consequences in the research stage would seem to be justified if there is really potential to greatly reduce the severe impacts of elevated GHG levels. I just don't sense an adequate level discussion here of how realistic implementation of SRM might occur. [Michael MacCracken, United States of America]	Noted. But peer-reviewed literature assess cost of the SRM options itself.
1611	40	32	40	40	It needs to be pointed out that none of these studies abide by the statement in lines 27-28. That is, they do not account for the potential negative impacts of geoengineering. Rather, they assume that they are zero because they cannot quantify them. This invalidates all these analyses, and this needs to be pointed out in this report. [Alan Robock, United States of America]	Accepted, text revised
9690	40	32	40	40	Arino et al. (2016) (http://doi.org/10.1073/pnas.1520795113) showed an option value of SRM, and could be a useful addition. [Masahiro Sugiyama, Japan]	Noted; we accept the point but we have to be selective as to what literature to include to stay within the agreed page limit of the chapter/section/box
1610	40	34	40	34	economically optimal or suboptimal is economics jargon. What does it mean? [Alan Robock, United States of America]	Accepted, sentence deleted
16438	40	35	40	37	Regarding the suggestion of potential "disproportionate harm", note that virtually all research studies suggest that the result of SRM is to return conditions closer to the baseline and so countries are experiencing significant benefits by not being exposed to the impacts of an elevated GHG concentration. Again, the point being made here generally arises when noting the SRM does not achieve a perfect return to the desired baseline, which seems to me the wrong comparison to be making. The assessment needed is if nations are better off with elevated GHG without SRM versus elevated GHG with SRM, and if SRM is done in ways that models show is plausible, there should not be nations that will be experiencing disproportionate harm, especially if one considers the quite large footprint from which most countries draw resources. This is not to say that there should not be assistance to those nations that are not brought fully back to the baseline, but in this case, it is those who have emitted the GHG and caused the need for remedial SRM that would seem to be those who should be liable. I would also note that if there are those with disproportionate harm, there will also likely be those with disproportionate gain, and might it be that at least some of the support for those so benefitting should be provided to those not so well off? This actually does seem to be how things are working given the way GEF is set up, so this type of assistance is already underway to a limited extent and promised to greater level in the Paris Agreement. It just does not seem that SRM that is benefitting at least most nations should be seen as the culprit in this analysis. [Michael MacCracken, United States of America]	Noted. Majority of studies assess SRM approaches and their negative impacts themselves, without comparisons with World without SRM. Text revised a bit.
18455	40	37	40	37	Move "Manoussi and Xepapdeas" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	editorial
7812	40	37	40	37	Dahlmann et al. 2016 is seriously incomplete. Lovins et al (2004, pp 79–83)—extensively peer-reviewed, Pentagon-sponsored, and understating actual US oil savings by 3 Mb/d so far without or 7 with domestic tight-oil supplies—and an even more elaborate synthesis (Lovins et al 2011, p 239 n 916) documented MIT, NASA, Boeing, and other jet aircraft designs with 3–5x efficiency gains and attractive economics. In general, cryoplanes' ~15% net advantage (after reoptimizing the turbines for hydrogen) offsets their liquefaction energy, yielding comparable energetics to kerosene, better safety, and similar or better economics based on current market prices for unsubsidized wind and PV power to run electrolyzers at airports. For further details on hydrogen, please see Lovins, Twenty Hydrogen Myths, 2003, www.rmi.org/rmi/Library/E03-05_TwentyHydrogenMyths, and Lovins et al. (2004), pp. 227–242, updated somewhat by Lovins (2011, 2018). [Amory Lovins, United States of America]	Accept. The whole section on airlines, shipping and storage has been rewritten in 4.3.2.
7666	40	37	40	37	Dahlmann et al. 2016 is seriously incomplete. Lovins et al (2004, pp 79–83)—extensively peer-reviewed, Pentagon-sponsored, and understating actual US oil savings by 3 Mb/d so far without or 7 with domestic tight-oil supplies—and an even more elaborate synthesis (Lovins et al 2011, p 239 n 916) documented MIT, NASA, Boeing, and other jet aircraft designs with 3–5x efficiency gains and attractive economics. In general, cryoplanes' ~15% net advantage (after reoptimizing the turbines for hydrogen) offsets their liquefaction energy, yielding comparable energetics to kerosene, better safety, and similar or better economics based on current market prices for unsubsidized wind and PV power to run electrolyzers at airports. For further details on hydrogen, please see Lovins, Twenty Hydrogen Myths, 2003, www.rmi.org/rmi/Library/E03-05_TwentyHydrogenMyths, and Lovins et al. (2004), pp. 227–242, updated somewhat by Lovins (2011, 2018). [Amory Lovins, United States of America]	Accept. The whole section on airlines, shipping and storage has been rewritten in 4.3.2.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7813	40	39	40	39	"Most studies" do not properly analyze and some do not even consider liquid-hydrogen-fueled cryoplanes, yet they have been extensively designed (and some even tested) by Boeing, Airbus, Tupolev, NASA, and the US Air Force, among others. In general, as note din my comments on p 4-20, line 37, they have found equal or better attributes compared to current kerosene0fueled airplanes. The further option of fuel cells and high-temperature-superconductor motors running unducted fans in LH2-electric airplanes, noted in 2004 by Peeters (Lovins et al 2011, p 239 n 916), later turned out to offer ~5–7x efficiency gains in commuter-range missions, and has been exploited in military aircraft now operating. In general, advanced biofuels and hydrogen are both realistic and worthy competitors for decarbonizing airplanes, heavy trucks, and ships, but all three offer massive efficiency opportunities—3x for trucks (Ogburn et al 2008, Lovins 2015, 2018), with 2x already demonstrated by industry in USDOE's Supertruck program and exceeded in 2017 cross-country trials, probably 4x with even more-advanced Sturman digital=valve engines, and ?2x fir ships, plus logistical improvements for all. I therefore feel that section 4.1.2.4's pessimism and its message that biofiuel substitution is the main option reflects today's best understanding and practice of neither efficiency nor hydrogen competition. See generally Lovins (2018). [Amory Lovins, United States of America]	Accepted. The whole section on airlines, shipping and storage has been rewritten in 4.3.2.'
7667	40	39	40	39	"Most studies" do not properly analyze and some do not even consider liquid-hydrogen-fueled cryoplanes, yet they have been extensively designed (and some even tested) by Boeing, Airbus, Tupolev, NASA, and the US Air Force, among others. In general, as note din my comments on p 4-20, line 37, they have found equal or better attributes compared to current kerosene0fueled airplanes. The further option of fuel cells and high-temperature-superconductor motors running unducted fans in LH2-electric airplanes, noted in 2004 by Peeters (Lovins et al 2011, p 239 n 916), later turned out to offer ~5–7x efficiency gains in commuter-range missions, and has been exploited in military aircraft now operating. In general, advanced biofuels and hydrogen are both realistic and worthy competitors for decarbonizing airplanes, heavy trucks, and ships, but all three offer massive efficiency opportunities—3x for trucks (Ogburn et al 2008, Lovins 2015, 2018), with 2x already demonstrated by industry in USDOE's Supertruck program and exceeded in 2017 cross-country trials, probably 4x with even more-advanced Sturman digital=valve engines, and ?2x fir ships, plus logistical improvements for all. I therefore feel that section 4.1.2.4's pessimism and its message that biofiuel substitution is the main option reflects today's best understanding and practice of neither efficiency nor hydrogen competition. See generally Lovins (2018). [Amory Lovins, United States of America]	Accepted. The whole section on airlines, shipping and storage has been rewritten in 4.3.2.'
16439	40	39	40	44	It is the potential global complexity of all this that led me to urge that initial SRM be aimed at moderating specific regional impacts (see MacCracken, M.C., 2016: The rationale for accelerating regionally focused climate intervention research, Earth's Future 4, 649-657, doi:10.1002/2016EF0004500. If one considers amplified Arctic warming, for example, this could well be considered first by the Arctic Council, which has a good history of involvment of Indigeneous peoples of the region in decision processes. Also, with a focus on alleviating some particular regional impact, the metric for measuring success could well be much more specific than can be associated with changes in the global average temperature). So, it seems to me that a much more reasonable consideration of SRM would be to be thinking about starting at less than the global level--jumping from doing no SRM to doing global seems a very large jump, and it might well make sense to put a step in between where research and implementation are focused on determining if regional SRM can be successfully implemented before going global. [Michael MacCracken, United States of America]	Noted, Due to space limitations this paragraph was deleted
1612	40	42	40	42	2015 is not recent. [Alan Robock, United States of America]	Editorial
16434	40	42	40	47	Most of this analysis is for situations with relatively sudden and large SRM interventions, and indeed there can be potential issues with this type of intervention. For an implementation involving a gradual phasing up of SRM to offset overshoot warming, the magnitude would be much like the effects of a slowly building volcanic eruption not too unlike what happened the first decade of this century, and the criticisms here are much less valid. So, again, it is really important to be talking about the type of intervention that is being discussed. [Michael MacCracken, United States of America]	Taken into account. Text revised to be related to overshoot scenario
1613	40	46	40	46	change "authors" to "the authors" [Alan Robock, United States of America]	Editorial
16440	40	48	40	48	With respect to the recommendation to "construct compensation system of SRM", again,while research and evaluation are done, it is essential to making sure the assessment is of elevated GHG without and with SRM, and if this is done, it would very much seem to me that the need for a compensation system applies very, very much more to the situation of elevated GHG without SRM than to elevated GHG with SRM. Unfortunately, much of the literature, for some reason, does not frame the evaluation in this way. I would hope that this report would do better, especially in that the implementation approach envisioned for here should be for peak shaving rather than sudden and full reversal of all warming. [Michael MacCracken, United States of America]	Noted. We should assess peer-reviewed literature. This sentence was rewritten
16435	40	49	40	49	And there are no researchers in the SRM field who would support such a substitution. Not only does this do nothing for ocean acidification and imply a very long commitment to continuing SRM, but there are limits to the magnitude of SRM that is possible due to problems such as coagulation or stratospheric aerosols and suitable clouds for MCB, and so full substitution is just not likely to be even possible, much less sensible. [Michael MacCracken, United States of America]	Taken into account, we mentioned this
21183	40	49	40	50	The second sentence is not supported by the first1 [David Cooper, Canada]	Taken into account. Text revised
11013	40	49	40	51	Response to: "There is no literature supporting the complete substitution of mitigation by SRM. This suggests that SRM would be used sparingly, which would decrease the potential side-effects, including the termination effect, and could address some of the societal issues (Sugiyama et al. 2017)." This reasoning is erroneous. The existence of such literature or lack of it does not necessarily restrain actions. The phrasing also seems misleading or biased since it does not mention that there are objections to even thinking of SRM as a viable option. See Gardiner, A. F. S. M. (2016). Why Geoengineering is not Plan B'. Justice and Geoengineering. C. Preston, Rowman and Littlefield. [Michael Thompson, United States of America]	Taken into account. Text revised, but due to the space limitation we cannot add reference to the text
6775	40	49	40	51	The second sentence of this paragraph does not follow as a legitimate conclusion from the first. It is true that Sugiyam et al. (2017) have suggested that "one might choose to use SRM sparingly because of concerns surrounding environmental risks and social and ethical implications" and that "This would decrease the potential side effects of SRM, including even the termination effect, and could possibly address some of the societal issues", but this neither follows from an observation that no literature proposes complete substitution of mitigation by SRM, nor can be used to conclude that SRM 'would be used sparingly' in practice. It is merely once possible scenario suggested by the authors of the paper cited. [Jennifer Morgan, Netherlands]	Taken into account. Text revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16436	40	49	40	55	Finally, discussion of a plausible approach to SRM implementation. I think it would be very helpful to have such a discussion of potential types of SRM implementation up front, discussing sudden versus gradualand iterative implementation, limited temperature reduction rather than return to the 19th century baseline climate, long versus limited duration, global versus regional objectives, etc. and commenting that most of the research to date has focused on the types of implementation that are easiest to model rather than that would make most potential and plausible sense from a policy perspective. It would also really help to indicate that slicing the peak off the warming is an approach that would involve relatively modest SRM and could be phased out as CDR is phased up. Such context for the discussion here is really needed, especially discussing the relationship of SRM (quick and relativly low cost effect) and CDR (slow and takes time to buildup but also helps on ocean acidification). [Michael MacCracken, United States of America]	Taken into account. Text will describe possible scenarios of implementation
20492	40	51	40	52	“Some studies indicate for how much forcing or temperature reduction goal they prefer to use SRM” This is sufficiently inelegant as to border on the opaque. “Some studies indicate preferred forcing or temperature-reduction goals for SRM” might be preferable [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text changed
18456	40	52	40	52	Move "Kosugi" into grey shaded Mendeley field with "2013" [Wilfran Moufouma Okia, France]	Editorial
21184	40	52	40	52	who"prefer"s? suggest to avoiud this vern here [David Cooper, Canada]	accepted, text revised
18457	40	53	40	53	Move "Keith & MacMartin" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Editorial, done
6776	40	53	40	55	It is true that Keith & MacMartin (2015) expressed the view that a 'small' amount of deployment could make economic sense, but this should be presented in its proper context as an opinion from those authors, i.e. "Keith & MacMartin (2015) suggest that a small amount...etc." [Jennifer Morgan, Netherlands]	Accepted, text was rewritten
11014	40	53	40	55	A single reference is not adequate to support the statement that "A small amount of deployment could make economic sense (Keith and MacMartin 2015)" given the existence of more recent literature questioning that deployment of SRM would be as inexpensive as widely believed (Reynolds, J. L., et al. 2016. "Five solar geoengineering tropes that have outstayed their welcome." Earth's Future. Volume 4, Issue 12, Version of Record online: 13 DEC 2016, pp.). The statement also does not sufficiently account for limits to humans' ability to know the costs prior to deployment. As such, it is also inconsistent with the point embedded in the earlier passage saying that given the uncertainties about impact of deployment of SRM on food security, such deployment is not advisable, observing principles of precaution. [Michael Thompson, United States of America]	Accepted, this sentence deleted
6777	40	53	40	55	Furthermore, the distinction, if any, between what Keith & MacMartin (2015) refer to as 'small' deployment, and what would be 'moderate' deployment, is unclear from their paper - the two terms appear to be used synonymously and what the authors actually advocate is 'moderate' depolyment rather than small. Their rational is based on a highly stylised and theoretical model treatment of costs and benefits. Furthermore, what they term 'moderate' would still be at a scale aimed to offset the rate of growth in radiative forcing by half, which would still imply very significant levels of deployment. None of this is captured in the text of Chapter 4 as it stands and as such the text could be very misleading in terms of perceived scales, depth of numerical analysis, breadth of consensus and justifications. [Jennifer Morgan, Netherlands]	Accepted, this sentence deleted
18458	40	55	40	55	Move "Crutzen" into grey shaded Mendeley field with "2006" [Wilfran Moufouma Okia, France]	Editorial, done
20687	41				Section 4.4. I suggest better linking these 'enablers' to specific options presented in 4.3. For example, under governance (4.4.3) there is a description of global, local, and community-based, with their respective case studies, but these can also include the specific mitigation or adaptation options referred to in 4.3. [Debora Ley, Guatemala]	Partially accepted, some case studies do provide this linking but there is no space to add new cases
7919	41		41		Enabling environments and transformative change. See Westphal and Thwaites for important elements for transformation as identified in low-carbon energy case studies: Westphal and Thwaites. 2016. "Transformational Climate Finance: An Exploration of Low-Carbon Energy". World Resources Institute. [Westphal Michael, United States of America]	Taken into account. Thank you for a useful reference. It has not been included in favour of peer reviewed literature.
7107	41	3		49	I have not understood the ethical issues here: which are they and how are they motivated? [Érika Mata, Sweden]	taken into account, clarifications added
11003	41	3	41	3	Appalled at 5-level subsectioning! [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	editorial
17681	41	3	41	49	There is a lengthy discussion of the ethical issues surrounding SRM. SRM does raise ethical issues, but so do mitigation policies required to reach the 1.5 target. Consider for example the use of biofuels, hydraulic fracturing, hydroelectric power, nuclear energy - these and other mitigation policies have all raised ethical issues. Or consider the implictions of stranding fossil fuel assets for those dependent on them for their livelihood. Or consider the fair distribution of rights to emit greenhouse gases. So, if the chapter is to discuss the ethical issues surrounding SRM then it should as a matter of consistency also discuss the ethical issues surrounding alternative energy policies. For discussion of these see Simon Caney ‘Climate Change and Non-Ideal Theory: Six Ways of Responding to Noncompliance’ in Climate Justice and Non-Ideal Theory (Oxford: Oxford University Press, 2016) edited by C. Heyward and D. Roser, 21-42. For discussion of the ethical issues surrounding the stranding of fossil fuel assets see Caney Climate Change, Equity and Stranded Assets (Oxfam America: Research Backgrounder, 2016). [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. One paragraph about ethics was added to CDR section (4.3.6), ethical issues of all mitigation technologies are addressing in chapter 5, but they don't cover SRM, so we are discussing them here
19729	41	3	41	49	can these issues of social acceptability and ethics also be explored for the previous sections on bioenergy with CCS, REDD, direct captue and storage etc.? Why are these issues only unpacked for SRM? [Tara Shine, Ireland]	Taken into account – Section 4.3.6 now features a new paragraph on ethics, noting that the ethics literature on CDR is extremely sparse compared to the ethics literature on SRM.
17682	41	3	41	49	continued: For discussion of the equitable distribution of greenhouse gases - see Caney 'Just Emissions', Philosophy & Public affairs vol. 40 no.4 (2012), pp.255-300. One widely shared view is that mitigation must honour human rights. See Simon Caney 'Global Justice, Climate Change, and Human Rights' in Leadership and Global Justice (Basingstoke: Palgrave Macmillan, 2012) edited by D. Hicks and T. Williamson, 91-112 and Simon Caney 'Climate Change, Human Rights and Moral Thresholds' in Human Rights and Climate Change (Cambridge: Cambridge University Press, 2010), edited by S. Humphreys, 69-90. [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Rejected, we are not discussing here equitable distribution of greenhouse gases. "Social acceptability and ethics" only in terms of SRM
19730	41	3	41	49	Human rights need to fully integrated into this section. In particualr there are examples to draw on where lack of attention to the right to participation or the right to water or the right to a liveihood have resulted in lower social acceptance of mitigation actions. [Tara Shine, Ireland]	Accepted, discussion about human rights exists in the text, but due to limited space we can't cover topic in the detailed
19731	41	3	41	49	see the OHCRH guide Understanding Human Rights and Climate Change - online at http://www.ohchr.org/Documents/Issues/ClimateChange/COP21.pdf [Tara Shine, Ireland]	Accepted, discussion about human rights exists in the text, but due to limited space we can't cover topic in the detailed
20663	41	3	41	49	Consider moving (and expanding) upon section 4.3.7.2.1 and maybe even moving it "closer to the left hand margin". Social acceptability and ethics could arguably feature much stronger in chapter 4 (if the literature supports it). The options presented in section 4.3 would be more helpful to decision makers if literature could be found that assesses social acceptability, trade-offs, and benefits...this is particularly the case for options that are well known but possibly socially contested AND technological solutions that are perhaps not well known and carry potentially very high consequences if implemented (possibility for a reader to substitute an "easier" question like an untested technological solution for a "harder / more complex" known question like distribution of resources. [Koko Warner, Germany]	Accepted. Section 4.3.6 (on CDR) now features a new paragraph on ethics, noting that the ethics literature on CDR is extremely sparse compared to the ethics literature on SRM.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20415	41	3	41	49	The following article might be worth citing here regarding the moral hazard and slippery slope arguments: Quaas, M. F., J. Quaas, W. Rickels, O. Boucher, Are there good reasons against open-ended research into solar radiation management? A model of inter-generational decision-making under uncertainty, Journal of Environmental Economics and Management, 84, 1-17, doi:10.1016/j.jeem.2017.02.002, 2017. [Olivier Boucher, France]	accepted, reference added
9691	41	3	41	49	This section neglects many studies on public perception on SRM, despite the section header including "social acceptance." Burns et al. (2016) (http://doi.org/10.1002/2016EF000461) reviewed existing studies. Recent additions include Visschers et al. (2017) (http://doi.org/10.1007/s10584-017-1970-8), Asayama et al. (2017) (http://dx.doi.org/10.1016/j.geoforum.2017.01.012), Wibeck et al. (2017) (http://doi.org/10.1007/s10584-017-2067-0) [Masahiro Sugiyama, Japan]	taken into account, some papers sited, Burns et al. (2016) is a Commentary which we are not assessing in the main body of the text
1614	41	4	41	4	Preston 2013) Add to reference list Robock (2012): Robock, Alan, 2012: Is geoengineering research ethical? Peace and Security, 4, 226-229. [Alan Robock, United States of America]	Noted; we accept the point but we have to be selective as to what literature to include to stay within the agreed page limit of the section
11864	41	4	41	49	There ought to be something in here somewhere about the ethical case for geoengineering, which is essentially that it could reduce protect people and ecosystems from substantial climate risks. The sentence about Chen and Xin (2017) belongs in such a paragraph, rather than in the paragraph about moral hazard. The other obvious citation here is David Keith, The Case for Climate Engineering (MIT Press, 2012). [David Morrow, United States of America]	Accepted, ethics section revised. David Keith, The Case for Climate Engineering (MIT Press, 2012) is not a peer-reviewed one and not a new one, we are focussing mostly on literature after AR5 (2013).
11010	41	4	41	5	The claim that the ethical literature is polarised is doubtful. In fact, there is a remarkable amount of consensus in this literature on the key ethical concerns around SRM. See Preston, C., Ethics and geoengineering: Reviewing the moral issues raised by solar radiation management and carbon dioxide removal'. WIRES Climate Change 4/1, 2013, 23-37. [Michael Thompson, United States of America]	Accepted, text revised
15694	41	4	41	9	Any other option than UN and multilateral governace is undemocratic and abusive and shouldn´t be mentioned by IPCC! If truly democratic governance of geoengineering is "time consuming", that is the condition. IPCC shouldn´t embarrasse itself by taking into account any other possibility. [Elenita Daño, Philippines]	Noted, we discuss peer-reviewed literature and not doing our own research. But text will be revised a bit
15446	41	4	41	9	Any other option than UN and multilateral governace is undemocratic and abusive and shouldn´t be mentioned by IPCC! If truly democratic governance of geoengineering is "time consuming", that is the condition. IPCC shouldn´t embarrasse itself by taking into account any other possibility. [Elenita Daño, Philippines]	Noted, we discuss peer-reviewed literature and not doing our own research. But text will be revised a bit
11865	41	5	41	15	The paragraph on moral hazard should mention empirical work showing that the sign and magnitude of the moral hazard effect are both unclear. A key example is: Merk et al (2015),DOI 10.1007/s10584-014-1317-7 [David Morrow, United States of America]	Accepted, reference added, text revised
20493	41	5	41	7	As noted before it seems odd to talk about moral hazard in discussion of SRM but not in discussion of CDR, where it applies as strongly if not more so (see comment on Chapter 2 pages 56 and 59, above). At least one of the studies referenced in support of this statement deals with the moral hazard of both SRM and CDR approaches. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - Section 4.3.6 now features a new paragraph on ethics, including moral hazard. However, please note that SRM and CDR often get lumped together in the ethics literature despite having very distinct features and therefore also separate ethical concerns. We have therefore chosen other references in 4.3.6.
20938	41	9		22	The principle of intergenerational equity (Eq), the right to the future and the rights of future generations (human and non-human species, principle of interspecies justice) must be deeply analized considering the implications of possible solar radiation management (SRM) policies. [Erick Pajares, Peru]	Accepted, ethics section revised, issues of intergenerational equity mentioned
18459	41	9	41	9	Move "Klepper and Rickels" into grey shaded Mendeley field with "2014" [Wilfran Moufouma Okia, France]	Editorial. Done
20494	41	10	41	11	It is not clear what constitutes the Earth's "natural state". If its natural state has a specified atmospheric cabon dioxide concentration, then most of the aproaches in this report will also not produce a so-called "natural state". The Earth hasm for example, never in recent time had a "natural state" in which the carbon dioxide level was 350ppm -- but a steady 350ppm is the avowed aim of one of the most prominent campaigning organisations devoted to climate action. SRM is thus not unique in not providing a return to a "natural" state. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, this sentence deleted
18460	41	11	41	11	Move "Reynolds" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Editorial. Done
1731	41	13			After the words "of SRM are addressed", please add the sentence "If the side effects of SRM are highly uncertain, there will be a risk of the termination of the already started SRM project, which would very likely lower the expected economic benefit of the started project (Ekholm and Korhonen 2016). Ekholm, T. and Korhonen, H. 2016. Climate change mitigation strategy under an uncertain Solar Radiation Management possibility. Climatic Change, Vol. 139, Issue 3–4, pp 503–515. [Ilkka Savolainen, Finland]	Noted; we accept the point but we have to be selective as to what literature to include to stay within the agreed page limit of the section
18461	41	13	41	13	Move "Moreno-Cruz" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Editorial. Done
6778	41	13	41	15	The paper by Moreno-Cruz (2015) is a highly abstract theoretical treatment that sets its own metrics by which mitigation actions are judged to be more or less 'efficient'. It does not include consideration of the actual or relative risks to natural systems or human societies arising from mitigation as opposed to SRM - rather the two appear in the author's analysis to have complete equivalence in terms of environmental, social and moral acceptability. In reality, in a world in which it is vital to tackle climate change as far as possible by ealing with emissions at source, the concept of 'inefficient' levels of mitigation in favour of SRM has little if any credibility. It is essentially an artefact of game theory approaches. [Jennifer Morgan, Netherlands]	Noted. This sentence was deleted
18462	41	15	41	15	Move "Chen and Xin" into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Editorial. Done
3858	41	15	41	17	The draft relies heavily on Chen and Xin (2017, Advances in Climate Change Research) to discuss the relationship between SRM and the Paris Agreement. Chen and Xin call for SRM as an inevitable outcome of the Paris Agreement and encourages China's development of such a program. I would suggest a more nuanced and tempered discussion of the international politics surrounding SRM development and governance. Again, Nicholson, Jinnah, and Gillespie's manuscript currently under review at Climate Policy, would also offer a far more balanced and measured voice regarding the instrumental need for SRM (or not) than the primary piece currently relied on in the IPCC Draft report on this point. It also points to further literature on this point that could complement Chen and Xin's analysis. [Sikina Jinnah, United States of America]	Accepted, Discussion based on Chen and Xin deleted due to limited space. Nicholson, Jinnah, and Gillespie's manuscript cited
18463	41	17	41	17	Move "Preston" into grey shaded Mendeley field with "2013" [Wilfran Moufouma Okia, France]	Editorial. Done
6779	41	17	41	21	Preston (2013) presents some interesting arguments that are worth reflecting, as does Gardiner (2011). However, it would be better to make more direct reference to the latter a a primary source, rather than using Preston (2013) as a secondary interpretation, and would also be worth looking again at the construction of the sentence on this in Chapter 4. In the context of the preceding sentence, it is currently difficult to grasp exactly what is being conveyed in relation to 'moral hazard' etc. It would be worth expanding this paragraph with a bit more explanation rather than risk conflating quite different issues as disussed by Preston (20130) and Chen & Xin (2017). [Jennifer Morgan, Netherlands]	noted, but this paragraph was deleted, also note that due to the space limitation we cannot add reference to the text

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11011	41	17	41	22	Key literature is missing here, and key ethical concerns are not mentioned. Among others: Augustin Fragniere and Stephen M. Gardiner. 2016. 'Why Geoengineering is not Plan B'. In Christopher Preston, ed. Justice and Geoengineering. Rowman and Littlefield; Stephen M. Gardiner. 2014. 'Why 'Global Public Good' is a Treacherous Term, Especially for Geoengineering', Climatic Change 123: 101–106; DOI 10.1007/s10584-014-1079-2.; Ben Hale, 'The World That Would Have Been: Moral Hazard arguments against Geoengineering' in Christopher Preston (ed), 'Engineering the Climate' (Lexington Books, 2014, pp. 113-132. Some key ethical concerns that are missing: (1) moral schizophrenia: Stephen M. Gardiner. 2013. 'Geoengineering and Moral Schizophrenia: What's the Question?'. In William Burns and Andrew Strauss, eds. Climate Change Geoengineering: Legal, Political and Philosophical Perspectives; (2) SRM as an insurance policy to benefit future generaitons if mitigation fails: Stephen M. Gardiner. 2010. 'Is "Arming the Future" with Geoengineering Really the Lesser Evil? Some Doubts About the Ethics of Intentionally Manipulating the Climate System'. In Gardiner, Caney, Jamieson and Shue, eds. Climate Ethics: Essential Readings, Oxford, pp. 284-312; ; on justifying SRM with the precautionary principle - Hartzell-Nichols, L., 2012. Precaution and Solar Radiation Management. Ethics, Policy & Environment, 15 (2), 158–171; on the dangers to future people of lock in from research to deployment - and how this impacts thinking about governance of research - see Catriona McKinnon, 'Solar Radiation Management Resarch: Governance for Future People', under review at Environmental Politics. [Michael Thompson, United States of America]	Taken into account. One of proposed papers cited, others are not peer-reviewed of in the form of "Opinion, responses" - not a Research article.
18464	41	18	41	18	Move "Gardiner" into grey shaded Mendeley field with "2013" [Wilfran Moufouma Okia, France]	Editorial. Done
18465	41	20	41	20	Separate into two Mendeley in-text citations: Gardiner 2010 and Preson (2013) with "as quoted in" in between [Wilfran Moufouma Okia, France]	Editorial. Done
15192	41	21	41	21	How is the SRM related to the right of women?! [Yana POPKOSTOVA, France]	accepted, text revised to right of human
20495	41	22	41	22	those concerned with is extraneous. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	accepted, text revised, phrase deleted
15695	41	24	41	27	Voiluntary code of conducts are not enough, if strict policy for not outdoor experiments is not in place. Governace of geoengineering MUST be in place before any outdoor experimentation proceeds. Field experiments could lead to dangerous technological "lock-in". See Oldham et al, http://rsta.royalsocietypublishing.org/content/372/2031/20140065 [Elenita Daño, Philippines]	Noted; we accept the point but we have to be selective as to what literature to include to stay within the agreed page limit of the section
15447	41	24	41	27	Voiluntary code of conducts are not enough, if strict policy for not outdoor experiments is not in place. Governace of geoengineering MUST be in place before any outdoor experimentation proceeds. Field experiments could lead to dangerous technological "lock-in". See Oldham et al, http://rsta.royalsocietypublishing.org/content/372/2031/20140065 [Elenita Daño, Philippines]	Noted; we accept the point but we have to be selective as to what literature to include to stay within the agreed page limit of the section
11866	41	24	41	27	In the paragraph on ethical guidelines for researchers, it might be worth mentioning Morrow, Kopp & Oppenheimer (2009), DOI 10.1088/1748-9326/4/4/045106 [David Morrow, United States of America]	Noted; we accept the point but we have to be selective as to what literature to include to stay within the agreed page limit of the section
7680	41	32	41	35	Unmentioned is the opportunity to improve cooking-pot efficiency by ~3–6x through technologies individually commercialized around the world but not yet combined. It is probably easier to change pots than stoves, though both should of course be combined and integrated. [Amory Lovins, United States of America]	Accepted. The whole section on airlines, shipping and storage has been rewritten in 4.3.2.'
7826	41	32	41	35	Unmentioned is the opportunity to improve cooking-pot efficiency by ~3–6x through technologies individually commercialized around the world but not yet combined. It is probably easier to change pots than stoves, though both should of course be combined and integrated. [Amory Lovins, United States of America]	Accepted. The whole section on airlines, shipping and storage has been rewritten in 4.3.2.'
6780	41	35	41	37	The last sentence of this paragraph is again too unqualified to be defensible - the judgment that compensation schemes could address injustices may well be the views of some authors, but it is vital that such generic claims are not reproduced in such an uncritical way. If it is the intention to express the views of certain authors on these matters, then it should be explicit that those are the views as expressed by those authors, using language such as 'according to' or similar. It is also important to present countervailing views in such a potentially contentious issue. [Jennifer Morgan, Netherlands]	Taken into account, text significantly rewritten
15305	41	36	41	36	How/in what way one party can experience a disproportionate harm from SRM? [Yana POPKOSTOVA, France]	Noted, this sentence deleted
1601	41	39	41	39	A final issue of SRM No. There are many other issues you did not address. See Table 1 in Robock (2016). These include: Less solar electricity generation, Degrade passive solar heating, Effects on airplanes flying in stratosphere, Effects on electrical properties of atmosphere, Affect satellite remote sensing, Degrade terrestrial optical astronomy, More sunburn, Environmental impact of implementation, Whiter skies, Affect stargazing, Commercial control, Whose hand on the thermostat?, Societal disruption, conflict between countries, Conflicts with current treaties, and Military use of technology. [Alan Robock, United States of America]	Taken into account. Some of them addressed in the SRM Box, others are not assessing in the peer-reviewed literature
21185	41	39	41	39	Rather thisshoudl be the first issue! [David Cooper, Canada]	Taken into account, this part have been rewritten
11012	41	39	41	44	On the participation of marginalised and voiceless people in debates about SRM add Christopher Preston, 'Solar Radiation Management and Vulneable Populations' in Christopher Preston (ed), Engineering the Climate (Lexington Books 2014), pp. 77-94 [Michael Thompson, United States of America]	Noted, this section expanded, but proposed paper is not peer-reviewed one.
12287	41	39	41	44	This final issue deserves more attention since this one of the core elements in the governance issue. [Jan Fuglestvedt, Norway]	Taken into account, this part have been rewritten
18466	41	41	41	41	Move "Suarez and van Aalst" into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Editorial, done
18467	41	42	41	42	Move "Whyte" into grey shaded Mendeley field with "2012" [Wilfran Moufouma Okia, France]	Editorial, done
15689	41	46	41	49	The question of governance of SRM is highly political, not technical, so asking for more research by the same that promote geoengineering is not useful. Delete whole paragraph [Elenita Daño, Philippines]	Accepted, text revised. Section do not asking for more research at the end
15441	41	46	41	49	The question of governance of SRM is highly political, not technical, so asking for more research by the same that promote geoengineering is not useful. Delete whole paragraph [Elenita Daño, Philippines]	Accepted, text revised. Section do not asking for more research at the end
3076	41	48	41	48	revision - "a compensation system for SRM" [Christopher Bataille, Canada]	Editorial, text revised
11005	41	52	41	52	This section is not at all specific to 1.5. You could say the same about 2 or even higher warming levels. Need to state this at the start of the section. The drafting is very discursive and could be tightened up to manage the page count. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, this section is being re-drafted for SOD
10558	41	52	43	14	You need to expand your analysis beyond neoclassical economics (NIE) to give a more interdiciplinary view of the possible solutions and challenges to reach those solutions. [Jose Antonio Puppim de Oliveira, Brazil]	Accepted. Reference to a specific enabling framework, and Dougglas North removed from this section.
17701	41	52	78	33	This whole section would benefit very much, for readability and the time needed for commenting it, for a structure that allowed to focus on measures regarding specific sections. [Pierpaolo Cazzola, France]	Accepted. This section is being re-drafted for SOD.
1534	41	54	44	10	I would really encourage you to consider the framework that Michael Grubb lays out in Planetary Economics (Routledge, 2015), which suggests that as you go from marginal to transformative change as the goal, you shift your theoretical framework from an equilibrium / optimizing one to an evolutionary or behavioral one. I say roughly the same thing in my book (Transforming Energy, Cambridge, 2015, summarized in http://dx.doi.org/10.1016/j.erss.2017.05.023 . Both books suggest that this has profound implications for the governance framework and set of appropriate policy instruments. [Anthony Patt, Switzerland]	Accepted. This is very useful and Grubb's 3 types of barriers to change are noted in the revised text.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1214	41	54	45	19	The beginning of this section 4.4.1 is confusing. Are these 2 types of enabling environments useful? Why not start 4.4. with laying out what would be needed to implement far-reaching and rapid change? Enhancing governance may well become the first real sub-section here. [Petra Tschakert, Australia]	Accepted. The lay-up of Section 4.4 has been changed. 4.1 now much reduced and governance text taken to sub-point on this topic.
12471	42				what is the point to have these detailed discussion under 4.4.1.1, it looks authors are preparing a guidebook [Dr Noim UDDIN, Australia]	Accepted. This section has been revised and the detail added to subsequent sections.
20638	42		100		The later sections of the chapter take a lot of room compared to the discussion of technologies. This balance may need adjustment. [Hans Poertner, Germany]	Taken into account. We are looking into it, but the sections in 4.4 are tremendously important as they are on how to implement these technologies.
18033	42	1	42	5	Please, consider adding to the paragraph the words in red: The far-reaching and rapid change required to remain below 1.5 C and allow societies to cope with the associated climate changes will depend on circumstances that enable and cohere innovations in technology (Creutzig et al. 2015), buildings and infrastructure (most obviously in urban areas) (Rode et al. 2014;Roberts 2016b), finance (Campiglio 2016; Pauw 2017; Diaz-Rainey et al. 2017), human behaviour (Steg 2016; Moloney et al. 2010) and mode of interaction in science-society interfaces (Vogel et al., 2007). Ref. Vogel, C., Moser, S. C., Kasperson, R. E. and Dabelko, G. D. (2007) 'Linking vulnerability, adaptation, and resilience science to practice: Pathways, players, and partnerships', Global Environmental Change, 17(3–4), pp. 349–364. doi: 10.1016/j.gloenvcha.2007.05.002. [Annamaria Lehoczky, Spain]	Accepted. Thank you for a useful addition and reference.
7108	42	4		5	According to what logics is human behavior listed here in comparison to sectors (technology, infraestructure, buildings, finance)? [Érika Mata, Sweden]	Taken into account in Section 4.4.3 on behavioural change.
7109	42	8		11	This classification of the "behavior and lifestyle" among other social components of the operative environment seems more logic to me. [Érika Mata, Sweden]	Accepted and section removed. The point is taken into account in Section 4.4.3 on behavioural change.
19732	42	23			Section on dynamic features of enabling environments. This section needs to have a sub section on human rights [Tara Shine, Ireland]	Accepted. Have expanded the existing section on "durable rights framework" which is broader than the conventional human rights, and also accommodates countries that have not signed up to the UN Declaration.
7110	42	23	44	10	This classification could be more useful if key issues could be specified for sectors and regions. [Érika Mata, Sweden]	Taken into account. Section 4.1 now references importance of cross-regional and region-specific responses. Differentiation across regions is being developed in feasibility assessment. Section 4.3.4.
6207	42	29	42	29	The term 'accountable governance' here (as the comment further up) is rather to unspecific to warrant the claim. The key question is 'to whom' is governance accountable, and by what means are they held to account? Without knowing that, the claims made here for why accountability is important do not make sense. The other point to make here in terms of enabling environments nad governance would be from the literature on experimentation in climate governance - where the thing that enables more transformative shifts is a mode of governance focused on supporting novel innovations, experiments. see for example: Hoffmann, Matthew J. 2011. Climate Governance at the Crossroads: Experimenting with a Global Response after Kyoto. Oxford University Press; Bulkeley, Harriet, Vanesa Castán Broto, and Gareth Edwards. 2015. An Urban Politics of Climate Change: Experimentation and the Governing of Socio-Technical Transitions. London: Routledge; Bulkeley, Harriet, and Vanesa Castán Broto. 2013. Government by Experiment? Global Cities and the Governing of Climate Change. Transactions of the Institute of British Geographers 38:361–375. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted and text amended.
14093	42	40			mutual trust' , and also reciprocity (see p50 line 13) [Elvira Poloczanska, Germany]	Accepted and text amended to include this idea.
14091	42	40	42	40	Refer to the role of collective social capital for adaptation and mitigation. This links also with trust, effective institutions, and community resilience. [Elvira Poloczanska, Germany]	Noted. Text has been amended to include the role of trust and reciprocity. But no specific citation provided.
14092	42	40	42	40	For effective partnership working, visions don't need to be shared in their entirety but there does need to be some shared purpose. There will be some differences and some similarities in goals between the parties; 'a shared visión' implies a single goal held by all - this is not realistic and also not necessary [Elvira Poloczanska, Germany]	Accepted. Text has been amended to reflect partnerships, characterised by a shared sense of risks and purpose.
19733	42	40	42	51	See the examples of women's participation in decision making which should be part of all partnerships. Plus methods to ensure gender balance in partnerships. [Tara Shine, Ireland]	Taken into account. Text amended to include the role of women in decision making and female education around climate change with references from peer reviewed literature (Azeiteiro et al. 2017; Lutz and Muttarak 2017; Wamsler 2017).
19734	42	40	42	51	Women's Participation An Enabler of Climate Justice. First edition: November 2015. Online at http://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-_Womens-Participation-An-Enabler-of-Climate-Justice_2015.pdf [Tara Shine, Ireland]	Taken into account. Text amended to include the role of women in decision making and female education around climate change with references from peer reviewed literature (Azeiteiro et al. 2017; Lutz and Muttarak 2017; Wamsler 2017).
19735	42	40	42	51	The Full View second edition: ensuring a comprehensive approach to achieve the goal of gender balance in the UNFCCC process (2016). Mary Robinson Foundation and UN Women. Online at http://www.mrfcj.org/wp-content/uploads/2016/11/MRFCJ-Full-View-Second-Edition.pdf [Tara Shine, Ireland]	Taken into account. Text amended to include the role of women in decision making and female education around climate change with references from peer reviewed literature (Azeiteiro et al. 2017; Lutz and Muttarak 2017; Wamsler 2017).
6579	42	45	42	45	Typo: national framing, not 'farming'. [J. David Tabara, Spain]	Editorial. Text revised.
18468	42	55	42	55	Ziervogel has a Mendeley link but Blanchet 2015 does not [Wilfran Moufouma Okia, France]	Editorial
20252	43	1	43	3	Museums can provide an arena. [Morien Rees, Norway]	Noted. But not in the 1.5C climate literature.
2750	43	3	43	6	Why immediately the urban focus? What about urban-rural linkages, predominance of poverty in rural areas in many countries still (e.g. many countries in Africa)? [Penny Urquhart, South Africa]	Accepted. Text expanded.
4188	43	8		14	Female education can also include out of classroom education for older women as well. The idea of gender-based forecasting, a WMO initiative, looked at a variety of ways to help get climate and hazard risks into the hands of women. I reported on this for Reuters: http://news.trust.org//item/20141105084703-1dkyn/ [Michelle Leslie, Canada]	Accepted and text revised with references from peer reviewed literature (Azeiteiro et al. 2017; Lutz and Muttarak 2017; Wamsler 2017)
10254	43	8	43	14	This paragraph is very poorly written. It deserves far more attention. [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - text revised.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1540	43	8	43	14	Section: 4.4.1.1 Dynamic features of enabling environments page 4-43, line 8-14 Comment: Education particularly women education could be linked to SDGs , women empowerments. For example, in article by Yadav and Lal (2017) the positive effects of educating women in mitigation and adaptation is highlighted and conceptualized. For example, women can play crucial role in establishment and management of climate smart households through household waste managements, adopting farming methods, which have been built on sustainable climate resilience agro-ecological agriculture. Consider the following potential addition for page 4-43, line 8-14 There is an strong linkage between women empowerment and education and successful women involvement in climate change adaptation policy and action implementation (Yadav and Lal 2017) . In addition, women should be considered as effective source of domestic knowledge and experience particularly on adaptation and disaster reduction (Yadav and Lal 2017; Allwood, 2014). For example, women can play crucial role in establishment and management of climate smart households through household waste managements, adopting climate-resilient farming methods, which have been built on sustainable climate resilience agro-ecological agriculture (Yadav and Lal 2017). Methods which has been used so far for women education on climate change resilience have been mentioned by literatures, (e.g. Hill, 2011; Lutz et al., 2014) Allwood, G. (2014). Gender mainstreaming and EU climate change policy. Browser Download This Paper. Lutz, W., Muttarak, R., & Striessnig, E. (2014). Universal education is key to enhanced climate adaptation. Science, 346(6213), 1061-1062. Hill, C. (2011, September). Enabling rural women's economic empowerment: Institutions, opportunities and participation. In Background Paper for expert group meeting, Accra (pp. 20-23). [Fatemeh Bakhtiari, Denmark]	Noted. Yadav and Lal text does not appear to be available yet but will look out for it. Allwood text is grey literature which will not serve this section.
1296	43	8	43	14	While important for creating an environment conducive to achieving a 1.5 C world, public education alone is not enough -- other biases and mental heuristics must be addressed, as shown by e.g. Hamilton, L.C. (2011), "Education, politics, and opinions about climate change evidence for interaction effects." [Colin Raymond, United States of America]	Accepted and text revised.
19736	43	8	43	14	See this useful referenec for additonal arguments: Essay by Ravi Kanbur for the Mary Robinson Foundation. Education for Climate Justice. 2015. Online at http://www.mrfcj.org/wp-content/uploads/2015/09/Education-for-Climate-Justice.pdf [Tara Shine, Ireland]	Accepted. This is a useful reference. Subject to approval as grey literature.
7283	43	8	43	14	The special issue adds some state of the art knowledge to this paragraph AZEITEIRO, U.M., LEAL FILHO, W., (Eds.) 2017. Climate Literacy and Innovations in Climate Change Education, Int. J. of Global Warming, Inderscience Publishers. 12 (3) IF 1.043 (2015/16) Q2 [Ulisses Azeiteiro, Portugal]	Accepted. Reference included in revised text.
11179	43	8	43	14	This section on education and climate change could also consider the impacts of climate change on education, to elaborate on the point "there are strong two-way links between female education and climate risks". [Michiel Schaeffer, Netherlands]	Accepted. This is an introductory section. Role of education now given greater prominence in a new sub-section of 4.4.
1472	43	8	43	14	Education' is currently given scant coverage as an enabling mechanism for all of the areas considered in this chapter. Space-allowing, I would urge the authors to expand this section/enhance other relevant sections, to highlight the role of education in terms of all elements of climate change capacity-building (from school-level environmental education helping to support individual behaviour change, through formal technical training, to high level climate education to support academic, government, private sector and NGO leadership in all nations). Knowledge-sharing is flagged up, but is not given sufficient weight in my view. Reference should be made to the Paris Committee on capacity-building, as well as more use of examples of city-city collaborations and similar sub-national programmes (e.g. SPHEIR programme [GCRF] in the UK). [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. This is an introductory section. Role of education now given greater prominence in a new sub-section of 4.4.
21186	43	11	43	11	re polpulation and education.see also KC, S. and Lutz, W. (2017). The human core of the shared socioeconomic pathways: Population scenarios by age, sex and level of education for all countries to 2100. Global Environmental Change 42, 181–192. https://doi.org/10.1016/j.gloenvcha.2014.06.004 [David Cooper, Canada]	Accepted. Lutz reference very useful and added.
15306	43	13	43	13	While the assumption that female education is linked to climate risk is made sparingly throughout the text, and indeed, there is some literature examining such an interrelationship, in this report, the statement stands without any weight and is repeated without the support of one factual example/relationship/study and the reader is left with his/her own assumptions on what this relationship could be. The argument needs to be bolstered by an example. [Yana POPKOSTOVA, France]	Accepted. Limited references now added.
9345	43	13	43	14	In addition to the emphasis on "Better educated communities are more enabled to adapt and take long term decisions regarding their futures," the need to better integrate sustainable development principles into education is also receiving attention. Recent publications from the literature include, "Walter Leal Filho et al., Implementing climate change research at universities: Barriers, potential and actions, Journal of Cleaner Production Volume 170, 1 January 2018, Pages 269-277" <https://doi.org/10.1016/j.jclepro.2017.09.105> as well as "Walter Leal Filho et al., Identifying and overcoming obstacles to the implementation of sustainable development at universities, Journal of Integrative Environmental Sciences Volume 14, 2017 - Issue 1 <http://dx.doi.org/10.1080/1943815X.2017.1362007> [Siir KILKIS, Turkey]	Accepted. Citations added and text revised.
10255	43	17	43	17	Community engagement (local projects) is also important. [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Noted.
18826	43	17	44	10	Systemic elements of enablilng environments should include coordination and integration of climate policies and strategies with the Sustainable Development Goals. See for example, Northrop, E., H. Biru, S. Lima, M. Bouye, and R. Song. 2016. "Examining the Alignment Between the Intended Nationally Determined Contributions and Sustainable Development Goals." Working Paper. Washington, DC: World Resources Institute. [David Waskow, United States of America]	Agree and thank you for a useful citation.
19737	43	18	43	23	add a reference to the right to participation and to article 10 of the Rio Convention and article 6 of the UNFCCC. [Tara Shine, Ireland]	Noted but specific reference is not included. The sections on rights framework has been expanded. Not the purpose of this report to cite UNFCCC. Focus is on post-AR5 literature.
20253	43	18	43	23	Promoting a trustworthy means of communcating the importance of alignment of public awareness in local communities, policy driven change, technological efficiencies and economic and finance factors is vital - the present channels have proved inadequate. [Morien Rees, Norway]	Accepted. Included in new section on science policy interface and communication.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6580	43	18	43	23	Consider the literature on public perception on climate change, e.g. See comment 9; and for instance: Tàbara, J. D. and Miller, D. 2012. 'Reframing public opinion on climate change'. In: Jaeger, C. C., Hasselmann, K., Leipold, G., Mangalagiu, D., and Tàbara, J. D., Reframing the Problem of Climate Change: From Zero Sum Game to Win-Win Solutions. Oxon, UK, New York, USA & Canada: Earthscan and Taylor and Francis. Pages 54-81. [J. David Tabara, Spain]	Accepted. This is an important point that is reflected in the revised text. The specific Tabara citation has not been used (there is a strong emphasis in this report on literature since AR5) but may be considered under Section 4.3.4 on behaviour change and 4.3.1 on feasibility. enabling environment.
11180	43	19	43	21	The decoupling of emissions and economic growth in select economies...is enabled by a growing social concern around climate change that generates incentives for policy and technological change - growing social concern over related issues, e.g. air quality and health, dietary health, energy security etc. is also important and should be menetioned here. [Michiel Schaeffer, Netherlands]	Accepted - text revised.
10560	43	23	47	35	This whole section is very general, and not backed by any scientific or conceptual discussions. You may remove all together. [Jose Antonio Puppim de Oliveira, Brazil]	Rejected This section is being re-drafted for SOD, based on the most recent and relevant literature
11181	43	25			On systemic approaches, co-benefits of adaptation and mitigation should also be mentioned. [Michiel Schaeffer, Netherlands]	Accepted - text revised.
1539	43	25	43	34	Section 4.4.1.2 Systematic approaches. Page 43 Line 25-34 Comments: In my opinion, this paragraph should elaborate more on integration of adaptation, mitigation. Currently the provided information are not clear. Particularly, the box 4.4 does not have strong connection with the content of the paragraph. I would suggest providing an example of a joint adaptation and mitigation (JAM) strategy first in detailed and then discussing on its integration with Development and SDGs (e.g.. climate smart agriculture presented by Gonzalo et al. 2017 or Nilsson et al. 2016 which present the interactions between SDGs). Yadav, S. S., & Lal, R. (2017). Vulnerability of women to climate change in arid and semi-arid regions: The case of India and South Asia. Journal of Arid Environments. Ortiz-Gonzalo, D., Vaast, P., Oelofse, M., de Neergaard, A., Albrecht, A., & Rosenstock, T. S. (2017). Farm-scale greenhouse gas balances, hotspots and uncertainties in smallholder crop-livestock systems in Central Kenya. Agriculture, Ecosystems & Environment, 248, 58-70. Nilsson, M., Griggs, D., & Visbeck, M. (2016). Map the interactions between sustainable development goals: Mans Nilsson, Dave Griggs and Martin Visbeck present a simple way of rating relationships between the targets to highlight priorities for integrated policy. Nature, 534(7607), 320-323. The following lines could be consider as potential addition for section 4.4.1.2 Systemic elements of enabling environments Line 25-34 According to Gregorio et al. (2017) to leverage the effect of climate policy integration, decrease the trade-offs effects and increase the synergies, there should be an internal policy coherence not only between adaptation and mitigation objectives but also between climate change policy objectives and development objective. Moreover, to mainstream climate change into sectoral policies and providing cross-sectoral coordination, horizontal and vertical policy integration are suggested. Di Gregorio, M., Nurrochmat, D. R., Paavola, J., Sari, I. M., Fatorelli, L., Pramova, E., ... & Kusumadewi, S. D. (2017). Climate policy integration in the land use sector: Mitigation, adaptation and sustainable development linkages. Environmental Science & Policy, 67, 35-43. [Fatemeh Bakhtiari, Denmark]	Taken into account. The specific references have not been used but the broader points are reflected in the substantially revised text.
7890	43	25	43	47	Include references / mention of the developments of a global Circular Economy and transition from a Linear to a Circular system e.g: (source adapted from :http://www.easac.eu/fileadmin/Reports/Easac_15_CE_web_corrected.pdf) The circular economy is a concept not just for exhaustible resources such as metals, but also for renewable resources and includes recognition of the importance of preserving, restoring and enhancing the environment and natural resources (natural capital). Even so, the circular economy is insufficient to address specific issues such as climate change, ocean acidification, loss of natural ecosystems, soil degradation, species extinction, water supply and shortages, so should not detract from the many separate and targeted national and international policies on those issues. Current arguments in support of the circular economy point to continued growth in population and per capita consumption and thus increasing demands both for renewable and for non-renewable resources, which have led to an environmental footprint for humanity that is unsustainable (Hoekstra and Wiedmann, 2014). According to UNEP (2012) analyses, consumption already exceeds several critical global, regional and local thresholds; a conclusion also reached by analyses of the 'planetary boundaries' which should not be exceeded to ensure a sustainable future for humanity (Rockström et al., 2009; Steffen et al., 2015). [Geraldine Ann Cusack, Ireland]	Accepted - text revised. Circular economy is not specifically mentioned in revised text, but has been adopted in 4.3.4 (Urban).
4797	43	36	43	41	Leadership is helpful but not essential in International Relations; an alternative (perhaps more viable because it needs less political courage) is the creation of 'winning' coalitions, coalitions strong enough to force others to comply or adapt. [Marcel Wissenburg, Netherlands]	Noted. But no reference to peer reviewed literature provided. The Geels et al (2017) paper makes similar point and is adopted.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7643	43	38			You might consider adding a reference to Carter and Jacobs (2014) here. It is a study of the similarly 'bold political leadership'.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, Denmark]	Accepted - text revised. Thank you for a useful reference.
7644	43	38			Consider adding: 'as well as influencing public attitudes (Brulle et al. 2012, Sohlberg 2016).' Brulle, R.J., Carmichael, J., and Jenkins, J.C., 2012. Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010. Climatic Change, 114 (2), 169–188.Sohlberg, J., 2016. The Effect of Elite Polarization: A Comparative Perspective on How Party Elites Influence Attitudes and Behavior on Climate Change in the European Union. Sustainability, 9 (1), 39. [Conor Little, Denmark]	Noted. Considered under section 4.4.3 on behaviour change.
14094	43	40	43	40	Explain the terms 'sun-rise' and 'sun-set' sectors. [Elvira Poloczanska, Germany]	Noted. This is a glossary term.
11067	43	43	21	23	Please check Peters et al. 2017 is a meaningful reference here (see above). Maybe they refer to some primary source? [Jakob Wachsmuth, Germany]	Accepted. Peters reference removed.
18034	43	49	43	53	Please, consider adding to the paragraph: Climate Services aims to provide different kinds of decision-makers with usable and actionable information on climate variability, climate change impacts and its related risks, opportunities and uncertainties (EC – Climate Services Roadmap). To tailor climatic products to the various needs of users more intensive forms of knowledge exchange and collaboration across traditionally divided science-practice-policy communities is essential (Lemos and Morehouse, 2005; Hering et al., 2014; Lourenço et al., 2015). Refs. European Commission (2015) A European research and innovation Roadmap for Climate Services. Luxembourg. doi: 10.2777/750202. Lemos, M. C. and Morehouse, B. J. (2005) 'The co-production of science and policy in integrated climate assessments', Global Environmental Change, 15(1), pp. 57–68. doi: 10.1016/j.gloenvcha.2004.09.004. Lourenço, T. C., Swart, R., Goosen, H. and Street, R. (2015) 'The rise of demand-driven climate services', Nature Climate Change. 6(1), pp. 13–14. doi: 10.1038/nclimate2836. Hering, J. G., Dzombak, D. A., Green, S. A., Luthy, R. G. and Swackhamer, D. (2014) 'Engagement at the Science–Policy Interface', Environmental Science & Technology. 48(19), pp. 11031–11033. doi: 10.1021/es504225t. [Annamaria Lehoczky, Spain]	Accepted. Climate services now referenced - science communicators and communication platforms. References reviewed but not included as text substantially revised.
765	43	49	43	53	This paragraph highlights the need for knowladge partnership, the citation mention "natural and social sciences " as well as economists. However one of the main causes of man made GHG emmissions are machines and processes invented and opperated by engineers. The technoilogy uses energy and rescourses. Therefore where do they fit in the mix of knowladge partnerships to help provide input to this "callenging and complex transition"? They need to be added to the mix of experts and included in climate change policy and literature. The same applies to page 26 lines3-4 . [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. New reference is to science-policy interface more generally.
12472	44				GNH - authors are requested to refer WGIII Chapter 3 in this regard. It looks authors are creating new info rather than assessing exisiting literature and even looking previous IPCC AR. [Dr Noim UDDIN, Australia]	General comment. It appears that the comments allude to why authors are not referring to AR5 and looking at new information. Call to be taken by CLAs.
19738	44	1	44	3	This section on a durable rights framework should be expanded - drawing on the work of OHCHR, UNEP (and Columbia Law School), the Mary Robinson Foundation, the IBA. Refer to the UN Guiding Principles on business and human rights. [Tara Shine, Ireland]	Accepted with new reference to procedural justice and climate change responses. We have relied on peer reviewed literature.
5132	44	1	44	3	The reference to a durable rights framework is welcome, and this should be expanded to include an explicit mention of the role of a rights framework in the procedural aspects of identifying, prioritizing, and implementing climate action in the context of the SDGs. Navigating trade offs (a challenge highlighted in Section 4.4.2) will require government and others to adhere to rights frameworks in the process of climate action planning. While we may share broad-based outcomes as our goals (i.e. the SDGs & the goals of hte Paris Agreement), the likely need for trade offs indicates that HOW we achieve those goals is as important as achieving hte goals themselves. Process will matter. [Tonya Rawe, United States of America]	Accepted with new reference to procedural justice and climate change responses.
19739	44	5	44	10	Useful reference that also makes these points : Zero Carbon Zero Poverty: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Mary Robinson Foundation, 2015. Online at http://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Taken into account but citation not used as section tries to focus on peer reviewed literature.
18035	44	5	44	10	Please, consider adding to the paragraph: Climate adaptation services can bridge the gap between the sources of primary climate information and local spatial adaptation planning through integrated decision support tools that include vulnerability assessment and the design and appraisal of adaptation options (e.g., Goosen et al., 2013). Ref. Goosen, H., de Groot-Reichwein, M. A. M., Masselink, L., Koekoek, A., Swart, R., Bessembinder, J., Witte, J. M. P., Stuyt, L., Blom-Zandstra, G. and Immerzeel, W. (2013) 'Climate Adaptation Services for the Netherlands: An operational approach to support spatial adaptation planning', Regional Environmental Change, 14(3), pp. 1035–1048. doi: 10.1007/s10113-013-0513-8. [Annamaria Lehoczky, Spain]	Accepted. Climate services point now included as link between data and action.
2751	44	5	44	5	Critical to link this with the need to resolve policy fragmentation and sectoral policies that work against one another and this end goal. [Penny Urquhart, South Africa]	Noted. Text has been substantially revised to reflect this point in this and other sections (see 4.3.1)
10935	44	11			Fighting climate change denial : Paid deniers and falsehoods on climate change matters could and should be considered as Crime Against Humanity at this stage and persecuted accordingly. An international court for Climate could be created to give an international impulse to this. [Beat Brunner, Switzerland]	Rejected on the grounds that this would be "policy prescriptive". Section on "rights frameworks" has been enhanced and revised.
10936	44	11			Adding rights to harvest the solar energy on your roof and facades and environmental heat in the air and ground without need for permitting as long as national noise standards to not disturb neighbors at night are met inside your own land would help a lot moving to renewable energies for electricity, heating and hot water. [Beat Brunner, Switzerland]	Noted and text amended in 4.3.4. Although this specific point is not mentioned in favour of broader enabling environment legislation, energy governance and building standards.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10937	44	11			Another proposed recommendation to governments and institutions: When communicating about climate change : 1. Do not use future, but present : Climate change is now. 2. Use short term dates : 2018, 2020, maybe 2022. Do not talk about far-looking dates like 2050 or 2100. Most of us will be dead by then so not concerned 3. When setting long-term goals, like 2020 or 2050, also set intermediate goals for this quarter, and next quarter, and next years. Otherwise nothing happens. 4. The report should also have in the actions chapter (4?) a 1-page list of immediate actions for governments : Right now, after reading chapter 4, it is overwhelming, and it's our duty to recommend immediate actions, that are clear and easy to enact. We need also an executive summary of the executive summary, with graphs, nicely laid out and appealing to read. Right now the series of same-looging paragraphs over several pages in the executive summary look daunting and do not entice to read them. A graphics designer could help there. And also grouping by captions. [Beat Brunner, Switzerland]	Rejected on grounds that this would be "policy prescriptive". General point about communication and behaviour change is noted in the revised text.
7111	44	14	45	20	Could the examples in Box 4.1 and 4.2 be assigned as representative of a particular segment an categorization of implementation environments, in order to facilitate replicability? [Érika Mata, Sweden]	Accepted. To be discussed with CLAs for better categorization to facilitate replicability.
17744	44	32			Reference missing [Afua Adu-Boateng, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; references provided in SOD.
6208	44	42	45	20	We need more detail here as to how the Manizales case study is a case study relevnat specifically regarding the 1.5C goal. At the moment it is just a rather general description of environmental policy in that city. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. To be made explicit in the context of 1.5C goal.
3077	45	9	45	10	Odd grammar in main sentence. "Planning remains mindful of steep gradients"? What does this mean? [Christopher Bataille, Canada]	Accepted. To be explained.
1377	45	23			Implementing SD and the SDGs could be found a bit redundant for a title, would not "Implementing the SDGs" be sufficient? [Roger Cremades, Germany]	Rejected, SD is broader than SDG. SDGs have specific indicators and timeframes and when we discuss SD we are going beyond the SDG indicators and timeframe
15044	45	23			While the SDGs may be relevant to conceptualizing 'sustainable development' within the discussion of global warming of 1.5 degrees, the SDGs are not the focus of this exercise. Authors should stick closely to the mandate given to them from the Panel and not incorporate other goals which broaden the analysis of this report beyond the mandate of the IPCC and issues specifically relevant to global warming of 1.5 degrees. [Farhan Akhtar, United States of America]	Noted, SD and SDGs are now discussed in Ch. 5
10559	45	23	45	23	You cannot "implement" SD or SDGs. You can implement policies to steer development towards a more sustainable path, which in turn can "achieve" some of the goals (that are not well defined yet, in terms of targets and indicators) [Jose Antonio Puppim de Oliveira, Brazil]	Noted, SD and SDGs are now discussed in Ch. 5
17236	45	23	45	23	Heading is unclear [Himangana Gupta, India]	Noted, SD and SDGs are now discussed in Ch. 5
18793	45	23	46	34	Section 4.4.2 should highlight to a greater extent the potential synergies between achievement of climate action and the SDGs. For example, NDCs show a high potential level of convergence with SDG targets. See for example, Northrop, E., H. Biru, S. Lima, M. Bouye, and R. Song. 2016. "Examining the Alignment Between the Intended Nationally Determined Contributions and Sustainable Development Goals." Working Paper. Washington, DC: World Resources Institute. [David Waskow, United States of America]	Noted, SD and SDGs are now discussed in Ch. 5
18827	45	23	46	34	Section 4.4.2 should highlight to a greater extent the potential synergies between achievement of climate action and the SDGs. For example, NDCs show a high potential level of convergence with SDG targets. See for example, Northrop, E., H. Biru, S. Lima, M. Bouye, and R. Song. 2016. "Examining the Alignment Between the Intended Nationally Determined Contributions and Sustainable Development Goals." Working Paper. Washington, DC: World Resources Institute. [David Waskow, United States of America]	Noted, SD and SDGs are now discussed in Ch. 5
1215	45	23	47	35	We discuss implementing SD and the SDGs at length in Ch5. We would advise that you remove this section 4.4.2 entirely, along with boxes 4.3 and 4.4. We could take up part of your Brazil case study in the context of discussing case studies of emerging climate-resilient development pathways (Brazil is part of our mix). [Petra Tschakert, Australia]	Accepted, SD and SDGs are now discussed in Ch. 5
15042	45	25	45	25	This question did not emerge from the Paris Agreement. There is no need to mention the Paris Agreement in this sentence, as the focus should be specifically on the transition to 1.5 deg C world. [Farhan Akhtar, United States of America]	Noted, SD and SDGs are now discussed in Ch. 5
6582	45	25	45	26	This opening statement apparently seems correct, but consider whether it contains a bias by mentioning only part of the question related to the 1.5C° challenge. In particular it seems to imply a trade-off between the achivement of the SDGs and the achievement of staying below the 1.5ºC target; but it does no consider or mentions a much greater trade-off between the achievement of the SDG and going beyond the 1.5ºC target. In fact, going beyond the 1.5-2C° target may render many SDG unfeasible. [J. David Tabara, Spain]	Noted, SD and SDGs are now discussed in Ch. 5
17683	45	25	45	25	A good place to address the concerns raised above might be section 4.4.2. A naturaland common way to think about equity is that a just or equitable mitigation policy must, at the very least, not compromise the sustainable development goals. Section 4.4.2. would then be a good place to discuss the nature of equity and the just transition to a decarbonised economy. Relevant issues here concern the fair distribution of the remaining budget of greenhouse gas emissions. For discussion see Simon Caney 'Just Emissions', Philosophy & Public Affairs, vol.40 no.4 (2012), 255-300; Simon Caney '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 'Cosmopolitan Justice, Responsibility, and Global Climate Change', Leiden Journal of International Law, vol.18 no.4 (2005), 747-775. [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this is now discussed in Ch. 5
15043	45	28	45	28	The Paris Agreement does not have a direct linkage to SDG13. Their outcomes by the related, but they are not linked in any way. [Farhan Akhtar, United States of America]	Accepted
15307	45	31	45	31	Energy decentralization and digitalization hold an important promise in this direction, addressing both energy access deficiencies and energy security and generation problems. [Yana POPKOSTOVA, France]	Accepted, energy decentralization, electrification, and microgrids are discussed as options under 4.3.
7347	45	32	45	32	Delete the text "and fuel switching". [Eleni Kaditi, Austria]	Rejected, and it's line 47, text has been moved to Ch. 5
11182	45	36	45	42	Some challenges associated with achieving the SDGs and 1.5 deg pathways would also apply for 2 deg pathways, but as written this section implies that it is keeping below 1.5 deg that would be particularly challenging for implementing the SDGs. It would be useful to highlight that 2 deg pathways would also entail similar challenge. The impacts of climate change and their effects on attainment of the SDGs should also be mentioned here, along with potential co-benefits for the SDGs from a transition to a 1.5 pathway (e.g. jobs, health) [Michiel Schaeffer, Netherlands]	Noted, SD and SDGs are now discussed in Ch. 5

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11467	45	36	45	42	This paragraph needs some re-wording as it implies that pursuing sustainable development could undermine decarbonization when the intent (I assume) is to point out that sustainable development means doing things in a very different way in order to ensure that the goals of decent work, industrialization, infrastructure provision etc. also support the 1.5 degree goal. After all, if they don't then they're not sustainable. In addition, I do not understand the logic behind the statement that leaving no-one behind might challenge the efficacy of market-based instruments in promoting innovation. I cannot understand why implementing any kind of baseline social 'safety net' to lift people out of abject poverty would undermine innovation. [Stewart Lockie, Australia]	Accepted, this is now discussed in Ch. 5
7891	45	36	45	42	Include references / mention of the developments of a global Circular Economy and transition from a Linear to a Circular system e.g:(source adapted from :http://www.easac.eu/fileadmin/Reports/Easac_15_CE_web_corrected.pdf) The EMF (2015) summarises indicators that can be used to measure an economy's current performance and to inform sustainable policy as: Resource productivity - GDP per kilogram domestic material consumption, Circular activities - Recycling rate, Eco-innovation index (index from green investment, employment, patents, etc.), Waste generation - Amount of waste per GDP output, Amount of municipal waste per capita Energy and greenhouse gas emissions - Share of renewable energy, Greenhouse gas emissions per GDP output. Society's main purpose in the circular economy is to reduce the adverse interactions between the economy, the environment and its natural resources to safeguard the well-being of future generations thereby contributing to sustainability. Among the factors supporting a shift from a linear to circular economy is climate change. Production and consumption patterns need to be sustainable in the long term also with respect to greenhouse gas emissions, which have to be globally reduced to zero by 2050 to respect the 2 °C global warming threshold (UNFCCC, 2015). Current global consumption patterns appear to be 50% over sustainable levels (Global Footprint Network, 2015). Since in developed countries, 55–65% of greenhouse gas emissions are related to the extraction, transport and processing of raw materials (OECD, 2012), circularity, through a reduction in the energy needed to extract, transport and process these materials, reduces greenhouse gas emissions. [Geraldine Ann Cusack, Ireland]	Noted, this section is now discussed in Ch. 5
7348	45	40	45	42	Delete the text "Additionally, the universal commitment of the SDGs to 'leave no one behind' (United Nations 2016b) could challenge the triggering and feasibility of market-based instruments and innovation in introducing new emission reduction or carbon dioxide removal technologies, as Box 4.3 on bio-ethanol in Brazil illustrates". [Eleni Kaditi, Austria]	Noted, SD and SDGs are now discussed in Ch. 5
7349	45	45	45	45	Add the text "co-benefits" before "trade-offs". [Eleni Kaditi, Austria]	Noted, SD and SDGs are now discussed in Ch. 5
5133	45	51	45	55	While it can be argued that solutions derived by/in communities are more likely to be locally appropriate, it should not be ignored that inequality exists at all levels -- from households to global level. So community-derived solutions still need to be examined in relation to the factors of feasibility. THis is particularly the case around gender -- as some solutions, if determined by community elites, may not be appropriate or may undermine achievement of other SDGs. A similar challenge would exist for other segments of community population who may be marginalized or have less power in decision-making (elderly, minorities, etc). [Tonya Rawe, United States of America]	Noted, this section is now discussed in Ch. 5
20254	45	51	45	55	Howver without community action, it will be business as usual. [Morien Rees, Norway]	Noted, this section is now discussed in Ch. 5
2633	45	51	45	55	is there any literature assessing restructuring the SDGs so that climate action and poverty alleviation is complementary rather than contradictory which can be reviewed here? [Zoha Shawoo, United Kingdom (of Great Britain and Northern Ireland)]	Noted, SD and SDGs are now discussed in Ch. 5
766	45	51	45	52	It stated that "there is no simple answer". I do not know what case study literature is being referred to here as there are no citations, however one very feasible, albite not actually totally attainable at this time, is the solar hydrogen economy. (note: perhaps it is more attainable than CCS as described in page 4-34 lines 2-4), combining this with direct current usage instead of alternating current usage for the home and office use, then GHGs, global warming and the SDG's can be tackled simultaneously. See; Kinn, M. (2011). Benefits of Direct Current Electricity Supply for Domestic Application. (MPhil Thesis), The University of Manchester. Retrieved from http://www.dcisthefuture.org/papers Kinn, M. (2016). An Analysis of the Sociotechnical Transition Process from the Existing Centralised Alternating Current Voltage Electrical System in the UK to One Where Distributed Direct Current Voltage is Used to Meet The Energy Needs of the Built Environment. (PhD), The University of Salford, Manchester. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this section is now discussed in Ch. 5
6209	46		46		similarly - Brazil is well known for its early bioethanol innovations. But we need to know if this is the sort of transition that could be consistent with 1.5C or is simply not quite as bad as the status quo. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this section is now discussed in Ch. 5
2573	46				case study should add chinese ways for climate change adaptation, " strictest water resource management (SWRM) ", it including "Water use, Water use ef?ciency,Water pollution redlines" for water management under changing environment, also including demand control and quota management ways, pls find the literature"The new concept of water resources management in China ensuring water security in changing environment,Demand control and quota management strategy for sustainable water use in China", they are really good ways for climate adaptation. Wang Xiaojun?Zhang Jianyun?He Ruimin?Amgad ElMahdi?ElSawah Sondoss?Shang Manting?A Strategy to Deal with Water Crisis under Climate Change for mainstream in the middle reaches of Yellow River?Mitigation and Adaptation Strategies for Global Change?2011?16?5??555-565? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Bi Shouhai?Yu Yibin?He Ruimin?Zhang Xu?Demand control and quota management strategy for sustainable water use in China?Environmental Earth Sciences?2015?73?11??7403-7413? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Guan Enhong?Wu Yongxiang?Gao Juan?He Ruimin?Adaptation to climate change impacts on water demand?Mitigation and Adaptation Strategies for Global Change?2016?21?1?? 81-99? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?The new concept of water resources management in China: ensuring water security in changing environment,Environment?Development and Sustainability?2017? [Xiaojun WANG, China]	Noted, this section is now discussed in Ch. 5

Comment No	From Page	From Line	To Page	To Line	Comment	Response
2586	46				case study should add chinese ways for climate change adaptation, " strictest water resource management (SWRM) ", it including "Water use, Water use ef?ciency,Water pollution redlines" for water management under changing environment, also including demand control and quota management ways, pls find the literature"The new concept of water resources management in China ensuring water security in changing environment,Demand control and quota management strategy for sustainable water use in China", they are really good ways for climate adaptation. Wang Xiaojun?Zhang Jianyun?He Ruimin?Amgad ElMahdi?ElSawah Sondoss?Shang Manting?A Strategy to Deal with Water Crisis under Climate Change for mainstream in the middle reaches of Yellow River?Mitigation and Adaptation Strategies for Global Change?2011?16?5??555-565? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Bi Shouhai?Yu Yibin?He Ruimin?Zhang Xu?Demand control and quota management strategy for sustainable water use in China?Environmental Earth Sciences?2015?73?11??7403-7413? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Guan Enhong?Wu Yongxiang?Gao Juan?He Ruimin?Adaptation to climate change impacts on water demand?Mitigation and Adaptation Strategies for Global Change?2016?21?1?? 81-99? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?The new concept of water resources management in China: ensuring water security in changing environment,Environment?Development and Sustainability?2017? [Xiaojun WANG, China]	Noted, this section is now discussed in Ch. 5
2547	46				case study should add chinese ways for climate change adaptation, " strictest water resource management (SWRM) ", it including "Water use, Water use ef?ciency,Water pollution redlines" for water management under changing environment, also including demand control and quota management ways, pls find the literature"The new concept of water resources management in China ensuring water security in changing environment,Demand control and quota management strategy for sustainable water use in China", they are really good ways for climate adaptation. Wang Xiaojun?Zhang Jianyun?He Ruimin?Amgad ElMahdi?ElSawah Sondoss?Shang Manting?A Strategy to Deal with Water Crisis under Climate Change for mainstream in the middle reaches of Yellow River?Mitigation and Adaptation Strategies for Global Change?2011?16?5??555-565? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Bi Shouhai?Yu Yibin?He Ruimin?Zhang Xu?Demand control and quota management strategy for sustainable water use in China?Environmental Earth Sciences?2015?73?11??7403-7413? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?Guan Enhong?Wu Yongxiang?Gao Juan?He Ruimin?Adaptation to climate change impacts on water demand?Mitigation and Adaptation Strategies for Global Change?2016?21?1?? 81-99? Wang Xiaojun?Zhang Jianyun?Shamsuddin Shahid?The new concept of water resources management in China: ensuring water security in changing environment,Environment?Development and Sustainability?2017? [Xiaojun WANG, China]	Noted, this section is now discussed in Ch. 5
7968	46	1	46	44	Box 4.3: I was wondering why you did not select the Illinois Industrial CCS project as a case study. This is BECCS on a bioethanol plant at commercial scale (1 MtCO2/a). [Jasmin Kemper, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this section is now discussed in Ch. 5
4206	46	3			Suggestion to add case study for bio-ethanol production with carbon storage as a current working example of BECCS. More info here: https://www.carbonbrief.org/analysis-negative-emissions-tested-worlds-first-major-beccs-facility . I can contribute text if desirable - mc@gassnova.no [Mike Carpenter, Norway]	Noted, this section is now discussed in Ch. 5
1476	46	3	46	43	This case study overstates the evidence that sugar-cane ethanol in Brazil is a significant net mitigation strategy. There remain insufficient greenhouse gas LCA data to be sure that the C benefits so far estimated are robust. For instance, N2O emissions from sugar cane are poorly constrained and, as with other biofuels, can offset a significant amount of the net CO2e savings achived through fossil fuel substitution (e.g. Crutzen et al. 2008 and Reay 2011) [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this section is now discussed in Ch. 5
14280	46	11	46	11	'further' should probably be 'longer'. [Jason Donev, Canada]	Noted, this section is now discussed in Ch. 5
21187	46	16	46	23	note that among biofuel crops sugarcane in brazil is particularly efficiet at using sunlight to fix CO2,and therefore that LUC and carbon debt,while significant, is lessthan other crops [David Cooper, Canada]	Noted, this section is now discussed in Ch. 5
21188	46	16	46	23	note that these positive results are due to strong land use policy in Brazil, including forest code, use of agroecological zoning,and prohibition of sugarcane bioethano lproduction in Amazon. [David Cooper, Canada]	Noted, this section is now discussed in Ch. 5
3620	46	16	46	42	Urge the report authors to be more forceful in evaluation of Searchinger's critiques of carbon saving potential of ethanol. If want to have an impact on policy-makers it is not enough to say politely that other studies don't confirm Searchinger's findings. I encourage some delving into the different assumptions made by different authors. If there is no potential of biofuel to contribute to c reductions than resources should be devoted elsewhere, if there is potential for biofuels then say that. As an example, work criticizing energy balance of corn ethanol (Pimental and Patzek, 2005) is now generally understood to have assumptions of emboddied energy in machinery and fertilizer that are orders of magnitude higher than other LCA. [Stewart Fast, Canada]	Noted, this section is now discussed in Ch. 5
18469	46	18	46	18	Move "Searchinger and Heimlich" grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Noted, this section is now discussed in Ch. 5
18470	46	22	46	22	Remove "p. 297" - put this page number in Mendeley intstead [Wilfran Moufouma Okia, France]	Noted, this section is now discussed in Ch. 5
17743	46	31			Reference missing [Afua Adu-Boateng, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this section is now discussed in Ch. 5
3621	46	46	47	19	Very interesting box but it does not answer the key question that the section introduces: eg. Are SDG goals and 1.5 warming compatible? To answer that we need to know was there ghg reductions in the "high rise dwelling" scenario compared to the "in situ" scenario. If so then (given SDG11 and SDG6 gains) the case shows that SDG goals and 1.5 goal are compatible (the community cohesion / social capital difference – while important – is a red herring in the terms of the purpose of the section. [Stewart Fast, Canada]	Noted, this section is now discussed in Ch. 5
14281	47	3	47	3	Year missing on reference (Teferi). Is that because it's submitted, but not yet published? [Jason Donev, Canada]	Noted, this section is now discussed in Ch. 5
18384	47	22	47	22	The bibliographic entry for IPCC, 2014 should have the title as just "Climate Change 2014: Impacts, Adaptation, and Vulnerability" if intending to refer to both Parts A and B of the AR5 WGII report. Right now if just refers to Part B. [Wilfran Moufouma Okia, France]	Noted, this section is now discussed in Ch. 5
3078	47	25	47	25	first, of in stead of "first, is" [Christopher Bataille, Canada]	Noted, this section is now discussed in Ch. 5
767	47	31	47	35	This paragraphe is after Box 4.3. yet it refers to "The next case study". Perhaps it belongs before Box 4.3 and need to refer to Box 4.3 [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Noted, this section is now discussed in Ch. 5
19740	47	38			Section on multi-level governance - see the work of IIED on decentralised ciimate finance and decentralised adapation planning. [Tara Shine, Ireland]	Partly accepted decentralised adaptation planning discussed in the section; finance discussed in another section
15690	47	38			Governance discussion was not included in the SR15 approved outline. IPCC is not the adequate forum to dicuss governance, adn it´s not in its mandate.The whole 4.4.3 section should be deleted. [Elenita Daño, Philippines]	Rejected, governance is key to strengthening the implementation
15442	47	38			Governance discussion was not included in the SR15 approved outline. IPCC is not the adequate forum to dicuss governance, adn it´s not in its mandate.The whole 4.4.3 section should be deleted. [Elenita Daño, Philippines]	Rejected, governance is key to strengthening the implementation
10221	47	38			For me this section was too all encompassing and too long, covering material better suited to AR6, could you focus on the part directly relevant to SR1.5? [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Rejected; almost impossible to discuss governance only related to 1.5. It needs to be placed in a wider context.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
10561	47	38	48	5	This is an important topic (multi-governance), but it is not clear what "extra" efforts in terms of governance would be needed to reach the 1.5C goals. All you said could be valid for the 2C. [Jose Antonio Puppim de Oliveira, Brazil]	Rejected; almost impossible to discuss governance only related to 1.5. It needs to be placed in a wider context.
4738	47	38	48	6	Perhaps it should be stated (and supported by showing relevant references) that regardless the enhancements of the multi-level governance models, our main goal for such governance models is to make them people-centered and not solely technical/expert-oriented. [Spyros Schismenos, China]	Accepted with no change. Citizens (as people) are mentioned several time in the text.
11004	47	40	47	40	This line illustrates a more general point. This sentence and others in the chapter implicitly "assume" the feasibility of 1.5. Chapter 1 says we don't answer the feasibility question [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Proposed change of sentence: ..implementing responses for 1.5C pathways..
9285	47	43			Cite: Romero-Lankao et al., 2018 (In Press) [Cynthia Rosenzweig, United States of America]	Accepted. Cited in several places in the section
20255	47	45	47	45	Lifestyle and behaviour change to be successful will need to be anchored in local communities, through bottom up initiatives that offer the indivdual a physical arena where a social arena permits dialogue with her peers. [Morien Rees, Norway]	Accepted: physical arena added
14095	47	49	47	52	Are the other chapters also working to this definition of governance? [Elvira Poloczanska, Germany]	Noted: Definition of Governance shall be included in the Glossary
20256	47	49	47	52	Interaction between actors needs to at the least offer a physical arena that communites are comfortable with. [Morien Rees, Norway]	Accepted: physical arena already added in the previous paragraph
11044	48	9	50	25	Again, the "politics" dimension is almost completely missing. This might be due to the solutions-orientation of this subchapter, but without a realistic idea where the main problems are located (beyond short-term elections cycles), proposed solutions remain a bit sketchy, if not naive. See, among others, Cairney 2016 (The politics of evidence-based policymaking) [Oliver Geden, Germany]	Accepted, already mentioned at page 52-line 18 (FOD version).
14096	48	11	48	11	enabling or impeding [Elvira Poloczanska, Germany]	Accepted. added "or impede"
19741	48	16	48	24	A climate justice approach informed by the Principles of Climate Justice and a commitment to human rights can provde a framework for institutions to capture synergies between 1.5 pathways and the SDGs. Principles of Climate Justice accessible here: http://www.mrfcj.org/principles-of-climate-justice/ [Tara Shine, Ireland]	Noted: We do not discuss justice here. This is for chapter 5
15423	48	18	48	18	The governance of the low-carbon transition is developed in a context of multi-party transnational framework (EU Member States - EU institutions - UN - Country groupings (African Union, Island nations, etc. - Multilateral climate agreements - private actors) and surrounded by multiple policy (financial crisis, Brexit, anti-globalisation) and technological (digitalisation) challenges. The intersecting actor and policy problems might have an adverse impact on the democratic governance of the process, and the author of this comment currently examines mechanisms to stress-test the energy governance of the transition against potential democratic deficit dynamics. The impact of the EU as a transnational governance actor on its compounding Member states' national energy governance (Europeanisation), but also on international climate politics (policy diffusion) would be an important case study to be included in the report as an investigation of the democratic credentials and impact of EU transnational governance arrangements. Further, in the complex context of multi-party/multi-level planning exercise and in the absence of solid enforcement mechanisms, the paradigm of compliance becomes key. How can a transnational energy governance scheme be not only democratic but enforceable and what is the role of the institutional design? [Yana POPKOSTOVA, France]	Noted, but not space to add an example on the EU Transnational energy governance, as suggested. Issue of enforceability and compliance in governance in paragraph starting at page 52-line 18.
6583	48	26	48	26	As the line refer to 'Capacity for Change' and basically 'change' does not say much about its intensity, reach or speed, consider to include the notion of 'transformative capacities' (in plural). [J. David Tabara, Spain]	Noted, but this sentence has been deleted due to lack of space
6210	48	26	48	32	This is rather more general for the whole section, but becomes obvious here. The multilevel governance framing has a significant blindspot in missing forms of governance that occur transnationally. AR5, WGIII, chapter 13 discusses this in a fair bit of detail. The example of C40/ICLEI doesn't fit the multilevel model in that the governance that goes on between cities (as opposed to what happens within a single city) does not fit into a 'level'. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted but non added due to lack of space, if space allows we will add in TOD the following sentence "Non-state actors have set up several 'transnational climate governance initiatives" (AR 5 WG III Ch 13) "
7892	48	26	48	33	Include references / mention of the developments of a global Circular Economy and transition from a Linear to a Circular system e.g: By aligning climate policies with regional country and local community focused SDG developments it necessarily illuminates the potential of community-led action on circular economy thinking, climate change, wellbeing and sustainability. The overarching issue of strengthening an implementing a global effort to addressing climate changes needs to begin locally through: • encouraging public participation and increased citizen engagement in local community initiatives, • helping inspire a community led approach and make pathways visible for others to follow, • developing the capacity of 'community champions' and 'social innovators', • building bridges and strengthening partnerships among many sectors of society thinking circularly (businesses and consumers) plus increasing cohesion among all stakeholders, • promoting country-led community projects across regions of the world (Europe, Africa, Asia, Americas….etc) • raising awareness and localizing the Sustainable Development Goals, Circular Economy models and related climate focused targets. [Geraldine Ann Cusack, Ireland]	Rejected, not relevant for discussion on governance.
19742	48	35	48	42	Make special mention to the importance of community participation and the participation of grassroots women. See for example: Women's Participation An Enabler of Climate Justice. First edition: November 2015. Online at http://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-_Womens-Participation-An-Enabler-of-Climate-Justice_2015.pdf [Tara Shine, Ireland]	Accepted - references and text added.
4799	48	35	48	42	Cross-stakeholder interaction can backfire: it can paralyze a political system (a) if not all parties share the same environmental preferences and interests and (b) if more is at stake than environmental interests alone. Success is not just a question of coordination; coordination is possible only where interests do not clash. [Marcel Wissenburg, Netherlands]	Accepted - text and references added
18471	48	37	48	37	Move "Kern and Alber" into grey shaded Mendeley field with "2009" [Wilfran Moufouma Okia, France]	Done.
14097	48	39	48	39	Also international networks, such as the Global Island Partnerhship (GLISPA), are examples of horizontal collaboration, and important in the climate change mitigation and adaptation context. [Elvira Poloczanska, Germany]	Accepted Global Island Partnership added at page 42 line 1934
18472	48	41	48	41	Move "Hsu et al." into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Done.
9286	48	45			Cite: Romero-Lankao et al., 2018 (In Press) [Cynthia Rosenzweig, United States of America]	Accepted reference added
20257	48	46	48	48	Museums are spaces that can accomodates communication of both approaches, locally for the bottom up approach while a global infrastructure that allows for communication for the top down national and supranational one. [Morien Rees, Norway]	Rejected; not relevant here.
3079	48	50	48	52	This applies to the whole document. Other than Oberthur and Groen 2017 I have as yet not seen anything regarding stakeholder pathway, visioning or planning exercises to gather information on options and build political consensus. As one example I refer you to the abstract of "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" for reference to a pathways exercise to backcast from a 2C compatible 2050 target for purpose of stimulating debate, and building concensus to design and implement policy packages. [Christopher Bataille, Canada]	Accepted reference added

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11468	49	1			I would use the term "International governance" to avoid any suggestion this section will challenge the sovereignty of nation states. [Stewart Lockie, Australia]	Accepted, changed to "International governance" accordingly.
3083	49	1	50	25	4.4.3.2.1 is good, but test it on some other veterans of the UNFCCC negotiations to make sure it is how they remember it [Christopher Bataille, Canada]	Noted Thank you.
6214	49	1	50	25	This whole section on global governance could be much better organised and presented. Most generally, it seems to me it could draw on the relevant ch of AR5 more directly, which has a much fuller discussion, consider what has changed in this literature (not an awful lot, although some significant work on coordination across different sites of cliamte governance, as in the pieces by Betsill et al and by Hale and Roger mentioned above), and then be much mroe specific about what thinking about 1.5C makes us think about this literature. The discussion of 1.5C in relation mostly to the Paris Agreement is rather unclear, I wasn't really sure what the point. I think it owuld be reasonable to claim that the PA design enables much more regular, iterative, tightening of NDCs and much more flexible, 'experimental' forms of climate governance which are consistent with the needs of governing for a rapid transition. perhaps that is what is intended on p50, lines 6-17, but it is not very clear. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: the whole section on global governance has been re-organised and better presented
1535	49	1	50	25	You might also want to consider the importance of regional cooperation and development in the context of global governance, and creating a bridge to local governance. For example we showed in http://dx.doi.org/10.1016/j.enpol.2016.12.008 that implementation of Paris instruments on finance, capacity building, and south-south cooperation could make the difference for solar thermal electricity production to achieve a cost-competitive position vis-a-vis fossil generation within the timeframe required for a 1.5C target. In https://doi.org/10.1016/j.enpol.2012.04.065 we looked at the regional governance requirements for infrastructure siting, which would enable Europe to achieve a complete decarbonization of its power system, and found that major changes would be required. Others in doi:10.1038/nclimate3338 look at how international cooperation on wind power deployment could enable substantially higher penetration rates, needed for complete decarbonization, while retaining system reliability. DOI: 10.1038/NCLIMATE2276 did the same with respect to solar thermal power. Or maybe some of these ideas better fit section 4.4.3.3. [Anthony Patt, Switzerland]	Accepted, text added but references suggested not relevant.
6211	49	2	49	7	AR5 WGIII ch13 has a much fuller discussion of the differnt elements in global climate governance: the discussion here is rather behind the existing literature. (see for example: Bulkeley, Harriet, Liliana B. Andonova, Michele M. Betsill, Daniel Compagnon, Thomas Hale, Matthew J. Hoffmann, et al. 2014. Transnational Climate Change Governance. Cambridge University Press; Hale, Thomas, and Charles Roger. 2014. Orchestration and Transnational Climate Governance. The Review of International Organizations 9:59–82; Asselt, Harro van. 2014. The Fragmentation of Global Climate Governance: Consequences and Management of Regime Interactions. Edward Elgar Publishing; Betsill, Michele, Navroz K. Dubash, Matthew Paterson, Harro van Asselt, Antto Vihma, and Harald Winkler. 2015. Building Productive Links between the UNFCCC and the Broader Global Climate Governance Landscape. Global Environmental Politics 15:1–10. Some of these are mentioned in the next paragraph but it ought to be integral to how global governance of climate is stated upfront. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted, references cannot be added due to lack of space. This point will be kept in mind for TOD
20428	49	2	49	7	The first paragraph should also note that: other international aggreements also have a bearing on climate change for example multilateral trade agreements or bilateral agreements related to agriculture, energy or transport. [Jeremy Webb, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: multilateral trade agreements or bilateral agreements added
17745	49	4			Reference missing [Afua Adu-Boateng, United Kingdom (of Great Britain and Northern Ireland)]	Accepted: reference added
20429	49	5	49	7	Anthropogenic climate change is governed under the UNFCCC at the global level - as the UNFCCC defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." Any natural climate change, or natural variation, is not governed by the UNFCCC. [Jeremy Webb, United Kingdom (of Great Britain and Northern Ireland)]	Noted: sentence shortened so not anymore relevant
16441	49	9	49	11	Another reason seems to be that if binding targets with penalties are going to be imposed, nations will set targets that are so limited that there is virtually no chance of having a penalty imposed (consider Australia in the Kyoto process, the goal for which was to only increase emissions by, I think it was, 7-8%--so not even a rduction goal).With such limited targets, the commitments were nowhere near enough to accomplish much at all. With the Copenhagen and Paris approach of voluntary targets and the only penalty being public exposure of the failure to meet the goal, the targets could be aspirational and then groups promoting the effort such as environmental NGOs and manufacturers of renewable technologies could go all out and show that targets were achievable and, in many cases, not as ambitious as could actually be achieved, and so there could be a ratcheting up of targets to do even better--and with all countries pulling together and trying to out target each other with no fear of penalties, the targets could be much closer to what is needed, even if still not yet close to enough to keep the global average temperature increase to less than 1.5 C before having it decrease thereafter (and the need to decrease to below 1.5 C is as important as keeping the peak as low as possible). While not an expert in this area, what I have heard and read suggests the the reason given above was much more important than the reason given on line 11. [Michael MacCracken, United States of America]	Accepted. The sentence has been shortened but still the concept of the comment included
11183	49	9	49	11	While binding targets are seen by some as the strongest and most effective form of global climate governance, the failure to negotiate binding targets in the Paris Agreement (Patt 2017) is because a new temperature target does not only need emission reductions - this is an odd interpretation of why binding targets were not negotiated in Paris. There were political reasons for adopting a bottom-up system with nationally determined contributions, following the lack of success of binding tragets under the Kyoto Protocol. Blanket statements like this should be avoided. [Michiel Schaeffer, Netherlands]	Accepted. Changed wording of this sentence.
20430	49	9	49	19	The IPCC might want to refer to climate change as a problem of "collective action" like it did in the 5th Assessment Report in the Synthesis eport (page 102). It can then be said that this collective action includes sovereign states as well as non state actors. [Jeremy Webb, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, non state actors mentioned
4800	49	10	49	10	failure to negotiate' is a far from impartial (and for many a fairly offensive) characterization of the Paris Agreement; it supports the impression 'out there' that IPCC and its authors are politically naive and self-righteous. 'The absence of' (or words to that effect) is more neutral and more appropriate. [Marcel Wissenburg, Netherlands]	Accepted text changed.
768	49	13	49	13	It states "low probability of enable a transition". Perhaps it should read "of enabling" or "to enable" [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted editorial, will change.
3080	49	13	49	13	recommend " which have a low probability of enabling a transition to a 1.5C world" [Christopher Bataille, Canada]	Accepted editorial, changed.
14098	49	13	49	13	typo: enabling [Elvira Poloczanska, Germany]	Accepted editorial, will change.
20258	49	18	49	19	Museums offer an unique global infrastructure to communicate inernational climate govenance. [Morien Rees, Norway]	Rejected, Thank you not relevant here

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16442	49	23	49	24	This suggestion that "emissions can be allocated by country" is the type of top-down approach that was unsuccesful in Kyoto--or at least ended up with a Protocol that neither included all nations nor really accomplished much more than to slighlty slow the increase in emissions. Getting agreement on the basis of the allocation scheme on a global basis would lead to interminable debate, delaying action that is urgently needed. The first part of this sentence needs to be rewritten, maybe saying that with nations committed to emissions reductions, carbon markets can be established ... I would note in this regard, however, that the notion of making the markets international was a reason that environmental NGOs objected to the Kyoto Protocol, complaining that the US (and other rich countries) would then simply buy up the low cost mitigation in other nations instead of making a serious effort to limit their own emissions. I think this whole sentence might best be dropped as a significant over-simplification of considerations arising with international carbon markets, etc. [Michael MacCracken, United States of America]	Accepted, sentence has been deleted
769	49	32	49	39	The same here as in comment 44 above. Everyone should agree that there is a need to reduce our consumption of energy. One way to that is to re-engineer technology to be more efficient, and use alternative energy sources than those that produce GHGs. Therefore engineers need to be involved in providing input as to how climate governance needs to focus on ways to help them achieve their objectives. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Rejected; not relevant here.
14099	49	33	49	33	has' focussed [Elvira Poloczanska, Germany]	Accepted, editorial, changed.
18473	49	33	49	33	Move "Aykut" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Editorial
6584	49	33	49	33	Aykut reference missing [J. David Tabara, Spain]	Accepted: added.
6212	49	41	49	41	what is meant by the 'failure of the KP'? This is often stated but it has mostly a rhetorical rather than analytical quality - this is the case here. If it is that the commitments under the KP were not met, this is largely not true. If it is the case that the KP's commitments were inadequate to the task, then this is not a failure of the 'KP' but of the system and actors that produced it. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted Text changed.
3081	49	42	49	42	was it the absense of rules, or the inability to agree on rules? [Christopher Bataille, Canada]	Accepted text changed as proposed
17315	49	44	49	45	The sentence "A burden sharing approach led to an adversarial game among nations to decide who shall be allocated 'how much' of the remainder of the emissions budget." could do with a reference or two to support its claim. [Christian Holz, Canada]	Accepted we included three references
18474	49	46	49	46	Shukla 2006 and Javaraman et al, 2011 don't have Mendeley links [Wilfran Moufouma Okia, France]	Editorial
13142	49	48	49	48	Another focal point of the Kyoto Protocol is Article 17, which set out the establishment of the Emission Trading System (ETS) to meet quantified emission limitation and reduction commitments; however, so far ETS is mainly restricted to local or regional level, and World Bank Group (2014) described that scattered ETSs increase the complexity in tracking progress, comparing achievement and linking actions across jurisdiction. Connected ETSs provide platform for political commitment and enable the alignment of national strategies, cap structure and operational system, and trial linkage between existing ETSs is the key to provide insights on the establishment of ETS for countries without their own ETS and facilitate the expansion of the trial linkage into a global scale (Yu, 2016). Reference: - World Bank Group (2014). Networked Carbon Markets., 1. - Yu, Y.H. (2016). Facilitation of linkage of EU-ETS and China-ETS in responding to climate change issues., 27,31. [Yau Hing YU, China]	Rejected, we are dealing with governance issues not with ETS regimes.
4695	49	50			Add abbreviation "Paris Agreement (PA)" - see next page line 2 [Radim Tolasz, Czech Republic]	Rejected editorial, we have changed everywhere to Paris Agreement
18475	49	51	49	51	Remove "p. 6" - put this page number in Mendeley intstead [Wilfran Moufouma Okia, France]	Editorial
28	49	52	49	52	Please refer to R Herrala and R.K. Goel (2016), Sharing the emission reduction burden in an uneven world, Energy Policy 94, 29-39, who make a concrete proposal for an alternative facilitative model for NDCs on page 31. [Risto Herrala, United States of America]	Rejected not relevant here. It is quoted in the NDC box
5609	50	2	50	2	Normally "under the Art 6" should be expressed as "under Art. 6" [YUJI MIZUNO, Japan]	Accepted; editorial
770	50	2	50	3	The words are 'Art 6', 'PA' and ' Art 6.4'. Further along in this chapter (page 71 line 53) the wording is Art dot 2 - 'Art. 2' . However all other uses write it out in full, Article and similarly PA is written in full Paris Agreement, page 54. There is a need for consistency. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted Editorial, changed as requested
5611	50	3	50	3	joint credit mechanism (JCM) should be "the Joint Crediting Mechanism (JCM)". [YUJI MIZUNO, Japan]	Noted; editorial
5612	50	3	50	3	The JCM is not based on Art 6.4 and 6.7, but based on Article 6.2. [YUJI MIZUNO, Japan]	Rejected the Mechanism in introduced in 6.4 and 6.7
19743	50	6	50	11	Include a reference to human rights law and standards. [Tara Shine, Ireland]	Rejected, not relevant in this paragraph.
16443	50	8	50	8	It seems to me that "evolution of the finance and monetary system" is really too mild a description of what is needed in this area. Basically, much greater financial resources are needed if the transition is to occur--and because many aspects of the transition will pay off in the long term (and a good bit even in the near term), the increase in resources could involve much higher levels of green bonds comparable to the level of effort made in the Marshall Plan after WW II, which was accomplished by capitalizing development banks sufficiently that enough could be done with financial paybacks that the private banks simply could no longer afford to stay out of the redevelopment effort, and the European economy took off in a way that was way beyond traditional ways of thinking. Such an incentive to transition is again needed where money invested in banks can be leveraged to do much more than can be done by just counting country contributions without leverage. [Michael MacCracken, United States of America]	Noted, not relevant for this section on governance but added cross-reference to section 4.4.8 which deals with this topic.
3082	50	9	50	9	who is "they"? [Christopher Bataille, Canada]	Accepted text deleted
14100	50	17	50	17	not with iterated games (which is how global governance works) – see Robert Axelrod 1984 book The Evolution of Cooperation' re 'tit for tat' start nice then reciprocate with some forgiveness at times [Elvira Poloczanska, Germany]	Accepted text changed.
2687	50	19	50	22	The reference (Nordhaus 2015) does not refer to coalitions of transnational actors as substitutes to states but on climate clubs (but not really as a complement to the UNFCCC as he just proposes trade sanctions to be included in the international climate agreement), so it should be moved to the next parentheses (with Abbott, Biermann etc.) . [Achim Hagen, Germany]	Accepted; reference removed.
2688	50	19	50	22	An overview of transnational actors in climate governance coalitions is given by: 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. [Achim Hagen, Germany]	Accepted; reference added.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1917	50	19	50	25	The substantial increases in abatement cost to reach the 1.5 degrees target (p13 l. 35 - 36; p. 75 l. 23 - 28), will amplify the role abatement cost and their uncertainty play in climate negotiations. Moreover, abatement costs differ over regions and this heterogeneity will therefore determine cooperation in climate agreements, making financial transfers crucial. There is theoretical (Finus and Pintassilgo 2013; Weikard 2009) and empirical evidence (Meya et al. 2017) that heterogeneity increases coalition stability when transfers are available and decreases coalition stability when they are not. Meya et al. (2017) study the effect of empirical uncertainties, calibrated to results from metastudies, in abatement and damage cost on climate negotiations. They find that when transfer schemes are available heterogeneity in the regional distribution of abatement cost and damages can increase the stability of climate coalitions. From this one con interfere that for a more stringent 1.5 degree target it will become crucial to have compensation schemes in place for differences in abatement cost across signatories. References: Finus, M. & Pintassilgo, P. (2013). The role of uncertainty and learning for the success of international climate agreements. Journal of Public Economics, 103, 29-43. Meya, J.N., Kornek, U., Lessmann, K. (2017): How empirical uncertainties influence the stability of cli-mate coalitions. International Environmental Agreements: Politics, Law and Economics (accepted). Weikard, H. P. (2009). Cartel stability under optimal sharing rule. The Manchester School, 77, 575-593. [Jasper Meya, Germany]	Noted, this text was deleted, therefore this comment is not anymore relevant
6213	50	22	50	22	The Bulkeley et al 2012 reference is more appropriate for the previous point (transnational actors) than for the one where it is put (clubs of countries). [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, reference moved to the previous place
21150	50	25			The Montreal Protocol has already successfully avoided a substantial amount of warming by phasing out CFCs and HCFCs, which in addition to being ozone-depleting substances are also powerful GHGs (Zaelke et al 2012, Strengthening Ambition for Climate Mitigation: The Role of the Montreal Protocol in Reducing Short-lived Climate Pollutants, RECIEL, doi:10.1111/reel.12010). [Nathan Borgford-Parnell, Switzerland]	Noted. International agreements already mentioned at the beginning of the session, no need to mention it again here
10676	50	25	50	25	The Montreal Protocol has already successfully avoided a substantial amount of warming by phasing out CFCs and HCFCs, which in addition to being ozone-depleting substances are also powerful GHGs (Zaelke et al 2012, Strengthening Ambition for Climate Mitigation: The Role of the Montreal Protocol in Reducing Short-lived Climate Pollutants, RECIEL, doi:10.1111/reel.12010). [Kristin Campbell, United States of America]	Noted. International agreements already mentioned at the beginning of the session, no need to mention it again her
15424	50	25	50	26	, but would have a potentially transformative impact on the ambition of the top-down approach (giving a strong mandate to representatives and demanding accelerated action) and the enforcement of ambition. [Yana POPKOSTOVA, France]	Noted but non space to add the proposed text.
19744	50	28			Section on community and local governance : for examples of the risks associated with not including local communities in climate action - see the case studies collected by the Business and Human Rights resource Centre. https://business-humanrights.org/en/case-studies-renewable-energy [Tara Shine, Ireland]	Accepted, text added but references suggested not peer review literature
19745	50	28			for case studies showing the benefits of including local communities in climate action see: Mary Robinson Foundation - Rights for Action. Rights for Action Putting People at the Centre of Action on Climate Change (Nov 2015) Online at http://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-Rights-for-Action-edition-2.pdf [Tara Shine, Ireland]	Accepted, text added but references suggested not peer review literature
9287	50	28			Cite: Romero-Lankao et al., 2018 (In Press) [Cynthia Rosenzweig, United States of America]	Accepted reference added
4896	50	28	51	44	Please consider making reference to community-based renewable energy schemes in this section. [Sigrid Kusch, Germany]	Accepted added a reference in the next page
11469	50	28	51	44	Statements about what local government can do, what they are responsible for, and so on, need to be qualified with respect to the unique national legal contexts in which they are located and the boundaries thus established for local government roles and responsibilities, resourcing etc. The literature cited has a distinctly European flavour and should not be over-generalized. [Stewart Lockie, Australia]	Accepted: several non European references added
1536	50	28	53	4	A concrete and important example concerns governance frameworks at the local to regional level concerning infrastructure siting. There is this huge literature on public opposition to solar, wind, and power lines, and a growing strand of it is showing how the procedural rules permiting decisions, as well as whether the state vs. private sector vs. community cooperative is the agent seeking to build the infrastructure, make a profound difference in acceptance. See e.g. https://doi.org/10.1016/j.enpol.2017.05.033 , https://doi.org/10.1016/j.erss.2016.10.002 . [Anthony Patt, Switzerland]	Reject, not relevant for the box
13391	50	28	51	44	From a series of study done in several Indonesian cities found that climate change awareness raising for government officers and local leaders (as well as communities); community partnership programmes involving increased local embedment and knowledge; and local vulnerability risk assessment programmes, both scientifically and socially have become the key to address capacity-building adaptation inadequacies in the region (Yoseph-Paulus and Hindmarsh, 2016). Since these local actors, especially the local government would acquire the capacity for the creation of local regulations especially to address climate change issues, and integrating climate change into existing local regulation around environmental protection and spatial planning documents such as regional spatial plan, medium and long term development plan which form the basis of development in Indonesia at local government level (Yoseph-Paulus, 2017). Furthermore the issue of food security, for example, was included in medium term development plan of Aceh Province 2012–2017 as adaptation to climate change – even though it was not explicitly stated as a response to climate change but as a general development challenge instead (ibid.). [Rahayu Yoseph-Paulus, Indonesia]	Accepted Text added
18036	50	29	50	39	Please, consider adding to the paragraph: Campos et al. (2017) show that European climate change adaptation strategies are not effectively involving municipalities, and the study highlights the need for capacity building at municipalities and the role of European networks. Ref. Campos, I., Guerra, J., Gomes, J. F., Schmidt, L., Alves, F., Vizinho, A. and Lopes, G. P. (2017) 'Understanding climate change policy and action in Portuguese municipalities: A survey', Land Use Policy. 62, pp. 68–78. doi: 10.1016/j.landusepol.2016.12.015. [Annamaria Lehoczky, Spain]	rejected, unfortunately no space to add the suggested reference and text
2752	50	30	50	31	As before - not only cities …. rural and urban municipalities. [Penny Urquhart, South Africa]	Accepted: communities added
15497	50	32	50	32	, such as activating at local level the demand-side management and developing a nexus approach to the governance of the food, water and energy services at city level. [Yana POPKOSTOVA, France]	rejected, unfortunately no space to add the suggested reference and text
18476	50	34	50	34	Move "Fudge et al." into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
18477	50	37	50	37	Move "Carney and Shackley" into grey shaded Mendeley field with "2009" [Wilfran Moufouma Okia, France]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
12807	50	37	50	39	Community-based adaptation is important, as you have noted, and there is literature documenting such experiences and evidence especially in developing countries: Atela et al. (2017). Enhancing Adaptation to Climate Change in Developing Countries through Community-Based Adaptation. Nairobi: ACTS Press. This literature also offers crucial contributions from developing countries which bear a disproportionate impact of climate change, as noted in the report, and cuts across key developing countries. This comment also applies to section 4.4.3.3 lines 33-34 (evidence on adaptation to climate change at the community level) [Kennedy Mbeva, Australia]	Accepted, section has been revised and community-based adaptation is discussed more in-depth
18478	50	41	50	41	Move "Rutherford and Jaglin" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Accepted
7350	50	41	50	43	Delete the text "Rutherford and Jaglin (2015) acknowledge that 'while cities are often seen as the source of many energy issues and problems […] they may also be part of the 'solution', offering potential, wide-ranging opportunities for contributing to shifting energy policies onto more 'sustainable' pathways'". [Eleni Kaditi, Austria]	Rejected, no clear why it should be deleted
18479	50	48	50	48	Move "MacGillivray" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Accepted
11045	50	51	51	27	Box 4.5 is all about expected results, but not about actual results, which is a problem in the discourse on the EU Covenant of Mayors. If there are no measurable results yet, the box should be deleted [Oliver Geden, Germany]	Accepted Text changed to include measured results
13074	51	1	51	26	Box 4.5: The results indicated are "expected". There is a monitoring reports that shows that the results have been reached, maybe based with an indipendent review. The cost of the reduction of CO2 seems very high, so I suggest to give space and consider this example only if there are confirmation that has been a success story, not only a good project [Caserini Stefano, Italy]	Accepted Text changed to include measured results
14282	51	13	51	13	Euros or USD? Please be consistent. (Hard to do with lots of authors!) [Jason Donev, Canada]	Accepted Euro removed
14283	51	20	51	20	20,375 is too many significant figures, implying too high a degree of accuracy. [Jason Donev, Canada]	Accepted, text changed
7112	51	21		24	Could one then recommend education on ethics, environment and tolerance as a long-term mitigation measure? [Érika Mata, Sweden]	Rejected, not relevant for the box, should be mentioned in other section in 4.4 dealing with education
18480	51	32	51	32	Put "e.g." outside grey shaded Mendeley field [Wilfran Moufouma Okia, France]	Accepted: "e.g." deleted
9288	51	35			Cite: Romero-Lankao et al., 2018 (In Press) [Cynthia Rosenzweig, United States of America]	Rejected, section deleted
9289	51	35			Cite: Rosenzweig et al., 2015 [Cynthia Rosenzweig, United States of America]	Accepted: cited
1216	51	35	51	37	Our analysis of climate-resilient development pathway case studies (at state and community scales) also shows that participation, social learning and iterative decision-making are important governance features of strategies that deliver mitigation, adaptation, and sustainable development in a fair and equitable manner. Link to section 5.7.4. [Petra Tschakert, Australia]	Accepted, link and text added
771	51	43	51	43	What is a "zero-carbon alternative"? Surly everything has a carbon pay-back period? If it means at point of energy production, i.e. the action of production does not produce GHGs it should be stated. Others use the terminology "carbon neutral" where the carbon footprint associated with energy production is balanced out by zero carbon generation. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text deleted
19746	51	47			This section on interactions and processes should refer to the value of a rights based approach and discuss access to information the right to participation and access to justice. [Tara Shine, Ireland]	Rejected shall be addressed to Ch. 5
9290	51	47			There is good information on multi-level approaches in Romero-Lankao et al., 2018 (In Press) and Grafakos et al., 2018 (In Press) [Cynthia Rosenzweig, United States of America]	Noted, but the reference not relevant here
11470	51	47			It is unclear how multiple actors will come together because there are so many, nationally and sub-nationally, unique jurisdictions dictating how actors can come together. While the need for multi-level governance is self-evident (of course multiuple tiers of government must cooperate) the ways in which this will be operationalized will vary markedly between jurisdictions. Rather than trying to generalize about multi-level governance or establish categories, the section should simply try to identify where experiments appear to have worked and what has contributed to their success. Further, the statement that multilevel is governance is "particularly" relevant in low income countries is a nonsense. It is relevant everywhere. [Stewart Lockie, Australia]	Partly Accepted, "particularly" eliminated
10256	51	47	51	47	One also needs to mention well defined EU multi-level governance based on "smart specialisation" (see: Implementing Smart Specialisation Strategies, 2016, available at: http://s3platform.jrc.ec.europa.eu/documents/20182/154972/Implementing+Smart+Specialisation+Strategies+A+Handbook/2a0c4f81-3d67-4ef7-97e1-dcbad00e1cc9) [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Reject, not peer review publication and not relevant for 1.5C
20259	51	48	52	4	Not for the first time in this report the question is posed of how the actors with various motivation and agendas will find a common meeting place to undertake action toward enabling the 1.5 transition, 55 000 museums are available in 202 countries.This infra structure is already in place, and would thus offer the prospect of contributing to meeting the 1,5 goal despite the narrowing window of opportunity facing the world. [Morien Rees, Norway]	Reject not relevant here
18481	51	52	51	52	Move "Jordan and Huitema" into grey shaded Mendeley field with "2014" [Wilfran Moufouma Okia, France]	Accepted: editorial
772	51	53	51	53	It states "or on in contact" perhaps it should read " or are in contact" [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text corrected
18482	52	1	52	1	Move "Kovimaa" into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted editorial
4189	52	6		16	Governments must also be cautious of raising ambition. While most certainly the climate challenge must be treated with the utmost importance, if governments are to avoid increasing poverty and economic pressures which will result in a cascade of social impacts (including developed countries), they must be aware of the economic and social impacts that increasing ambition will have on residents. [Michelle Leslie, Canada]	Refer to Ch. 5: the comment is not well formulated as higher ambition NDC leading to 1.5C reduce adaptation costs
4696	52	9			Bad reference "Box 1 on NDCs" [Radim Tolasz, Czech Republic]	Accepted Editorial, now Box 4.12
773	52	9	52	9	It states "Box 1" I think it should be Box 4.12 [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted Editorial, now Box 4.12
2753	52	12	52	16	True. But at the same time, many developing countries have made much progress in formulating national policies, plans and strategies on responding to climate change - such as National CC Policies (e.g. The Gambia, Namibia, Ghana, South Africa, Pakistan, etc etc); National CC Strategies and Action Plans (e.g. Afghanistan, Kenya, Swaziland, Bangladesh etc etc; Low Emissions Climate Resilient Development Strategies in various countries (supported by UNDP); Strategic Programmes on Climate Resilience or PPCRs (supported by Climate INvestment Funds) in various countries including Bolivia, Zambia, Philippines etc etc. Therefore national processes to develop integrated CC and development responses go way beyond the NDCs - which of course are more narrow and set out mitigation commitments only. This should be reflected in the text. [Penny Urquhart, South Africa]	Accepted: suggested text. Added
18483	52	15	52	15	Put "e.g." outside grey shaded Mendeley field [Wilfran Moufouma Okia, France]	Accepted: editorial
4752	52	15	52	15	Remove comma after full stop in "(e.g., de)", which becomes "(e.g. de)" [Valentino Piana, Italy]	Noted: editorial
4801	52	18	52	18	This is one of the rare occasions where the reports admits there may be conflicts of interest inhibiting climate change policies; even so, the text still suggests (without proof or justification) that climate change policy is good and promoting other interests is bad. [Marcel Wissenburg, Netherlands]	Accepted: the text modified
4753	52	21	52	21	Remove comma after full stop in "(e.g., zero)", which becomes "(e.g. zero)" [Valentino Piana, Italy]	Editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
19747	52	25	52	27	Refer to the right to participation and the need to address the gender dimensiosnof climate change. See for example: Women's Participation An Enabler of Climate Justice. First edition: November 2015. Online at http://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-_Womens-Participation-An-Enabler-of-Climate-Justice_2015.pdf [Tara Shine, Ireland]	Refer to Ch. 5
18484	52	28	52	28	Move "Nightingale" into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted: Editorial
18485	52	28	52	28	Move "Green" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted: Editorial
2634	52	32	52	40	review literature on whether this will be able to fill the gap in the NDCs and limit to 1.5 deg? [Zoha Shawoo, United Kingdom (of Great Britain and Northern Ireland)]	Rejected, not relevant for this section
18486	52	42	52	42	Move "Hoppe and Weeselink" into grey shaded Mendeley field with "2014" [Wilfran Moufouma Okia, France]	Accepted: Editorial
6215	53		53		not clear how the case study in the Box is specific to the challenge of 1.5C [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted now link to 1.5 added
774	53	7	53	32	Box 4.6 is not referenced in this section and is referenced in the next on page 54 line 21. Is this therefore the appropriate place for this box to sit? [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted now referenced
4190	53	11		31	Environmnental degredation of forests in Gueatemala and human rights abuses have been widely reported in the cultivation of palm oil. It could be argued that the cultivation and production of this oil directly steers the global community away from SDGs and contributes to climate change through the removal of carbon sinks when forests are destroyed. Addtionally, as the industry is owned by a very small group of people, the majority live in abhorent conditions where human trafficking is not uncommon. [Michelle Leslie, Canada]	Rejected - out of the scope of the chapter.
14101	53	29	53	29	informal language [Elvira Poloczanska, Germany]	Editorial
11184	53	35	53	35	This section on enhancing institutional capacities could also consider the importance of institutional capacity for dealing with loss and damage / the impacts of climate change that go beyond adaptive capacity. How can institutions cope with loss and damage? How can they help populations to cope? [Michiel Schaeffer, Netherlands]	Rejected. The section currently deals with the residual damage through the strengthening of Co-operative institutions and safety nets (4.4.4.4). To argue for specific institutions for loss and damage we need specific relevant literature
1308	53	45	51		There is a need to acknowledge the scale and potential of the informal settlement opportunity/challenge in achieving a 1.5 degree world. We could have up to a third of humanity living in informal settlements by 2050. UN Habitat suggests the possibility 3 billion people in informal settlements by 2050: http://mirror.unhabitat.org/content.asp?typeid=19&catid=10&cid=928 and the current estimates for the total human population in 2050 is 9.7 billion: http://www.un.org/en/development/desa/news/population/2015-report.html [Debra Roberts, South Africa]	Partially accepted. This section addresses the institutional challenges of informal settlement but the implications of informal settlement in relation to 1.5c are dealt with in section 4.3.4. The material pointed to will be passed to that section authors
19748	54	3	54	4	See the recommendations on new institutions to deliver zero carbon and zero poverty in this report: Zero Carbon Zero Poverty: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Mary Robinson Foundation, 2015. Online at http://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	Accepted. This is relevant for section 4.4.1 on governance. The provided references will passed on to that section authors
19749	54	3	54	4	e.g. from page 34 of the above report: 'there is a critical role for strengthening the protection of human rights in existing institutions and developing new institutions to address the many interlocking requirements of a transition to an equitable zero-carbon future. institutions will be needed that can mediate equitable burden-sharing, recognising the unprecedented scale of international cooperation and support that will be needed. existing institutions, such as those associated with development assistance, foreign direct investment, and trading systems may provide helpful lessons, but are themselves far from adequate to the task. at the same time, and at a range of scales, more effective institutions will be needed to ensure democratic governance and participation based on the effective involvement of stakeholders. international and national institutions that support human rights will need to be expanded and strengthened, as will those charged with multilateral environmental governance. these institutions must be designed to enable adaptive management that can cope with the inherent uncertainties and dynamic conditions of a long-term carbon phaseout spanning decades and a diversity of national contexts. ' [Tara Shine, Ireland]	Accepted. This is relevant for section 4.4.1 on governance. The provided references will passed on to that section authors
9346	54	17	54	19	The statement "Given the amount of change required to achieve 1.5°C, it is critical that strengthening the response capacity of relevant institutions be addressed in ways that take advantage of existing decision-making processes at lower governmental levels and within cities (Romero-Lankao et al. 2013)" may be supported by additional literature on city-to-city learning mechanisms. Examples include "Campbell, T. (2012) Beyond Smart Cities: How Cities Network, Learn and Innovate, Earthscan, London." [Siir KILKIS, Turkey]	Accepted. The comment is relevant to section 4.5 on integration and enabling of transformation where a box (4.14) is devoted to the role of cities. The reference will passed on to that section authors
775	54	29	54	29	Km should be km [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
14284	54	29	54	29	"Km" should be "km" [Jason Donev, Canada]	Editorial
3085	54	31	54	31	weird placement of commas [Christopher Bataille, Canada]	Accepted. placement for the indicated commas is corrected
6585	54	32	54	34	A reference giving some evidence of this statement and how this has actually happened may be needed. [J. David Tabara, Spain]	Accepted. Sentence revised to fit with the interpretation in the context of Paris Agreement
14102	54	37			Needs to also mention the issue of misreporting (deliberate or otherwise) by countries e.g. see Jungfraujoch air monitoring findings [Elvira Poloczanska, Germany]	Accepted. Enhancing institutional capability on oversight role along with monitoring and reporting will take care of misreporting
18487	54	42	54	42	Paris Agreement, Article 13 needs Mendeley link [Wilfran Moufouma Okia, France]	Editorial
4697	54	43			Change "agreement" to "Agreement" [Radim Tolasz, Czech Republic]	Editorial
3084	54	46	54	46	global stocktake , not "glboal stock" [Christopher Bataille, Canada]	Editorial
18488	54	47	54	47	Paris Agreement, Article 14 needs Mendeley link [Wilfran Moufouma Okia, France]	Editorial
19750	54	50	54	50	section on financial institutions - stress the fact that finance institutions have to mainstream gender (as per their policies), repect human rights and ensure social and environmental safeguards for all actions related to adaptation and mitigation. [Tara Shine, Ireland]	Accepted. This is relevant for section 4.4.1 on governance. The comment will passed to that section
1541	54	50	55	22	Potential addition to the text: Winkler and Dubash (2016) caution against transformational change, to the extent that climate finance deployed through a transformational change paradigm may trump legitimate development priorities". Winkler, H., & Dubash, N. K. (2016). Who determines transformational change in development and climate finance?. Climate Policy, 16(6), 783-791. [Fatemeh Bakhtiari, Denmark]	Accepted. Comment is relevant to governance (section 4.4.1). Reference provided will passed to authors of that section
4191	55	1		7	The infrastructure bank in Canada is one example of government financing that could encourage partnerships between private industry and government to finance future renewable and low-carbon technologies. [Michelle Leslie, Canada]	Noted.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16444	55	1	55	7	These problems are exactly why Secretary of State General George Marshall basically established and capitalized his own banks to initiate the Marhsall Plan that started the recovery process in Europe after World War II. When Marhall's banks stasrted making a good economic return, the commercial banks could no longer afford to sit on the sidelines and came in to amplify the effect. There is a group making this case to day in their analysis of the situation (see http://envisionation.co.uk and I am one of those helping to encourage this effort) and so is trying to encourage greater capitalization of banks willing to issue green bonds for efficiency investments and more as a starting point, using the leverage of capital that banks are allowed to really build up the portfolio. So, the Marshall Plan is an example of how to overcome the problems discussed in this paragraph--what is needed are leaders who will step forward and make it happen (and the recovery of Europe after WW II probably required a greater effort than is needed now, given the significant advances in reducing the costs of renewables). [Michael MacCracken, United States of America]	Noted.
18489	55	6	55	6	Move "Hoch" into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Editorial
18490	55	9	55	9	Move "Linnerooth-Bayer and Hochrainer-Stigler" into grey shaded Mendeley field with "2015" [Wilfran Moufouma Okia, France]	Editorial
16445	55	17	55	22	The question is if these international financial institutions are able to leverage their resources to the extent that banks are able to do. For the Marshall Plan example, the leveraging was particularly important, and given the seeming reluctance to put up funds (basically limited to a 1 to 1 basis), finding a way to get leveraging going. For example, at the typical leveraging rate, a $400B capitalization would allow roughly $3T in loans to be made/bonds issued. That is the type of scaling up that is needed. [Michael MacCracken, United States of America]	Noted.
2754	55	17	55	22	It would be important to assess, here or elsewhere, the extent to which the required financial flows to LDCs and other developing countries to achieve a 1.5 pathway are in place - both for capacity development and implementation - and the barriers and ways to overcome them. [Penny Urquhart, South Africa]	Accepted. This relevant to section 4.4.8. The comment will be passed to the authors of that section
14285	55	18	55	18	I know what the IMF is (but does everybody?) What's IFC? [Jason Donev, Canada]	Accepted. Paragraph is removed
19751	55	21	55	22	In addition to providing direct support for mitigation and adaptation to climate impacts, financial resources will be necessary to support a wide range of "just transition" activities. the right to work and livelihoods will be at risk in many sectors, and it should not fall solely to national governments to address the disruptive effects of a rapid carbon phase-out. Particularly in poor countries with weak institutions of social protection, both direct international support as well as capacity building will be essential to protecting livelihoods and the basic rights to food, health, and shelter that market incomes provide. however, these resources must not come at the expense of resources for adaptation and compensation for loss and damage; even the most rapid possible phase-out will not eliminate climate impacts. [Tara Shine, Ireland]	Accepted. Paragraph is removed
21151	55	22			Additionally, the Multilateral Fund under the Montreal Protocol facilitates the transition away from ODSs and will do the same for HFCs with the Kigali Amendment [Nathan Borgford-Parnell, Switzerland]	Accepted. Paragraph is removed
10677	55	22	55	22	Additionally, the Multilateral Fund under the Montreal Protocol facilitates the transition away from ODSs and will do the same for HFCs with the Kigali Amendment. [Kristin Campbell, United States of America]	Noted. Paragraph is removed
14103	55	25			This section could also include the importance of social capital for adaptation (e.g., disaster response, migration, remittances, collective action), especially in highly vulnerable regions, such as small islands (cf. Adger 2003, 10.1111/j.1944-8287.2003.tb00220.x; Petzold and Ratter 2015, https://doi.org/10.1016/j.ocecoaman.2015.05.003). [Elvira Poloczanska, Germany]	accepted and reflected
19752	55	25	55	25	Section on cooperative instituitions and social safety nets. Add reference to work on i) social protection and ii)access to sustainable energy and social protection for resilience building. [Tara Shine, Ireland]	accepted and reflected
19753	55	25	55	25	i) The Role of Social Protection in Ending Energy Poverty: Making Zero Carbon, Zero Poverty the Climate Justice Way a Reality. 2016. Online at http://www.mrfcj.org/wp-content/uploads/2016/09/The-Role-of-Social-Protection-in-Ending-Energy-Poverty.pdf [Tara Shine, Ireland]	Accepted. Energy access reflected
19754	55	25	55	25	ii) see IIED publications: http://pubs.iied.org/pdfs/10157IIED.pdf; http://pubs.iied.org/pdfs/10156IIED.pdf and World Bank http://siteresources.worldbank.org/EXTSOCIALDEVELOPMENT/Resources/244362-1232059926563/5747581-1239131985528/WBSocProtec_Final.pdf [Tara Shine, Ireland]	Noted. Provided references are not citable according to the IPCC 1.5c report guidelines
7893	55	31	55	35	Include references / mention of the developments of a global Circular Economy and transition from a Linear to a Circular system e.g: [Geraldine Ann Cusack, Ireland]	Rejected. This irrelevant to strengthening of institutions for 1.5c
16446	55	32	55	33	If a comprehensive plan made clear that fuel for aircraft and shipping needs would have to be biofuels, farmers (and their financial supporters) might develop some real confidence and commitment to provide the biomass needed to accomplish this in a relatively short period. [Michael MacCracken, United States of America]	Noted.
11471	55	43			Traditional where? This statement about traditional social forms makes assumptions that are not universally true. [Stewart Lockie, Australia]	Accept. The word "traditional" is removed.
15045	55	52	55	53	This sentence is not an objective statement. Statements like these should be removed throughout the report. [Farhan Akhtar, United States of America]	Accepted. The sentence is removed.
1217	56				Why is Box 4.8 located here? Also, the box needs a more specific title: i.e. Indigenous Knowledge and Community Adaptation? [Petra Tschakert, Australia]	Accepted. The box is relevant to the strengthening of implementation institutions for 1.5c. Your suggestion for changing the title is incorporated.
6216	56		56		both boxes need to be made more clearly relevant to the challenge of 1.5C [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Noted
11472	56	3	56	13	Box 4.7 doesn't say anything of substance. Is this coming? [Stewart Lockie, Australia]	Accepted. The box is deleted.
11046	56	3	56	14	Box 4.7. is only about plans, not about concrete results, which is surprising given that the events took place a long time ago. If there are no actual results beyond plans to be reported, the box should be deleted [Oliver Geden, Germany]	Accepted. The box is deleted.
6586	56	4	56	14	Box 4.7. more elaboration on the actual effects of this example, and which actual policies and action have been implemented may be needed to improve credibility. [J. David Tabara, Spain]	Accepted. The box will be revised and expanded
19755	56	16	56	16	Box 4.8 on indigenous knowledge is very useful. Can it be complemented with a box on local and traditional knowledge? [Tara Shine, Ireland]	Accepted. Will consider but allocated space to the chapter may not permit
7284	56	16	56	53	The paper SETTI, A.F.F., RIBEIRO, H., AZEITEIRO, U.M., GALLO, E., 2016. Governance and the promotion of sustainable and healthy territories in the experience of Bocaina, Brazil RGCI – Revista de Gestão Costeira Integrada / JICZM - Journal of Integrated Coastal Zone Management 16: 57 - 69. http://www.aprh.pt/rgci/pdf/rgci-612_Setti.pdf | http://dx.doi.org/10.5894/rgci612 can be a contribution more. [Ulisses Azeiteiro, Portugal]	Accepted. The reference is added and will be considered for citation
2755	56	16	56	53	Need to present other perspectives from the literature that show potential limits of traditional knowledge in dealing with climate change - this was already presented in AR4 (e.g. see Boko et al 2007) and AR5 (e.g. see Niang et al 2014). [Penny Urquhart, South Africa]	Accepted. Limitations to indigenous practices to deal with climate change are reflected.
11473	56	16	56	53	I am not particularly comfortable with Box 4.8. Its lack of integration in surrounding text suggests tokenism and the content is shallow. Given Indigenous knowledge is taken up elsewhere in the chapter one solution would be to integrate this material elsewhere. Alternatively, Indigenous knowledge could be a more substantive section in the main text and a box or two on specific Indigenous peoples included as case studies. [Stewart Lockie, Australia]	Accepted. The box is revised.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1466	56	17	56	52	box: In the case of weather/seasonal forecasts, a more appropirate terminology is "local knowledge" or "traditional knowledge" (see Roncoli, C., Ingram, K., et Kirshen, P., 2002: Reading the rains: Local knowledge and rainfall forecasting in Burkina Faso. Society & Natural Resources, 15, 409-427.) [Philippe Roudier, France]	Noted.
4933	56	19	56	22	I appreciate that this box has been developed. However, its introduction should be reoriented to recognize that indigenous communities have been interacting, using, remembering and sharing information about their environments for millenia (ie, not for centuries, and not solely observing). References for millenial timescales of indigenous memory include: Leonard, Sonia, Meg Parsons, Knut Olawsky, and Frances Kofod. 2013. "The Role of Culture and Traditional Knowledge in Climate Change Adaptation: Insights from East Kimberley, Australia." Global Environmental Change 23 (3): 623–32., and Nunn, Patrick D, and Nicholas J Reid. 2015. "Aboriginal Memories of Inundation of the Australian Coast Dating from More than 7000 Years Ago." Australian Geographer 9182: 1–37. As well, given this, the challenge for modern climate science is to understand how to engage with indigenous knowledge holders to improve and support climate change science and adaptation. While the statement here that "indigenous knowledge can now contribute toward climate research" is likely not intended to be offensive or insulting, as indigenous knowledge is not the knowledge system that has generated modern climate change, this statement does come across that way. Recommend rephrasing to emphasizing the need for modern science to figure out how to connect with indigenous knowledge is more balanced and respectful. [Marcy Rockman, United States of America]	Accepted. The box is revised.
1925	56	19	56	22	For centuries, indigenous communities have observed the behaviour of flora, fauna, and climate phenoma on their crops, traditional land, and their communities. [Chrystal Mantyka-Pringle, Canada]	Accepted. Paragraph revised.
1926	56	24	56	25	Indigenous traditional knowledge is not unique for the Mayan communities. Sharing of knowledge from generation to generation is common among all indigenous communities. [Chrystal Mantyka-Pringle, Canada]	Noted.
4934	56	24	56	53	Recommend incorporating here some examples of use of traditional knowledge in ecosystem restoration/adaptation. Relevant reference regarding use of fire is: Lightfoot, Kent G., Rob Q. Cuthrell, Cristie M. Boone, Roger Byrne, Andrea S. Chavez, Laurel Collins, Alicia Cowart, Rand R. Evett, Fine V.A. Paul, Diane Gifford-Gonzalez, Mark G. Hylkema, Valentin Lopez, Tracy M. Misiewicz and Rachel E. B. Reid (2013) Anthropogenic Burning on the Central California Coast in Late Holocene and Early Historical Times: Findings, Implications, and Future Directions. California Archaeology 5(2):371-390. [Marcy Rockman, United States of America]	Accepted. Will consider reflecting the evidence based on the provided references
1927	56	28	56	31	There is a constant pull by the western world to integrate indigenous knowledge with scientific knowledge. One is not better than the other - they are just different. No validation is necessary but rather the two bridged and creat space for both knowledge systems. Please see Mantyka-Pringle et al. (2017) "Bridging science and traditional knowledge to assess cumulative impacts of stressors on ecosystem health" in Environment International for reference and in particular - page 132, section 'Moving beyond simple integration' and 'Challenges with blending TK and SK'. [Chrystal Mantyka-Pringle, Canada]	Partially accepted. The box does not suggest preference of one form of knowledge over another. Sentence suggesting validation will be revised.
1467	56	29			I do not fully agree. Even if local knowledge is totally different compared to observations, if people trust this knowledge for whatever reason, you have to take it into account in your plans. If not, the scientific information (eg forecasts) will never be used [Philippe Roudier, France]	Accepted. The sentence suggesting scientific validation is revised.
4936	56	38	56	52	An example of how to use and share indigenous knowledge about changing environments in the Arctic is ELOKA, Exchange for Local Observations and Knowledge of the Arctic (https://eloka-arctic.org/), hosted by the US National Snow and Ice Data Center. A statement that a diverse range of Arctic communities are already contributing to this exchange would be a useful addition to this box case study. [Marcy Rockman, United States of America]	Rejected. Revision of the box led to removal of arctic experience
1218	57		64		This section 4.4.5 is hard to read, contains a lot of generic material, and is quite long. Make more relevant? [Petra Tschakert, Australia]	Taken into account. We revised and shortened the text, and extended the discussion on adaptation behaviour and made it more relevant for 1.5C
6218	57		62		There is a very significant absence in this section on the literature which understands these aspects of climate change in terms of the notion of practice rather than that of behaviour. The work of Elizabeth Shove is central here but the literature is very broad. One of her pieces is mentioned on p15 but ought to be represented more adequately. This entails a very different way of understanding the challenge of shifting practices from high-carbon to low-carbon, especially in rapid time frames. In particualr, it would make for a more consistent analysis with the focus on socio-technical transitions earlier in the chapter, since that approach also eschews the methodological individualism underpinnign the discussion in this passage, and focuses on the complex relations between identities, daily practices, and technology/infrastructure. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Contextual factors are discussed on p. 57,line 15-20, identities are discussed on p 58. Socio technical transitions are discussed in section 4.2.3. Please note that page and line numbers refer to the FOD.
3091	57	1	61	30	4.4.5.1-3 are good, well written [Christopher Bataille, Canada]	Noted, Thanks.
14104	57	2			Glven that the title of chapter includes 'threat', somewhere in this section on enabling lifestyle & behavioural change there should be discussion of psychological threat responses (defence or coping strategy) such as denial, and also the influence of denialism (i.e. deliberate campaigns of disinformation) that spread doubt in people's minds about the science, contributing to inertia. [Elvira Poloczanska, Germany]	Noted.
15046	57	3			Much of the section on "enabling lifestyle and behavioral change" is not rooted in literature specifically relevant to 1.5 degrees. Therefore the information in this section, should it remain in the report at all, should be reframed to be specific to the scientific understanding of enabling changes to limit warming to 1.5 degrees. While the information on conditions to enable climate action is of interest, it should be reflected in the full assessment reports not in this special report. [Farhan Akhtar, United States of America]	Taken into account. there is hardly literature on behaviour change specific on 1.5 degree. Yet, similar strategies can be implemented for scenarios consistent with 2C or 1.5C, but more strongly so in the latter case. Behaviour change is key for 1.5C (see Chapter 2), so an assessment of this literature is important. We assess review papers and meta-analysis whenever possible, and rely on high quality peer-reviewed papers elsewhere.
11474	57	3			I am glad to see this section headed "Enabling…". I still suggest though it be headed "Enabling sustainable lifestyles and behviours" to acknowledge while some of us do need to change our consumption behaviours, others need the opportunity to escape poverty and in fact to consume more. [Stewart Lockie, Australia]	Accepted changed accordingly
20213	57	3			It would be helpful to include somewhere in this section an indication of the scale of behavioural changes that are both needed and possible. Chapter 2 talks about 1.5°C pathways involving 20% final energy demand reductions in 2030. This chapter should indicate how much of this might come from technology and how much from behaviour. [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	taken into account; this is discussed in Chapter 2; which types of behaviour changes can contribute to 1.5C pathways is now discussed in this section (previously included in section 4.2.3). Technology change involves behaviour change (i.e. people need to adopt or accept the relevant technology)
20214	57	3			In industrialised countries household energy use can vary by a factor of 40 between households, and a factor of 3 to 4 between homogeneous households (J. Morley and Hazas, M., The significance of difference: Understanding variation in household energy consumption, ECEEE Summer Study 2011, Panel 8.). [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, this is exactly why it is important to understand which factors affect behaviour (change) the focus of this chapter. We now which types of mitigation and adaptation are relevant for 1.5C
20215	57	3			Individuals and groups adopting low/carbon free household energy use, eating diets free from meat and dairy products, and refraining from flying or car use can achieve personal carbon footprints at least 60-70% below the industrial country average. [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, see comment 20213, we added a Table

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20216	57	3			Some ecovillages have per capita ecological footprints 50-60% below their national averages (S. Tinsley and George, H., Ecological Footprint of the Findhorn Foundation and Community, Sustainable Development Research Centre, Moray, 2006; M. Daly, 2017, Quantifying the environmental impact of ecovillages and co-housing communities: a systematic literature review, I.J. Justice and Sustainability, vol. 22 no. 11.) [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, see reply to 20213
20217	57	3			In one scenario for the UK final energy demand is reduced by 60% in between 2010 and 2030 through a combination of technology and behavioural change. It includes 15% less travel plus a mode shift, including a factor of three reduction in air travel. (P. Allen, Blake,L. Harper, P., Hooker-Stroud, A., James, P. and Kellner, T., Zero Carbon Britain: Rethinking the Future, Centre for Alternative Technology, Machynlleth, 2013). [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, see reply to 20213
5917	57	3	63	47	Enabling lifestyle and behavioural change are important. However, I would have preferred some discussions around the need for reducing the global human population. [Aage Stangeland, Norway]	Accepted, now included
2756	57	3	63	47	This is an interesting and valuable section - however, it takes too long before it becomes directly applicable to the subject of this report. The authors are advised to make it more relevant to 1.5, when shortening it. [Penny Urquhart, South Africa]	Taken into account, we clarified that this section focuses on factors and strategies that affect adaptation and mitigation actions strengthening the implementation of 1.5C worlds
10562	57	3	64	3	This section suffers from the same problem as the previous one. It is not clear what extra change in behavior would be needed to reach the 1.5C in addition to what would be needed to 2C. [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account, see reply to 20213. Similar behaviour changes are needed, but the speed and extent of change needs to be higher in 1.5C worlds
10222	57	4			For me this section was too all encompassing and too long, covering material better suited to AR6, could you focus on the part directly relevant to SR1.5? [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, all factors and strategies are directly relevant to 1.5, given high ambitions all strategies may be needed, see comment 2021. Moreover, the text is shortened
11475	57	5			Among those who are, in global terms, materially well off. [Stewart Lockie, Australia]	Taken into account, not only materially well off - also refers to adaptation, so we did not add this
11476	57	5	64	36	These summaries of the literature are generally quite good but more qualification is needed to avoid the suggestion that each piece of research is generalizable to all people. Most of the studies are undertaken with citizens of high income, developed and predominantly Western countries. Some are not and I think it is often the case that there is more variability within countries on these consumption-related matters than there is between countries. But still, this is supposed to be a research-based report and all claims should be qualified in respect to just how generalizable they are on the current evidence. [Stewart Lockie, Australia]	Taken into account. We indicate that factors influencing behaviour and effects of strategies differ across individuals and context. We included more literature from non-Western countries. We refer to meta-analyses and review papers whenever possible, and many papers refer to studies outside EU and Northern America
20260	57	6	57	10	there is a neccessity, in adddition to stating: a wide range of policy approaches can be employed to encourage and facilitate climate -related actions - that report also addresses the how and the where these approaches can be achieved. Outside the museum sector it is difficult to discover an arena that encourages and facilitates disseminationa and dialoge. [Morien Rees, Norway]	Accepted, included
20218	57	9	57	9	Individuals who identify as members of certain groups, including those with particular political views…. [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Rejected- unclear what the comment is about.
4897	57	13	62	55	Sections 4.4.5.1, 4.4.5.2, 4.4.5.3 overall appear lengthy and overly theoretic. In particular section 4.4.5.2 'Behavioural anomalies' seems rather not well balanced, overly theoretical and overall of limited added value in the context given here. Most information that is useful would fit under the previous section 4.4.5.1 'Factors related to climate change actions'. The two sections should be merged and contents shortened. The next section 'Strategies to promote actions on climate change' should also be revised: it can be shortened and better focused. [Sigrid Kusch, Germany]	Accepted. We revised and shortened the text, and integrated 4.4.5.2 in 4.4.5.1.
20219	57	13	60	41	These two sections provide a good overview of the motivational/affective aspects and cognitive choice aspects of individual behaviour change. They could be considerably shortened by cutting connecting text and using lists or bullet points of the many observations from the literature. The chapter is largely missing perspectives from studies of human collectives - social psychological, sociological, anthropological and organisational change and management. This is important because much consumption and behaviour is shaped by social norms and narratives. [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. social norms are discussed, idem group influence (page 58 line 28-33; page 62, line 8-14), we did not always use term social norms to avoid jargon, butter rather describe the process (as only limited space available). We added text on behaviour in organisations. Text has been shortened
20220	57	13	60	41	Cultures differ in the way they understand the “good life” and the implications for ethical behaviour, appropriate narratives, values and social roles (MacIntyre, A., 1985: After Virtue, Second edition, Duckworth, London.). In some societies subcultures and their behavioural norms are associated with socioeconomic class (Bourdieu, P., 1984: Distinction: A Social Critique of the Judgement of Taste, Harvard University Press, Boston, MA.). In others the cultural groupings are more complex but consumption patterns can still be understood as conforming to subcultural norms (Warde, A. 1997: Consumption, Food and Taste, Sage, London.) Different cultures also have different ways of understanding climate change, its causes, and the implications for ethical behaviour. (Thompson, M. and S. Rayner, 1998: ‘Cultural discourses’, Chapter 4 in S. Rayner and E. L. Malone (eds.) Human Choice and Climate Change. Volume 1. The Societal Framework, Battelle Press, Columbus, Ohio, pp. 265-343.). [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, this is related to social norms and value differences. We refer to cultural factors as important contextual factor p 57 line 18. See also section 4.2.3.5 p 15. Please note the page numbers refer to the FOD.
4802	57	25	57	28	The way this us formulated now suggests IPCC is the home of self-righteous, illibberal, intolerant, authoriarian wiseacres, leaving no room for diversity of conscience, conception of wellbeing, lifestyle etc. Even if that is true, it's not wise. [Marcel Wissenburg, Netherlands]	Taken into account, different conceptualisations of wellbeing and lifestyles are taken into account, see reply to 20220
18491	57	35	57	35	Gatersleben, Steg & Vlek neds Mendeley link [Wilfran Moufouma Okia, France]	editorial
4192	57	41		55	Additionally, lack of knowledge means that the entire lifecycle emissions of energy sources are misunderstood allowing individuals to favour some mixes over others when there could be cleaner and more affordable options. If we are to communicate the importance of sustainable development then I think it's critical that all energy sources are transparent with the amount of resources used, the enviornmental impacts, carbon offsets, lifespan of current technologies and the plan for waste/disposal or recycling at end of life. [Michelle Leslie, Canada]	Taken into account; the main point made in text: lack of knowledge may inhibit behaviour change. Yet we also indicate that enhancing knowledge may not result in changes in preferences as knowledge is not a strong predictor of behaviour
4803	57	41	57	41	Iit is not so much lack of knowledge as different ideas of the good life, different ethics and moralities, different priorities that explain non-compliance with what IPCC presents as the sensible way of life. Texts like the (again) affirm the suspicion that IPCC is the home of self-righteous and intolerant technocrats lacking all understanding of diversity and moral pluralism. [Marcel Wissenburg, Netherlands]	taken into account, this is included in the text see p 58 line 14-15, and p 61, line 30-47. Please note that page and line numbers refer to the FOD.
20261	57	41	57	42	dissemination of knowledge is a matter of communication: conversation rather that information, that is, dialogue as opposed to the often one direction flow offered by media of different hues. It cannot continue to be left in the hands of journalists. The internatinal community that has funded the scientific documentation of climate change must now give the same financial backing to the diseemination of climate change. There is, as Dr Juan Salazar states a need to create intersubjective spaces of communication and association to interest the public in the public interest” (Salazar 2011) where the basis for engaging climate change is not information but conversation and the cultivation of a culture of communication. [Morien Rees, Norway]	Accepted, the effects of information is discussed later, in section 4.4.5.2 (now 4.4.3.2)

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7894	57	41	57	55	Include references / mention of the developments of a global Circular Economy and transition from a Linear to a Circular system e.g:Knowledge based actions A circular economy concept that can be vital in reducing GHG emissions thus reducing negative impacts of climate changes can be understood through symbiotic industrial relationships where the beginning waste of one activity becomes the resource for another and the looping of associated activities benefit one another - ultimtely evolving to the most efficient designing out any waste from the beginning. A general consensus is in thinking and acting in circular systems and considering entire lifecycles of products and services from the design stages, with associated risks and opportunities, rather than thinking through the linear paradigm of Take, Make and Waste. This circular economy principle is seen from both an all-encompassing system, down to the view of an individual company or product And for society to transition to a circular economy there is a need for a shift in the mindset to the entire concepts of the circular economy rather than bending the workings of a linear economy. The transformation and adaptation to the Circular Economy must be scaled up through education and governance and scaled out through action and implementation. The basic cultural values and beliefs in the new system by all stakeholders is crucial for uptake and positive impacts for all sustainable developments. [Geraldine Ann Cusack, Ireland]	Taken into account elsewhere, different types of behavioural changes that would limit GHG emissions are discussed in 4.4.3.
15	57	44	57	45	It is highly relevant to note that "people overestimate savings for low-energy activities, while they underestimate savings for high-energy activities", but this should be support by a reference, e.g. Attari, S.Z., DeKay, M.L., Davidson, C.I., de Bruin, W.B., Public perceptions of energy consumption and savings, Proceedings of the National Academy of Sciences of the United States of America 107 (37), 16054-16059, 2010. [Steffen Kallbekken, Norway]	Accepted, yet the study Attari et al indicates that people underestimate energy savings, not overestimate, we indicated this
6660	57	46	57	47	The reference to the "mitigation potential of limiting meat consumption" is misleading, and should be replaced by a reference to the mitigation potential of limiting the consumtion of lifestock based / animal products (which includes e.g. dairy products). Per serving, not only ruminant meat but also dairy are more emissions intensive than pork and poultry (see e.g. Tilman and Clarke, "Global diets link environmental sustainability and human health", doi:10.1038/nature13959) [Astrid Schulz, Germany]	Taken into account. The particular text refers to a study on public understanding on energy use related to meat consumption, so it did not deal with dairy products. The climate impact of meat and dairy consumption is included in table 4.1
4898	57	47	57	49	It does not seem necessary to point out here that some individuals do not really know the definition of 'renewable energy'. Please consider deleting this - it might be correct, but is not a key issue here, and it is not of help to address the citizen as a partner. [Sigrid Kusch, Germany]	Taken into account, we left it in and now clarified that it makes clear that knowledge is not always accurate which may inhibit effective climate action
14286	57	48	57	49	"For example, some individuals think natural gas is a renewable energy source or think bioenergy is a fossil fuel as it involves burning materials (Butler et al. 2013; Devine-Wright 2003)." The problem isn't that they think that natural gas is renewable, or that bioenergy is a fossil fuel, what matters is what they think about the carbon footprint. I have spoken with a number of people (but have done no formal studies) that show people believe that 'natural gas will be able to reduce our GHG emissions so that climate change is no longer a problem' or that 'biofuels means burning things, so we're just sending up more CO2'. The focus needs to be on reducing GHGs, not on 'renewable energy'. The idea that we need to get across to both the public and the policy makers is carbon-neutral. [Jason Donev, Canada]	Taken into account, one way to reduce GHGs is using renewables rather than fossil fuels .we clarified that this may inhibit choosing options with low GHG emissions
18492	57	49	57	49	Taylor et al. 2014 neds Mendeley link [Wilfran Moufouma Okia, France]	Editorial
14332	58	1	58	25	Education especially as it relates to building climate literacy for informed action is miissing from this chapter. This section repeats the old line that knowledge is not enough, and rather than rely on literature focused on literature-- like Lee, T. M., Markowitz, E. M., Howe, P. D., Ko, C. Y., & Leiserowitz, A. A. (2015). Predictors of public climate change awareness and risk perception around the world. Nature climate change, 5(11), 1014-1020.. If US focused research is emphasized, also note work show how thin and often confused cliamte literacy efforts are, like Plutzer, E., McCaffrey, M., Hannah, A. L., Rosenau, J., Berbeco, M., & Reid, A. H. (2016). Climate confusion among US teachers. Science, 351(6274), 664-665.. Relying on Kahan and Hornsey, who look at beliefs in the US for the most part, overlooks wider work of Lutz and others at international scales. Also- no mention of community knowledge in this chapter, which is mentioned in Chapters 1 and 5. [Mark McCaffrey, Hungary]	Taken into account. The paper by Lee et al and Plutzer et al focus on predictors of climate change awareness and risk perception, not on behaviour which is the focus of this section. Assessment of the literature reveals that effects of knowledge on climate action is limited as we indicate in text
7285	58	3	59	22	The paper MORGADO, F., BACELAR-NICOLAU, P., RENDON-VON OSTEN, J., SANTOS, P., BACELAR-NICOLAU, L., FAROOQ, H., ALVES, F., SOARES, A., AZEITEIRO, U.M., 2017. Assessing University Student Perceptions and Comprehension of Climate Change (Portugal, Mexico and Mozambique). International Journal of Climate Change Strategies and Management. 9(3): 316 - 336 IF 2016: 0.611 Q3 http://dx.doi.org/10.1108/IJCCSM-08-2016-0123 can be a contribution more (since data is from three different continents/geographies/ cultures). [Ulisses Azeiteiro, Portugal]	Taken into account, this paper also focuses on climate change perceptions, see response 14332
18493	58	6	58	6	Abrahamse et al. 2005 needs Mendeley link [Wilfran Moufouma Okia, France]	editorial
18494	58	7	58	7	Demski et al 2017; Myers et al. 2012; Spence et al. 2011 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
16	58	9	58	12	The sentence links the rejection of climate change knowledge to particular political views. A recent paper establishes a direct link that is missing in the cited literature; the link between cultural worldviews (the Kahan et al reference) and rejection of policies: Cherry, T.L., Kallbekken, S., Kroll, S., Accepting market failure: Cultural worldviews and the opposition to corrective environmental policies, Journal of Environmental Economics and Management 85, 193-204, 2017. [Steffen Kallbekken, Norway]	Taken into account. Worldviews are not the same as political views. Link with cultural worldviews including myths of nature and acceptability of policy has been established in other papers too, see Steg & Sievers 2000 (Environment & Behavior) and Poortinga, Steg & Vlek (2002, Environment and Behavior). Section 4.4.5.3 (now 4.4.3.3) discuses relationship values and worldviews with acceptability (see p. 63, line 8-9)
18495	58	10	58	10	Kahan et al. 2010; O'Neill et al 2013 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
18496	58	11	58	11	Ding et al. 2011; McCright et al. 2013 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
7645	58	12			Consider inserting: 'Likewise, political leadership (elite cues) influences public attitudes on climate change (Brulle et al. 2012, Sohlberg 2016)' Brulle, R.J., Carmichael, J., and Jenkins, J.C., 2012. Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010. Climatic Change, 114 (2), 169–188.Sohlberg, J., 2016. The Effect of Elite Polarization: A Comparative Perspective on How Party Elites Influence Attitudes and Behavior on Climate Change in the European Union. Sustainability, 9 (1), 39. [Conor Little, Denmark]	Taken into account, included in section 4.4.3, in the paragraph below Figure 4.4.
18497	58	12	58	12	Scrugg and Benegal 2012 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
7646	58	13			line 13: Scruggs [sic] and Benegal 2012 is missing from the References section. [Conor Little, Denmark]	editorial
18498	58	16	58	16	Dietz 2013; Steg 2016 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
14287	58	19	58	19	What is meant by 'market-friendly', it's unclear in this context. [Jason Donev, Canada]	accepted, changed into free-market ideology
18499	58	20	58	20	Kasser et al. 2007 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
3622	58	20	58	44	Re motivational factors to engage in renewable energy adoption: Fast (2013) has shown that use of market tools like feed in tariff programs can reorient individual and community evaluation away from climate benefits and towards economic evaluation, thereby constraining discussion and rationale in ways that may have long term impacts on potential for longer term commitments to ghg reduction [Stewart Fast, Canada]	Taken into account, this topic is discussed in 4.4.5.3 (now 4.4.3.3)
18500	58	21	58	21	Dietz et al. 2005; Steg, 2016; Taylor et al. 2014 need Mendeley links [Wilfran Moufouma Okia, France]	editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
14288	58	21	58	22	"People who strongly value protecting nature, the environment and other people are more likely to act on climate change than those who strongly endorse hedonic and egoistic values" I'm not sure that this statement is true. I think they're more willing to act in a way that they believe helps the environment, but often lack information on how to do that effectively. My students often believe that they need to unplug their phone chargers, but buy an SUV because 'it all evens out'. A willingness to act on behalf of the environment doesn't equate to effective action. [Jason Donev, Canada]	Taken into account. the statement reflects findings in the literature, generally people with strong biospheric values act more pro-environmentally, but indeed not always consistently, eg because they lack knowledge - which is discussed in this section
18501	58	23	58	23	Jansson 2011; Wolkse et al. 2017 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
18502	58	26	58	26	Bamberg and Moser 2007; Wolkse et al 2017 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
18503	58	28	58	28	Farrow et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18504	58	30	58	30	Bamberg and Moser 2007 and the four other refs need Mendeley links [Wilfran Moufouma Okia, France]	editorial
18505	58	31	58	31	Wolkse et al. 2017; Singh et al., 2016 need Mendeley links [Wilfran Moufouma Okia, France]	editorial
18506	58	33	58	33	Biddeau et al 2016; Fielding & Hornsey 2016 [Wilfran Moufouma Okia, France]	editorial
18507	58	37	58	37	Griskevicius et al. 20130 and the three other refs need Mendeley links [Wilfran Moufouma Okia, France]	editorial
18508	58	38	58	38	Verplanken & Roy 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18509	58	40	58	40	Lefevre et al., 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
17237	58	40	58	40	Change 'affect' to 'effect' [Himangana Gupta, India]	editorial, changed into feelings
18510	58	46	58	46	Balcombe et al. 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18511	58	48	58	48	Steg et al., 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18512	58	49	58	49	Zaval et al. 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18513	58	51	58	51	De Groot and Steg 2009 and the five other references need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
3086	58	54	58	54	to engage [Christopher Bataille, Canada]	editorial
18514	58	54	58	54	Fielding and Head 2012 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
9347	58	54	58	54	There is a missing word "to" in the phrase "likely (to) engage in climate change actions" [Siir KILKIS, Turkey]	editorial
1219	59		60		The 'behavioural anomalies' described here in 4.4.5.2 are only anomalous if viewed through the lens of rational choice theory, which itself is perceived as an anomalous way of thinking to everyone outside of neo-classical economics! Perhaps the whole section (4.4.5) would benefit from addressing policy, economic, cultural and psychological barriers and enablers of lifestyle and behavioural change in separate sub-sections? [Petra Tschakert, Australia]	Accepted, we now refer to heuristics and mental shortcuts
18515	59	1	59	1	Barbarosa et al. 2017 and the five other references need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
14289	59	1	59	22	This section was fascinating, but how strong is the evidence? How sure are the conclusions? This report has been inconsistent with using the defined terminology of evidence. This is a very important section and should be handled carefully! [Jason Donev, Canada]	Taken into account. We assessed review papers and meta-analysis whenever available, and included multiple references to indicate the strength of the evidence base
18516	59	4	59	4	Van der Werff et al. 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18517	59	12	59	12	Jabeen 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18518	59	13	59	13	Taylor et al. 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
9897	59	14	59	16	The role of gender in climate adaptation merits more discussion, refer to - Carr, E. R. and Thompson, M. C. 2014. Gender and climate change adaptation in agrarian settings: current thinking, new directions, and research frontiers. Geography Compass 8: 182–197. Carvajal-Escobar, Y., Quintero-Angel, M., and Garcia-Vargas, M. 2008. Women's role in adapting to climate change and variability. Advances in Geosciences 14, 277-280. [Shipra Shah, Fiji]	Taken into account; we included a reference to a review paper on gender roles (Bunce & Ford 2015). Gender is further discussed in Chapter 5
18519	59	15	59	15	Eakern et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18520	59	17	59	17	Armah et al. 2015 and Grothmann and Reusswig, 2005 need a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18521	59	18	59	18	Dang et al. 2014; Mortreux and Barnett, 2009 need a Mendely link [Wilfran Moufouma Okia, France]	Editorial
4935	59	19	59	22	Cultural heritage, held in both tangible places, buildings, sites, and in intangible knowledge and stories, is a critical component of individual and community attachment to place. The importance of cultural heritage in representing ties to place and the potential impacts/loss of heritage due to climate change should be incorporated here. Relevant points and references include: due to requests of Small Island Developing States, loss of heritage is now included as part of the UN Framework Convention on Climate Change Warsaw Mechanism for Non-Economic Loss and Damage. As well, on 6 October 2016, the UN Council on Human Rights adopted resolution 33/20, which recognizes cultural heritage as a right in the face of intentional destruction. While climate change has not yet been listed as intentional destructive force, the implications and importance of cultural heritage in identity is relevant here. The effects of climate change on world heritage and tourism is described here: Markham, A., Osipova, E., Lafrenz, Samuels, K. and Caldas, A. (2016). World Heritage and Tourism in a Changing Climate. United Nations Environment Programme, Nairobi, Kenya and United Nations Educational, Scientific and Cultural Organization, Paris, France. And a detailed listing of current research and field observations of the impacts of climate change on cultural heritage is included in the recent US governement publication by the US National Park Service, Rockman, Marcy, Marissa Morgan, Sonya Ziaja, George Hambrecht, and Alison Meadow. 2016. Cultural Resources Climate Change Strategy. Washington, DC: Cultural Resources, Partnerships, and Science and Climate Change Response Program, National Park Service, see Graphic 2, available at: https://www.nps.gov/subjects/climatechange/culturalresourcesstrategy.htm. [Marcy Rockman, United States of America]	Taken into account, this section discusses enabling lifestyle and behaviour change, it is beyond the scope of this to discuss cultural heritage and relation with place attachment
18522	59	21	59	21	Adger et al. 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
20221	59	25			The previous section has outlined a good range of the factors that shape human behaviour and this section continues with helpful material. However, the heading and the language in the section about behavioural anomalies contributes to the view that the IPCC's approach to mitigation is dominated by economists. These are only behavioural anomalies for a theory that expects people to follow a particular kind of rationality. An anomaly is something that differs from what is normal or expected. If rational choice theory pretends to describe normal or expected behaviour, it is simply wrong! [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, we now refer to heuristics and mental shortcuts
11047	59	25	59	25	Why "anomalies"? What might look like an "anomaly" to economists is no surprise for other social or cultural scientists. Please use a more neutral term. [Oliver Geden, Germany]	Accepted, we now refer to heuritics and mental shortcuts

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20619	59	25	59	25	Behavioural anomalies' is a very critical term to use, and it has been applied in various parts of the text. The state-of-the-art on behavioural insights has already dispelled the myths around the human rational thinking theaory and made clear that humans behave in response to various factors, most often not driven by rationality. In this sense, calling this an 'anomaly' gives the impression that behaving in a nonrational way is out of the normality, when in reality this is how the brain functions in most situations. The literature that supports this comment is vast, for a few examples: Mont, O. et al (2013). Improving Nordic policymaking by dispelling myths on sustainable consumption. Nordic Council of Ministers 2013; Steg, L.; Vlek, C. (2009). Encouraging pro-environmental behaviour: an integrative review and research agenda. In: Journal of environmental psychology 29 (2009) 309-317. [Mariana Nicolau, Germany]	Accepted, we now refer to heuristics and mental shortcuts
6217	59	25	60	41	rather long, rambly section on a term in behavioural economics which only makes sense if you have started from rational choice assumptions, whereas a good deal of the literature in the previous section doesn't share that assumption, so wouldn't understand the things being discussed here as 'anomalies' at all. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, we now refer to heuristics and mental shortcuts, shortened the text and integrated it in 4.4.5.1 (now 4.4.3.1)
2757	59	25	60	41	This section could be cut or drastically shortened. It reads more like background theory than an assessment. [Penny Urquhart, South Africa]	Accepted, we shortened the text and integrated it in 4.4.5.1 (now 4.4.3.1
7115	59	25	60	41	General comment on section 4.4.5.2: a) I´m not sure that the concept "behavioral anomalies" is sufficiently stablished in the literature (nor proven to be so in this section), b) I have a small feeling that new literature is used that repeats old concepts, whereas a further effort would still be needed to classify this literature as to facilitate a market segmentation allowing for specific incentives to boost the implementation of "strategies to promote actions on climate change" of section 4.4.5.3. [Érika Mata, Sweden]	Taken into account, this section is now integrated in 4.4.5.1 (now 4.4.3.1), and shortened, and we no longer refer to anomalies. see response to 11047
776	59	25	72	2	I happened to want to look up a reference and could not find it in the Reference section beginning on page 101. I stared to look for others. I found at least 30 missing form these pages. It may be that ones I did find are cited outside these pages. It took a long time and I gave up. There is a need to make sure that all citations can be found in the Reference section after each chapter. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted; this has been fixed.
18523	59	26	59	26	Finucane et al 2000; Aarts and Dijksterhuis 2000; Kolckner et al. 2003 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
6587	59	26	59	26	Consider replacing 'always' by 'seldom' or 'only' (as in fact is 'rarely'; that only happens only in obsolete neoclassic economics textbooks, but not in real life) [J. David Tabara, Spain]	Taken into account and revised accordingly
19756	59	26	59	49	This section requires further explanation. [Tara Shine, Ireland]	Taken into account, section is now integrated in 4.4.5.1 (now 4.4.3.1
7113	59	31			It does not seem fair to attribute such definition to (Shogren and Taylor 2008). A similar concept is know since 1890 as related to the implicit discount rates of consumers' decision making (Marshall A, Principles of Economics, Macmillan:London, 1890). [Érika Mata, Sweden]	Taken into account, this section is now integrated in 4.4.5.1 (now 4.4.3.1) and shortened so comment no longer relevant
3087	59	41	59	41	either explain the Mozambique farmer example, or omit. [Christopher Bataille, Canada]	Accepted - the text has been amended to explain how divergences between farmer and policymakers' perceptions of climatic risks can have implications on adaptation implementation. The particular example of Mozambique is taken from Patt and Schroter (2008)'s influential paper in Global Environmental Change which demonstrated how disagreement over the severity of climatic risks undermined adaptation action.
18524	59	47	59	47	Singh et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
3088	60	1	60	1	from switching to [Christopher Bataille, Canada]	editorial
3089	60	7	60	8	there is a later more complete empirical literature on the endowment effect e.g. "Experimental Tests of the Endowment Effect and the Coase Theorem" Daniel Kahneman, Jack L. Knetsch, and Richard H. Thaler Journal of Political Economy 1990 98:6, 1325-1348; Daniel Kahneman, Jack L. Knetsch and Richard H. Thaler The Journal of Economic PerspectivesVol. 5, No. 1 (Winter, 1991), pp. 193-206 [Christopher Bataille, Canada]	Taken into account, we now focus on assessment of the empirical literature and do not review theoretical accounts
18525	60	14	60	14	Leyten et al. 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
3090	60	15	60	17	True, or backward? [Christopher Bataille, Canada]	Rejected- unclear what the comment is about.
18526	60	16	60	16	Ebeling and Lotz 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18527	60	24	60	24	Simon 1955, 1979 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
20	60	25	60	41	The section on "rationally bounded" includes many important examples, but misses one important aspect with large implications: Consumers typically overempahsize the upfront cost compared to operating cost when purchasing a number of different products (cars, appliances, properties), which leads to sub-optimal investments in energy efficiency. For instance, Allcott and Wozny (Gasoline prices, fuel economy, and the energy paradox, Review of Ecoomics and Statistics 96, 779-795, 2014) find that US consumers are only willing to pay 0.6 USD to reduce expected fuel costs by 1 USD. Importantly, there are strategies to reduce behavioural "anomaly". A choice experiment by Heinzle (Disclosure of Energy Operating Cost Information: A Silver Bullet for Overcoming the Energy-Efficiency Gap? Journal of Consumer Policy, 35(1), 43-64, 2012) found that providing consumers with information on five year and ten year consumption costs for washing machines has a significant impact on increasing the efficiency of the model that they state they would choose. Kallbekken et al (Kallbekken, S., Sælen, H. and Hermansen, E. T. (2013) Bridging the Energy Efficiency Gap: A Field Experiment on Lifetime Energy Costs and Household Appliances. Journal of Consumer Policy, 36(1), 1-16.) found that lifetime energy cost labels combined with staff training about the labels reduced the mean energy consumption of purchased tumble dryers in Norway by 4.9%. [Steffen Kallbekken, Norway]	Taken into account, and discussed in the section on habits and mental shortcuts
7114	60	30		39	Aren´t all these just examples of missinformation? [Érika Mata, Sweden]	taken into account, yes, but these are due to using heuristics, Even if the "right" information is given (e.g. via labelling), people may still apply e.g. satisfycing
18528	60	33	60	33	Steg et al., 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
7116	60	44			also for this section, could there be a table that lists the strategies, then summarizes to what extent they are effective for each sector and region, or for each of the market segments that could have been defined in the previous section 4.4.5.2? [Érika Mata, Sweden]	Taken into account - the effects of strategies varies across contexts and individuals so difficult to quantify
20222	60	44			The world's major faiths maintain, in different forms, an ethic of frugality which is in tension with the prevailing western culture of increasing material consumption (L. Bouckaert, H. Opdebeeck & L. Zsolnai (eds.), Frugality: Rebalancing Material and Spiritual Values in Economic Life, Peter Lang, Oxford 2008.). There is an opportunity to link the climate mitigation efforts with faith-based values and narratives provided this is done with sensitivity (Marshall, G., A. Corner, O. Roberts and J. Clarke, 2016: Faith & Climate Change: A guide to talking with the five major faiths, Climate Outreach, Oxford). [Laurence Michaelis, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, the role of values, ethics and worldviews is discussed in section 4.44.1 (now 4.4.3.1)
1477	60	44	60	47	I agree with the sentiment here, but the languag is appropriate for an IPCC report (which should be policy relevant but not policy prescriptive) - suggest the wording is amended to be more objective [David Reay, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, we revised the text
19757	60	44	61	55	This section would benefit from an exploration of the value of climate justice narratives in changing behaviour and also the role of empathy and connections between people and with people on the front lines. See for example the section on Shaping Narratives and mobilizing domestic Constituencies of demand (page 17) of the WRI and Mary Robinson Foundation working paper on Climate Justice (2013) Online at: http://cdn.agilitycms.com/wacc-global/resources/climate-justice/17.%20WRI-Climate-Justice(2013).pdf. [Tara Shine, Ireland]	Taken into account, justice and fairness are particularly relevant for acceptability, and thus discussed in section 4.4.5.4 , p 63, line 14-25 (now 4.4.3.1)

Comment No	From Page	From Line	To Page	To Line	Comment	Response
17	60	44	62	55	The chapter on "strategies to promote actions on climate change" is interesting and relevant, but focuses too much on success stories and does not pay sufficient attention to potential rebound or negative spillover effects (rebound effects are mentioned, but only in general in the final paragraph). I suggest to include some of these less optimistic findings. Suggested text: Truelove et al. (2014) find that "to date research on spillover effects has generated mixed and at times conflicting results". The size and even direction of such indirect effects is contested. Some studies find that individuals who have more pro-environmental attitudes or engage in more voluntary environmental behaviours, do not necessarily have a smaller ecological footprint than those who do not (Barr et al. 2010; Csutora 2012). Other studies find that environmental behaviour in one area can - to some extent - spill over to provide motivation for environmentally friendly behaviour in other domains (Thøgersen 1999; Thøgersen and Ölander 2003). Various mechanisms have been proposed to explain these types of spillover effects, including positive and negative motivational crowding (Frey and Jegen 2001), economic rebound effects (Binswanger 2001), moral or psychological rebound effects such as single action bias (Weber 1997) or moral licensing (Miller and Effron 2010), mental accounting (Thaler 1985), and several more. [Steffen Kallbekken, Norway]	Taken into account, now indicated that some studies suggest moral licensing may occur too, with reference to review by Truelove et al. The finding that low environmental concern does not necessarily mean low ecological footprint is not an indication of negative spillover or moral licensing, but reflects that strong pro-environmental attitudes do not always translate into behaviour, and highlights that other factors may play a role (e.g opportunities), we discuss this in the start section 4.4.5.1 (now 4.4.3.1). Motivational crowding is discussed on p 61, line 19-28. Page and line numbers refer to FOD.
18	60	44	62	55	References for the above comment: Truelove, H.B., A. R. Carrico, E.U. Weber, K.T. Raimi, M.P. Vandenbergh (2014). Positive and negative spillover of pro-environmental behavior: An integrative review and theoretical framework. Global Environmental Change 29: 127–138; Barr, S., G. Shaw, T. Coles, J. Prillwitz (2010). 'A holiday is a holiday': practicing sustainability, home and away. Journal of Transport Geography 18: 474–481; Csutora, M. (2012). One More Awareness Gap? The Behaviour-Impact Gap Problem. Journal of Consumer Policy 35, 145-163; Thøgersen, J. (1999). Spillover processes in the development of a sustainable consumption pattern. Journal of Economic Psychology 20, 53–81. Thøgersen, J., F. Ölander (2003). Spillover of environment-friendly consumer behavior. Journal of Environmental Psychology 23 (3), 225–236; Frey, B.S. and R. Jegen (2001). Motivation crowding theory. Journal of economic surveys 15 (5), 589-611; Binswanger, M. (2001). Technological progress and sustainable development: what about the rebound effect? Ecological Economics 36 (1), 119-132; Weber, E.U. (1997). Perception and expectation of climate change: Precondition for economic and technological adaptation. In: M. Bazerman, D. Messick, A. Tenbrunsel, K. Wade-Benzoni (Eds.), Psychological and Ethical Perspectives to Environmental and Ethical Issues in Management, 314-341. Jossey-Bass, San Francisco, USA; Miller, D.T. , D.A. Effron (2010). Psychological license: when it is needed and how it functions. Advances in Experimental Social Psychology 43, 115-155; Thaler, R. (1985). Mental accounting and consumer choice. Marketing Science 4 (3), 199-214. [Steffen Kallbekken, Norway]	Taken into account, see reply to comment 2136
20262	60	45	60	47	…policy and changes need to be implemented - here one perhaps should consider a bottom up approach, the implementation of policy and changes is a result of first activating the public through conversation to understand tne need for wide scale changes. [Morien Rees, Norway]	taken into account, Added that approaches can both be top-down and bottom-up. Bottom-up approaches in 4.4.3.3 and in Box 4.10 of the SOD
6588	60	45	60	47	This introduction reads like a tautology. [J. David Tabara, Spain]	Rejected- I do not see the tautology.
17238	60	47	60	47	It is better to change the word from 'adaption' to 'adaptation' [Himangana Gupta, India]	editorial
13143	60	48	60	48	Opening up of electricity market is one of the crucial measures for empowering and enabling people to engage in climate actions. While individuals have the choices to opt for electricity generated from traditional fossil fuel or renewables, it fosters citizens' awareness on fuel-mix of their families and society, as well as enhances the social activism on electrictiy and energy policies, which Kemfurt (2007) described that the liberalized electricity market can eventually influence the decision making of power utilities towards clean energy transition due to comparative market advantage. Furthermore, such liberalization provides companies, either covered by Emission Trading System (ETS) or not, with incentives and choices on the procurement of green electricity to fulfil the ETS requirements or for voluntary approach, and thus benefiting the development of ETS. Reference: - Kamfert, C. (2007). The European electricity and climate policy – complement or substitute?, (25), 115. [Yau Hing YU, China]	Taken into account, changes in economic systems are discussed in 4.4.6
7117	60	49		51	In Sweden - and generally from the European Commission - there is a huge political focus on behavior. [Érika Mata, Sweden]	Taken into account, no implications for text
18529	61	3	61	3	Adger et al. 2013 and the two other references need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
4804	61	4	61	8	It is not the business of IPCC to prescribe how citizens should live, what goals they should adopt and strive for, and by what means; nor is it the task of IPCC to prescibe governments to abandon neutrality and freedom by coaching individuals like cattle. IPCC should refrain from suggesting in any way that individual autonomy and responsibility should be overruled - neither by force nor by nudging. [Marcel Wissenburg, Netherlands]	editorial
18530	61	5	61	5	Stern 2011 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18531	61	14	61	14	Stern et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18532	61	15	61	15	Pritoni et al 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18533	61	17	61	17	Balcombe et al. 2013; Stern 2011 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18534	61	19	61	19	Bolderdijk et al 2013; Delmas et al. 2013 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18539	61	20	61	30	Abrahamse et al. 2005 needs Mendeley link [Wilfran Moufouma Okia, France]	editorial
18535	61	21	61	21	Asensio and Delmas 2015 and the other three references need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18536	61	23	61	26	Agrawal et al. 2015 and the other two references need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18537	61	25	61	25	Bolderdijk et al 2013; Dogan et al. 2014 [Wilfran Moufouma Okia, France]	Editorial
18538	61	28	61	28	Stern et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
4755	61	29	61	29	Move space in "Stern et al .2016", which becomes "Stern et al. 2016" [Valentino Piana, Italy]	Editorial
18037	61	31	61	48	Please, consider adding to the paragraph: To meet the demand of various climate information users and tailor climate products to their needs, climate services should facilitate opportunities for co-production of knowledge (Kirchhoff, Lemos and Dessai, 2013) that enables users to actively participate with valid expertise of the particularities of their decision-making context (Vaughan and Dessai, 2014). Ref. Kirchhoff, C. J., Lemos, M. C. and Dessai, S. (2013) 'Actionable Knowledge for Environmental Decision Making: Broadening the Usability of Climate Science', Annual Review of Environment and Resources. 38(1), pp. 393–414. doi: 10.1146/annurev-environ-022112-112828. Vaughan, C. and Dessai, S. (2014) 'Climate services for society: origins, institutional arrangements, and design elements for an evaluation framework', Wiley Interdisciplinary Reviews: Climate Change. John Wiley & Sons, Inc., 5(5), pp. 587–603. doi: 10.1002/wcc.290. [Annamaria Lehoczky, Spain]	Taken into account. This is discussed in 4.3.3

Comment No	From Page	From Line	To Page	To Line	Comment	Response
18540	61	33	61	33	Stern et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
17239	61	35	61	35	It is better to change the word from 'adaption' to 'adaptation' [Himangana Gupta, India]	Editorial
18541	61	36	61	36	Singh et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18542	61	38	61	38	Abrahamse et al. 2007 and the other four references need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18543	61	41	61	41	Campbell and Kay 2014 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18544	61	42	61	42	Abrahamse et al. 2005 needs Mendeley link [Wilfran Moufouma Okia, France]	editorial
18545	61	44	61	44	Dorward et al. 2015; Singh et al. 2017 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
958	61	46	61	46	This point discusses heat waves and information being targeted to vulnerable populations. It could also be mentioned that emergency response plans have also found to have had an impact on improving adaptation to these events. For example, this paper has assessed the performance of one of these response plans - Benmarhnia, T., Bailey, Z., Kaiser, D., Auger, N., King, N., & Kaufman, J. S. (2016). A difference-in-differences approach to assess the effect of a heat action plan on heat-related mortality, and differences in effectiveness according to sex, age, and socioeconomic status (Montreal, Quebec). Environmental health perspectives, 124(11), 1694. [Thomas Longden, Australia]	Accepted, included now
18546	61	47	61	47	Keim 2008; Vandentorren et al. 2006 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18547	61	50	61	50	Banerjee and Solomon 2003; Stadelmann 2017 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18548	61	51	61	51	Pahl et al. 2016 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18549	61	52	61	52	Midden and Ham 2012 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18550	61	55	61	55	Maan et al. 2011 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
1694	62		62		The statement in Chapter 4, "Overall, energy efficiency rebound effects are limited and energy efficiency improvements are not reversed by the rebound effect" [section 4.4.5.3, p. 4-62, lines 45-46] is, in my opinion, at minimum highly uncertain, and very likely incorrect. Rebound magnitudes are likely high [3,4,5,6,7,8,9,10,11,12,13,23,26,27]. There is evidence of backfire in some countries, certain circumstances, and some sectors [8,10,23]. See also comments for sections 2.3, 2.4, 2.6. The Gillingham et al. work cited in SR1.5 [19] is technically and analytically sound, and a solid piece of work, but the focus of its attack on the problem is restrictive. Specifically, the framework is narrow in that it speaks to the household side of the energy-economy equation and not to the productive economy side. About two-thirds of global energy use occurs in the productive economy, with only about a third consumed in household end use (household operation and personal transportation) [17]. On the production side it is used to produce goods and services (energy used in industry, commercial enterprises and commercial transportation). This is where large rebound magnitudes (and backfire in some cases) are seen to occur. [HARRY SAUNDERS, United States of America]	Taken into account, we removed the text on the rebound effect
1695	62		62		The economic modeling paradigm is different for these two sectors because whereas the household sector involves household preferences, productive economy decision making involves profit-maximizing behavior. This is not adequately comprehended in the Gillingham et al. work. Not only does the productive economy use the most energy, it is also where significant efficiency technologies have been at work and are planned, so rebound estimates need to comprehend this. The vast bulk of energy use becomes "embedded" in goods and services delivered to households. The total energy embedded in goods and services is shaped by household choices among them [7], yes, but importantly, it is also driven by producer technology choices, flexibility and efficiency investments. [HARRY SAUNDERS, United States of America]	Taken into account, we removed the text on the rebound effect
1696	62		62		References Cited 1. Saunders, H.D. (2008). "Fuel conserving (and using) production functions." Energy Economics 30: 2184–2235. http://dx.doi.org/10.1016/j.eneco.2007.11.006. [theory: rebound magnitude depends on flexibility/substitution elasticity; functional forms matter; rebound creates economic welfare] 2. S. R. Sorrell (2014), "Energy Substitution, Technical Change and Rebound Effects," Energies 7, 2850-2873, [showing criticality of substitution elasticity assumption; showing problem with typical AEEI implementations] 3. Roy J, Sathaye J, Sanstad A, Mongia P, Schumacher K: Production trends in Indian energy intensive manufacturing industries. Energy J 1999, 20:33-61. [large rebound in Indian manufacturing sector] 4. Chackravarty, D.; Dasgupta, S.; Roy, J. (2013), "Rebound effect: how much to worry?" Current Opinion in Environmental Sustainability 5(2), 216-228. [Large but varying rebound measured; rebound effects in developing countries likely to be higher than industrialized countries; rebound mitigation policy may not be appropriate for developing countries] 5. _____, (2015) "Corrigendum to 'Rebound effect: how much to worry' [Curr. Opin. Environ. Sustain. 5 (2013) 216–228], Curr Opin Environ Sustain (2015) 1" http://dx.doi.org/10.1016/j.cosust.2015.08.004 [rebound effects understated in original paper] 6. Roy, J.; Sanstad, A.H; Sathaye, J.A., Khaddaria, R. (2006), "Substitution and price elasticity estimates using inter-country pooled data in a translog cost model," Energy Economics 28, 706-719, [substitution elasticities are likely higher than commonly used in IAMs] [HARRY SAUNDERS, United States of America]	Taken into account, we removed the text on the rebound effect

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1697	62		62		7. Druckman, A., M. Chitnis, S. Sorrell and T. Jackson (2011). "Missing carbon reductions? Exploring rebound and backfire effects in UK households" Energy Policy 39: 3572–3581. http://dx.doi.org/10.1016/j.enpol.2011.03.058 . [household rebound can be large, and can even deliver both energy and GHG backfire; I-O model for UK households considering energy "embedded" in goods and services consumed] 8. Saunders, H.D. (2013), "Historical evidence for energy consumption rebound in 30 US sectors and a toolkit for rebound analysts." Technological Forecasting and Social Change 80(7): 1317–1330. [cited in AR5; high measured rebound in US productive economy, some backfire; other factor productivity gains increase energy use] 9. Saunders, H.D. (2015), "Recent Evidence for Large Rebound: Elucidating the Drivers and their Implications for Climate Change Models." The Energy Journal 36(1): 23-48. [evidence for large rebound; problems with energy intensity as a measure of energy efficiency; other factor productivity gains increase energy use] 10. Saunders, H.D. (2017), "Response to Cullenward and Koomey critique of 'historical evidence for energy efficiency rebound in 30 US sectors," Technological Forecasting and Social Change 119: 184–193. [not cited in AR5; rebuts critique; confirms high measured rebound in US productive economy, some backfire] 11. Barker, T. (2013) "Macroeconomic impacts of energy-efficiency policies" Presentation to the IEA Roundtable on Energy Efficiency, 25-26 January, 2013, Paris [total global rebound is about 50% by 2030; industrialized world (OECD) rebound effect is less than the developing world (non-OECD)] 12. Barker, T.; Dagoumas, A. and Rubin, J., (2009) "The Macroeconomic Rebound Effect and the World Economy". Energy Efficiency, 2(4): 411-427. [total global rebound is about 50% by 2030] [HARRY SAUNDERS, United States of America]	Taken into account, we removed the text on the rebound effect
1698	62		62		13. Barker, T., Ekins, P. and Foxon, T. (2007) 'The macroeconomic rebound effect and the UK economy', Energy Policy 35: 4935–4946 [large rebound for the UK economy] 14. Turner, K. (2009). "Negative rebound and disinvestment effects in response to an improvement in energy efficiency in the UK economy," Energy Economics 31(5): 648–666. http://dx.doi.org/10.1016/j.eneco.2009.01.008. 15. Turner, K. (2013). "'Rebound' effects from increased energy efficiency: a time to pause and reflect." The Energy Journal 34(4): 25–42. doi: http://dx.doi.org/10.5547/01956574.34.4.2. 16. Saunders, H.D. (1992) "The Khazzoom-Brookes postulate and neoclassical growth" The Energy Journal, 4): 131 148. http://dx.doi.org/10.5547/ISSN0195-6574-EJ-Vol13-No4-7. [theory: rebound magnitude depends on flexibility/substitution elasticity; functional forms matter; rebound creates economic welfare] 17. ExxonMobil, The outlook for energy: a view to 2030, (2009) available at http://www.exxonmobil.com/Corporate/energy_o_view.aspx. 18. Gillingham, K., Rapson, D., Wagner, G. (2014) "The Rebound Effect and Energy Efficiency Policy." Discussion Paper, Resources for the Future, RFF DP 14-39 [HARRY SAUNDERS, United States of America]	Taken into account, we removed the text on the rebound effect
1699	62		62		19. Gillingham, K., M. J. Kotchen, D. S. Rapson, and G. Wagner, (2013) "Energy policy: The rebound effect is overplayed." Nature, 36 493, 475–476, doi:10.1038/493475a. http://www.nature.com/doifinder/10.1038/493475a (Accessed October 7, 2013). 20. IEA (2014). "Capturing the Multiple Benefits of Energy Efficiency." 21. Nordhaus, T., (2017) "The Energy Rebound Battle," Issues in Science and Technology, Summer 2017, 51-58 [energy efficiency can advance and diminish peak fossil-fuel use despite rebound; energy efficiency can't solve climate change, but is a key contributor to human progress; see especially Conclusions section] 22. Saunders, H.D. (2011). "Mitigating Rebound with Energy Taxes." (unpublished): https://works.bepress.com/harry_saunders/28/ 23. Roy, J. (2000). "The rebound effect: some empirical evidence from India." Energy Policy 28(6-7): 433-438 24. Pielke, Jr., R., Wigley, T., Green, C. (2008). "Dangerous assumptions." Nature 452:531-532. 25. Stern, D.I. and A. Kander (2012). "The role of energy in the industrial revolution and modern economic growth." The Energy Journal 33(3):125–152. http://dx.doi.org/10.5547/01956574.33.3.5. 26. Lin, B., Chen, Y., Zhang, G. (2017). "Technological progress and rebound effect in China's nonferrous metals industry: An empirical study." Energy Policy 109:520-529. 27. Lin, B., Tan, R. (2017) "Estimating energy conservation potential in China's energy intensive industries with rebound effect." Journal of Cleaner Production 156:899-910. [HARRY SAUNDERS, United States of America]	Taken into account, we removed the text on the rebound effect
18551	62	1	62	1	Lu et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18552	62	2	62	2	Osbaldiston and Schott 2012 [Wilfran Moufouma Okia, France]	editorial
18553	62	3	62	3	Abrahamse et al, 2005; Delmas et al., 2013; Karlin et al. 2015 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18554	62	4	62	4	Darby 2006; Tiefenbeck et al. 2017 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
20263	62	9	62	11	The museum can provide arenas for face to face interaction [Morien Rees, Norway]	Taken into account, unfortunately, given space limitation, we can not go into this in too much detail, many other options could so too
18555	62	10	62	10	Abramhamse and Steg 2013 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18556	62	11	62	11	Abramhamse and Steg 2013 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18557	62	12	62	12	Weenig and Midden 1991 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18558	62	14	62	14	Middlemis 2011; Seyfang and Haxeltime 2012 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18559	62	16	62	16	Lokhorst et al. 2013; Abrahamse et al. 2005; Abrahamse and Steg 2013 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18560	62	18	62	18	Bamberg 2000, 2002 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18561	62	20	62	20	Steg 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18562	62	22	62	22	Osbaldiston and Schott 2012; Steg 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18563	62	22	62	24	Abrahamse & Steg 2013; Osbaldiston & Schott 2012 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18564	62	34	62	34	Adger et al. 2003 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
14105	62	34	62	37	Good to include this, but needs a reference [Elvira Poloczanska, Germany]	Accepted, reference included
18565	62	38	62	38	Lindenberg and Steg 2013; Robertson & Barling 2015; Stern et al., 2016 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18566	62	43	62	43	Brugger et al. 2015; Carrico et al. 2015 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18567	62	44	62	44	Brugger et al. 2015 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18568	62	46	26	46	Gillingham, Rapson, & Wagner, 2016 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18569	62	51	62	51	Juhl et al 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18570	62	51	62	51	Lauren et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	editorial

Comment No	From Page	From Line	To Page	To Line	Comment	Response
18571	62	53	62	53	Lacase 2015, 2016; Van der Werff et al., 2014 need a Mendeley link [Wilfran Moufouma Okia, France]	editorial
18572	63	3	63	46	Section 4.4.5.4: Add all the missing Mendeley links [Wilfran Moufouma Okia, France]	editorial
19	63	3	63	47	The chapter on "acceptability of policy and system changes" is very important, but the survey of the literature seems ad hoc (it reads to much like a bullet point list and not enough like an integrated review). I would suggest to base the review on the more systematic review by Drews and van den Bergh, and perhaps reuse some of the classifications of the literature they employ (Stefan Drews and Jeroen CJM van den Bergh, What explains public support for climate policies? A review of empirical and experimental studies, Climate Policy 16:7, 855-876, 2016). The recent paper by Andrea Barazini and Stefano Carattini (Effectiveness, earmarking and labeling: testing the acceptability of carbon taxes with survey data, Environmental Economics and Policy Studies, 19:1, 197-227, 2017) should be included. [Steffen Kallbekken, Norway]	Accepted. We revised the text, now discuss additional factors and included both references
7139	63	3	63	47	Comment: There is a wide range of literture demonstrating that public support for action on climate change is more complex than currently described. One of the greatest factors determing public support is political values and their association, either positively or negatively, with the issues of climate change and related issues. In addition it has been demonstrated that the information deficit model of communication has limited success when it comes to engaging populations and it is vitual to employ effective communication techniques based around human values whilst understanding the importance of social and cultural cues. Suggestion: add after line 13 - " Concern about climate change is influenced by a range of factors, but it is now well-established that knowledge about climate change is not the primary driver of public engagement: values, worldviews and political ideology are much more fundamental in shaping views about energy and climate change (Corner, Markowitz & Pidgeon, 2014; Hornsey et al, 2016). As numerous studies have shown, messages about climate change (and the perceived trustworthiness and reliability of the message communicator) are dependent on the political orientation of the individual receiving the message (Kahan, 2012). In particular, there is a clear and consistent relationship between an adherence to a laissez-faire ('free market') economic perspective and scepticism about climate change (McCright & Dunlap, 2011)." References: 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. Hornsey, M. J., Harris, E. A., Bain, P. G., and Fielding, K. S. (2016) Meta-analyses of the determinants and outcomes of belief in climate change, Nature Climate Change, 6, 622–626. Kahan D. (2012). Why we are poles apart on climate change? Nature 488, 255. McCright, A.M. & Dunlap, R.E. (2011). Cool dudes: The denial of climate change among conservative white males in the United States. Global Environmental Change 21(4), 1163-1172. [Jamie Clarke, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Indeed knowledge of CC is not the primary driver of public engagement, values, worldviews and political worldviews are more influential; this is discussed in 4.4.3.1 of SOD
6219	63	4	63	4	The statement 'Policy and system changes need public support' is highly under-specific. What the term 'public support' means here is unclear. If it is intended to mean all people support it, then the statement is demonstrably false, and there is no literature in political science that would support such a claim. But then if it doesn't mean that, then does it mean that policy needs uspport from a specific section of a population? if so, how much? Or does it mean that policy needs simply not to be oppposed by a signfiicant number of people (i.e. a notion of tacit consent)? And crucially, how is that public support mediated in a political system? In authoritarian and democratic systems this is very diffferent, but even in democratic systems, the electoral system, access to policy-makers via lobbying, and so on, all make important differences to how policy-makers have to take account of popular opinion. There is now a small but emerging literature on this in climate policy (see for example Lachapelle, Erick, and Matthew Paterson. 2013. Drivers of National Climate Policy. Climate Policy 13:547–71, and various discussions in AR5 WGIII, ch15). How this is then affected by a focus on 1.5C however is an important question. but more generally, this account needs to unpack what is meant by public support and consider how institutional variation affects how it feeds into cliamte policy. the other point aobut this section is why is it a subsection in the section on behavioural change? The material presented is all generic to public support for climate policy, not specifically for policies aimed at behavioural change. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. The text is rephrased to avoid confusion. The literature assessed focuses on policy aimed to promote behaviour change
7140	63	8	63	8	Comment: A great deal of research has looked into motivators for behaviour change and there is increasing recognition fro a global issue such as climate change tradtional social marketing techniques have limited applicability. Suggestion, add in line 8 after the sentence ending (Poortinga et al. 2003) " There is increasing evidence that social marketing alone is insufficient to build support for the more ambitious policy changes and interventions that constitute a proportional response to climate change. Reference: (Corner, A. & Randall, A. (2011)Selling climate change? The limitations of social marketing as a strategy for climate change public engagement, Global Environmental Change 21, 1005–1014) [Jamie Clarke, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We fully agree, and discuss a wide range of strategies for behaviour change, including social network approaches see section 4.4.5.3 of FOD, eg p 61 line 12-14, and approaches targeting identity, eg p 62 line 50-54
3722	63	15	63	19	The case to include fairness applies to multi-lateral processes explicity. See Winkler, H & Beaumont, J 2010. Fair and effective multilateralism in the post-Copenhagen climate negotiations. Climate Policy 10: 638–654. doi:10.3763/cpol.2010.0130 http://www.erc.uct.ac.za/Research/publications/10Winkler-Beaumont-Fair_effective_multilateralism.pdf [Harald Winkler, South Africa]	Taken into account, the text focuses on fairness related factors influencing public acceptability of climate policy and system changes. The paper by Winkler & Beaumont theorises on fair and effective multilateralism, which does not fit in the present sections, but is related to governance. Included in 4.4.1.2
3623	63	15	63	26	a reference or acknowledgment of the increaseing health concerns being expressed around wind turbine noise (Council of Canadian Academies, 2015) would be in order here. Possibly tying it to the concept that health impacts are mediated by procedural fairness concerns (i.e., health risk are exacerbated by procedural fairness concerns – and policies that aim to quickly develop wind energy infrastructure may need to be tempered to allow opportunities for local zoning control, siting changes etc for large scale reneewable infrastructure to sustain broad public support. (Fast et al 2016, Baxter and Walker 2013) [Stewart Fast, Canada]	Taken into account, due to space limitations we cannot discuss this in detail
5150	64	3	64	11	Update to Singapore - a new vehicle emissions scheme was announced in 2017 and will be implemented in 2018 to improve air quality and also to account for CO2 emissions from electricity generation for Electric vehcles and plug-in hybrids. More information can be read here: https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=08685840-d664-4713-9ccb-96dcd8936d08 [Winston Chow, Singapore]	Taken into account. The scheme will be implemented in 2018 so the effects can not be assessed yet
4754	64	4	67	4	Remove comma in "While, these", which becomes "While these" [Valentino Piana, Italy]	Editorial
4193	64	29		35	Did the number of vehicles decrease because people cared about climate change or because they couldn't afford to drive? [Michelle Leslie, Canada]	Taken into account. The study does not reveal this
17240	64	39	64	39	Case study of international linkages for enhancing technology transfer like Climate & Clean Air Coalition, International Solar Alliance, etc could be given. [Himangana Gupta, India]	Accepted. A case study on bioethanol in Brazil, addressing both innovation and international linkages, was added.
7119	64	41			What is the difference between section 4.4.6.1 and section 4.4.6.2? Section 4.4.6.2 is basically about ICTs, so the authors may consider a new title for the section. [Érika Mata, Sweden]	Taken into account. Section's scope is widened to other General Purpose Technologies.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7118	64	41			this section is very brief. Could there be a clasification of technological options by sectors? E.g. on potentials for solar heat and power: Norwood, Z., Nyholm, E., Otanicar, T., & Johnsson, F. (2014). A geospatial comparison of distributed solar heat and power in Europe and the US. PloS one, 9(12), e112442.; on distributed PV in Sweden: Nyholm, E., Odenberger, M., & Johnsson, F. (2017). An economic assessment of distributed solar PV generation in Sweden from a consumer perspective–The impact of demand response. Renewable Energy, 108, 169-178, Nyholm, E., Goop, J., Odenberger, M., & Johnsson, F. (2016). Solar photovoltaic-battery systems in Swedish households–Self-consumption and self-sufficiency. Applied Energy, 183, 148-159.; on domestic DSM in Sweden: Nyholm, E., Puranik, S., Mata, É., Odenberger, M., & Johnsson, F. (2016). Demand response potential of electrical space heating in Swedish single-family dwellings. Building and Environment, 96, 270-282.; on potentials for distributed RES in EU buildings: Mata É, Sasic Kalagasidis A, Johnsson F. Energy savings and CO2 emission reductions from building retrofitting in five European countries – Modelling and review of estimates (in review) [Érika Mata, Sweden]	Noted. The feasibility assessment by sector is done in section 4.3, not here.
14290	64	45	64	45	Innovations in nuclear power should also be mentioned here. Reactors based on a thorium fuel cycle, or a DUPIC cycle that takes LWR fuel and puts them into HWR (like a CANDU reactor) which drastically reduces nuclear fuel use. Innovations in molten salt reactors and small modular reactors (SMRs) could drastically change the landscape of the energy sector in very positive ways. For example, molten salt reactors would be able to burn current nuclear waste and get dozens of times the electricity out. These innovations should be explored and addressed here. This report has assembled an impressive array of expertise, but the specifics of the nuclear power industry are not well represented, this could be remedied by having an author specifically for nuclear power. [Jason Donev, Canada]	Taken into account. Nuclear power feasibility is addressed in 4.3.2.
6781	64	46	64	48	Solar is also outcompeting new fossil fuel power stations in less sunny parts of the world. https://qz.com/871907/2016-was-the-year-solar-panels-finally-became-cheaper-than-fossil-fuels-just-wait-for-2017/ Prices for onshore and offshore wind have also dropped dramatically and is cost competitive with new fossil fuels. http://time.com/4662116/renewable-energy-fossil-fuels-growth/https://www.bloomberg.com/news/articles/2017-04-13/germany-gets-bids-for-first-subsidy-free-offshore-wind-farms Another fact worth pointing out is that investments in RE is outpacing investment in FF and new capacity additions of RE is outpacing capacity additions of fossil fuels. [Jennifer Morgan, Netherlands]	See comment 6760.
6760	64	46	64	48	Solar is also outcompeting new fossil fuel power stations in less sunny parts of the world. https://qz.com/871907/2016-was-the-year-solar-panels-finally-became-cheaper-than-fossil-fuels-just-wait-for-2017/ Prices for onshore and offshore wind have also dropped dramatically and is cost competitive with new fossil fuels. http://time.com/4662116/renewable-energy-fossil-fuels-growth/https://www.bloomberg.com/news/articles/2017-04-13/germany-gets-bids-for-first-subsidy-free-offshore-wind-farms Another fact worth pointing out is that investments in RE is outpacing investment in FF and new capacity additions of RE is outpacing capacity additions of fossil fuels. The Lazard report in the US that shows utilit-scale wind and solar being cheaper than new natural gas at the very low end of the range. See an article about it here: http://www.utilitydive.com/news/renewables-challenge-natural-gas-plants-on-price-in-latest-lazard-analysis/432700/. The LCOE for new wind ranges from $32 to $62 per MW, new solar PV- thin film utility scale from $46 to $56 per MW and new gas combined cycle from $48 to $78 per MW. https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf. [Jennifer Morgan, Netherlands]	Taken into account. These aspects are covered in sections 4.3.2 as well as 4.5.2.
777	64	46	64	54	Missing from this paragraph is the home battery systems from the likes of Tesla, Moixa and many more. Home battery systems have become of age. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Noted, partly addressed in 4.3.2 but there was not space, nor literature provided, to address this specifically here.
2488	64	46	64	54	Need to take into account/acknowledgs costs of technology: unsustainable resource extraction, waste disposal, etc. [Lisa Lucero, United States of America]	Taken into account. Those aspects are covered in the feasibility assessment in 4.3.
6220	64	47	64	53	Lachapelle, Erick, Robert MacNeil, and Matthew Paterson. 2016. The Political Economy of Decarbonisation: From Green Energy 'Race' to Green 'Division of Labour'. New Political Economy 22:311–27. would be useful on the claim here. That article explicitly analyses the interaction between R&D policies (especially in the US), labour/industrial strategies (especially by China) and installation policies (such as feed in tariffs) in places like Germany. [Matthew Paterson, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Reference added.
18573	64	51	64	51	Nemet 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Noted. Reference not in the SOD anymore.
570	64	52	64	53	The text doesn't quote which is the current cost of batteries (in contrast to the numerical value for PV given a few lines earlier). McKinsey indicates a price of 227 USD per kWh (https://www.mckinsey.de/files/161223_mckinsey_e-vehicles.pdf). ICCT stands for 250 USD - in 2015 ((http://www.theicct.org/sites/default/files/publications/ICCT_LitRvw_EV-tech-costs_201607.pdf). Bloomberg New Energy Finance reports a cost - in 2017 - of 273 dollars, as for instance from their website ("Lithium-ion batteries, plus the necessary packaging equipment, will drop to $73 per kilowatt hour by 2030, from $273 currently, BNEF says".https://www.bloomberg.com/news/articles/2017-07-28/why-electric-vehicles-are-coming-but-not-yet-here-quicktake-q-a). For a time series and separate values for cells and battery pack see also this full graph: https://thinkprogress.org/chart-of-the-month-driven-by-tesla-battery-prices-cut-in-half-since-2014-718752a30a42/ . The number (273 USD) comes from a research note entitled "Bottom up cost scenarios for litium-ion batteries" by BNEF analyst Julia Attwood, which was published on Feb 2, 2017. Suggested integration deriving from this remark: "In addition, the cost of battery sharply declined, thanks to research and development and mass production for portable equipment applications, currently down to 227-273 USD per kWh (McKinsey, 2017; ICCT, 2016; BNEF, 2017)". [Valentino Piana, Italy]	Taken into account in section 4.3.2
571	64	52	64	53	Specific large-scale users and buyers can undercut the average price of batteries. "RW Baird believes that Tesla's current battery costs are ~$150 to ~$200 per kilowatt-hour" https://www.greentechmedia.com/articles/read/How-Soon-Can-Tesla-Get-Battery-Cell-Cost-Below-100-per-Kilowatt-Hour. Suggested integration deriving from this remark: "In addition, the cost of battery sharply declined, thanks to research and development and mass production for portable equipment applications, currently down to 227-273 USD per kWh (McKinsey, 2017, ICCT, 2016; BNEF, 2017), with some leading manufacturers possibly enjoying even lower costs". [Valentino Piana, Italy]	Taken into account but we lacked space to do it in the detail suggested here. We also included a peer-reviewed literature source.
18574	64	53	64	53	Nykvist and Nilsson 2015 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted link added
4194	65	2		14	What has an increase in robotics and AI meant and will continue to mean for the work force? What will happen to all the people who are displaced as a direct result of this innovation? Will this move us away from achieving SDGs? Will factory workers and others who are replaced by AI be able to be retrained or will we simply lose that part of the work force? [Michelle Leslie, Canada]	Rejected. It is a valuable point but the assessment of GPTs is beyond the scope of this report.
1027	65	2	65	14	Sharing economy from ownership to share (ex, automobile) in combination with AI and IoT may have huge possibility to save energy, though not intending to reduce emissions. It would be better to add these new behavioral change that has no relationship with climate change, still have a huge impact on climate change. [Mitsutsune Yamaguchi, Japan]	Taken into account in various places in this section, in section 4.4.3 (on behavioural change).
13075	65	2	65	2	Please explain what is "deep learning" technology [Caserini Stefano, Italy]	Taken into account. Term is not used anymore.
18575	65	4	65	4	IEA 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted link added
18576	65	7	65	7	IEA, 2017, Iguma and Kidori 2016 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted link added (Iguma and Kidori removed)

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6589	65	10	65	14	Consider to mention the global growth of e-waste and energy consumption derived from ITC production and running and e-waste treatment and its impact on global ecosystems resilience. [J. David Tabara, Spain]	Accepted. Resource use of ICT vs by ICT discussed in text
7226	65	11			insert after '...AI,': Additive Manufacturing [Leendert Verhoef, Netherlands]	Taken into account. Not added here but listed in Table 4.7.
14291	65	11	65	11	What is the “internet of things”? [Jason Donev, Canada]	Accepted. Explanation will be added to the Glossary in the Final Draft
18577	65	13	65	13	Laitner et al. 2010 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted. But comment is not relevant as the literature is deleted.
7225	65	14			A recent study by Verhoef et al. (2017) on the potential of additive manufacturing on the transport sector, shows that energy savings of 5 - 27 % can be achieved on the global energy demand, depending on global co-operation and penetration of the technology. Leendert Verhoef, Bart W. Budde, Cindhuja Chockalingam, Brais García Nodar, Ad van Wijk, 2017, The Effect of Additive Manufacturing on Global Energy Demand: An Assessment Using a Bottom-up Approach, Energy Policy, under review [Leendert Verhoef, Netherlands]	Accepted, reference added.
18578	65	17	65	50	Section 4.4.6.2 needs a Mendeley link [Wilfran Moufouma Okia, France]	Reject. Sections are not linked in mendeley.
7920	65	17	65	51	The section does not mention AV's, which may or may not reduce emissions. AV's could increase transport efficiency, but actually lead to higher car usage and result in 'green' congestion. They could alleviate the need for parking and allow denser urban cores, but they could alternatively enable sprawl, as congestion may be more tolerable. [Westphal Michael, United States of America]	Taken into account. The ambiguous contribution to mitigation, and lack of relevance for 1.5C, means that it's not mentioned here.
14107	65	18	65	18	This is a bit confusing as phrased. Do you mean to say “Like biological ecosystems, technology systems evolve over time by combining existing technologies”? [Elvira Poloczanska, Germany]	Accepted. Text removed
14106	65	19	65	19	The reference to complex systems theory is not clear here. If complexity theory is to be utilised in this section, then key elements such as emergence, uncertainty/surprise, and feedbacks regarding technological change need to be addressed. Otherwise, I suggest to remove this reference. [Elvira Poloczanska, Germany]	Accepted. Text removed
14108	65	22	65	22	‘by’ utilizing [Elvira Poloczanska, Germany]	Taken into account, text removed.
7120	65	29			I´d prefer that the options were presented here in an schematic way. [Érika Mata, Sweden]	Accepted. Table added to take care of this.
14109	65	31	65	32	delete "care should be taken that" – it is misleading. Gives meaning that care should be taken to make rebound effects as large as emission cuts! [Elvira Poloczanska, Germany]	Accepted. Text modified to focus on the solution rather than the problem.
11185	65	36	37		as ambitious mitigation policy might undermine economic progress if inadequately implemented - climate change impacts may also undermine economic progress, as might other policy agenda / unambitious mitigation policy (e.g. by losing the opportunity to be a first mover). Suggest rewording. [Michiel Schaeffer, Netherlands]	Accept. Text removed
3624	65	41	65	42	Thierer (2014) and Thierer (2016) are missing from references [Stewart Fast, Canada]	Noted. This literature was removed upon revising the text.
7121	65	54			The authors may consider a change in the title to summarize the key measure of the section, e.g. "innovation policy IS NEEDED to provide 1.5C-relevant insight". Any summary of innovative policies would be appreciated. [Érika Mata, Sweden]	Rejected. IPCC cannot be policy prescriptive. However, we do discuss the relevance of innovation policy.
4195	66	1		6	Canada launched Mission Innovation, but it is yet to be made clear as to how and what industries will get funding. What will the thresholds be for climate mitigation and adaptation in order to receive funding and will all technologies be considered if they meet the requirements. [Michelle Leslie, Canada]	Noted. No action required, it seems.
15004	66	3	66	3	While there is still little information to know what the authors intend to include in considering: "In this light there have been many calls for increasing R&D funding," they should be careful to be objective and and policy neutral. [Farhan Akhtar, United States of America]	Accepted, sentence removed.
15005	66	4	66	4	Mission innovation reference should be "seek to double", not "committed to double" [Farhan Akhtar, United States of America]	Accepted, text modified as suggested
3603	66	4	66	7	The author failed to mention the UNFCCC-backed new "Climate Technology Centre and Network" which is central to the international response to technological challenges, development and deployment. Its mission is to develop, transfer and adapt to local circumstances key mitigation and adaptation technologies, in a recipient country-driven framework, under which every entity in a developing country (both governmental and non-govemental) can ask the National Focal Point to be prioritised for support, also taking into consideration how this request fit the Nationally Determined Contribution and sustainable development strategies. If so, CTC-N is contacted and a Terms of Reference for a competitive bid across world-class institutes and solution providers is carried out, with missions to the recipient country, at no cost for them. The financial upscale and the increase in the ambition of the requested techologies (with more emphasis on development and not only on transfer of existing technologies) would make the CTC-N a central leverage for the international response to limiting warming to 1.5°C. See more at https://www.ctc-n.org/ , http://www.unido.org/environment/o591190/climate-policies-and-networks/climate-technology-centre-and-network.html and http://unfccc.int/focus/technology/items/7000.php . For a written published recent report on CTC-N activities, please quote in the literature: http://www.unido.org/fileadmin/user_media_upgrade/What_we_do/Topics/Energy_access/ctcn-ar16-bookcover-lowres.pdf Suggested integration deriving from this remark: "In this light, there have been many calls for increasing R&D funding for climate mitigation and adaptation (examples). In 2015, twenty countries responded by an initiative called 'Mission Innovation'. and committed to doubling their energy R&D funding, although at this point it is difficult to evaluate its effectiveness (Sanchez and Sivaram 6 2017). At the same time, the private sector started an initiative called the 'Breakthrough Energy Coalition'. On a broader scale, the UNFCCC-backed Climate Technology Centre and Network has already supported - free of charge - more than a hundred applications from developing countries covering the development, transfer and deployment of mitigation and adaptation technologies, in line with the respective Nationally Determined Contribution. The financial upscale and the increase in the ambition of the requested techologies (with more emphasis on development and not only on transfer of existing technologies) would make the CTC-N a central leverage for the international response to limiting warming to 1.5°C." [Valentino Piana, Italy]	Accepted text modified and CTCN and Breakthrough Energy Coalition referred.
1220	66	8			Ch5 does not discuss climate-resilient pathways but 'climate-resilient development pathways' (5.1. and 5.7). Remove x-reference to Ch5 here. [Petra Tschakert, Australia]	Accepted, reference removed.
18579	66	8	66	8	IPCC WGII 2014 Chapter 15, GEA 2012 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted link added
9348	66	10	66	10	The statement "Governments have employed various different innovation policies" is rather brief and may be continued as "including those that may be characterized as containing features of a sustainability-oriented innovation system." [Siir KILKIS, Turkey]	Accepted, but text was changed as a result of editing and other comments. In any case, more text is added on governmental innovation policy.
7351	66	10	66	10	Delete the text "innovation". [Eleni Kaditi, Austria]	Rejected. We are talking about innovation policy. Not policy in general.
7352	66	10	66	12	Delete the text "Revenues for R&D could come from the general budget, but could also be generated by carbon pricing schemes (see also section 4.4.7) or, for instance, energy or resource taxation." [Eleni Kaditi, Austria]	Rejected as the point here is important and has a literature base. However, the text is modified to make the meaning of carbon pricing clearer.
18580	66	13	66	13	Conninck and Sagar 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted link added
7122	66	17			Section 4.4.6.4. only seems to argue that technology is necessary. Such a justification may fit better as the first subsection of 4.4.6 rather than the last, i.e. in a typical general-to-specific rhetoric. So: 1) technology is necessary, 2) which specific new technologies, 3) the key role of ICTs (if the authors want to design an specific section for ICTs, but the link e.g. to consumer behavior or other specifics has not been motivated), 4) policy innovation. [Érika Mata, Sweden]	Rejected. We appreciate the suggestion but section 4.4.6.4 is really on how and whether international institutions interfere on technology development and transfer.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
15006	66	17	66	51	There are multiple references to technology transfer or references to technology in the Convention and the Paris Agreement that are incorrect or misleading. Replace "technology transfer and innovation" with "facilitating enhanced action on technology transfer and deployment" when referencing PA; or, generally, use "technology" or "technology innovation, deployment, diffusion, and transfer". Also, should not reference specific articles of the Convention (line 19), and reference to TNAs in line 48-49 is one selective component of the PA. [Farhan Akhtar, United States of America]	Accepted (the first half of comment) text modified on the wordings regarding technology and innovation. Rejected (the second half of comment) reference to relevant part of UNFCCC is necessary here.
18581	66	18	66	18	Move Article 4.5 outside grey shaded Mendeley field [Wilfran Moufouma Okia, France]	Accepted, editorial
18582	66	22	66	22	Conninck and Sagar 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted link added
15007	66	22	66	22	hard to imagine without a significant increase in global R&D expenditures -- delete. This is speculative; we can't quantify how R&D funding would lead to improved mitigation. The technologies exist, are falling in cost, and we could get to 1.5C without additional R&D -- more important to focus on policies, institutions, and private sector. [Farhan Akhtar, United States of America]	Accepted. Sentence is removed.
941	66	26	66	26	Perhaps the carbon fee and dividend system gaining traction in the US should be mentioned as a possible policy solution, which also is more acceptable to the public. [Elizabeth Aldrich, United States of America]	Noted. Unfortunately no references suggested.
15008	66	31	66	31	Also include IEA ETPs [Farhan Akhtar, United States of America]	Rejected. It is unclear what ETP means here. The IEA Energy Technology Perspective is not relevant in this context.
18583	66	38	66	38	Olhoff (2015) needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted link added
10682	66	39	66	43	Transferability of adaptation strategies and technologies can significantly be advanced by using archetypes, i.e. recurrent patterns, of socio-ecological systems based on the assumption that adaptation strategies that have been successfully applied in one location would be benefitial in other locations with similar socio-ecological conditions (Kok et al. 2016, Sietz et al. 2017). Archetypes of socio-ecological systems help to better integrate local to global scales of decision-making and implementation of adaptation strategies. ---- References: Sietz, D., Ordoñez, JC., Kok, MTJ., Janssen, P., Hilderink, HBM., Tittonell, P. and Van Dijk, H. (2017) Nested archetypes of vulnerability in African drylands: Where lies potential for sustainable agricultural intensification? Environmental Research Letters 12 (2017) 095006 ----- Kok, M., Lüdeke, MKB., Lucas, P., Sterzel, T., Walther, C., Janssen, P., Sietz, D. and de Soysa, I. (2016) A new method for analysing socio-ecological patterns of vulnerability. Regional Environmental Change 16(1): 229-243 [Diana Sietz, Netherlands]	Taken into account, text on adaptation innovations has been included. Contextual issues are discussed throughout the chapter and in case studies.
18584	66	45	66	45	UNFCCC, 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted link added
2635	66	45	66	51	mention CTCN? [Zoha Shawoo, United Kingdom (of Great Britain and Northern Ireland)]	Accept. It is not mentioned here but further up.
9694	66	45	66	57	The TNAs are to be linked with Nationally Determined Contribution (NDC) and National Adaptation Plan (NAP). In addition, technical assistances to developing countries from Climate Technology Center & Network (CTCN) are to be based on TNAs as well as linked with UNFCCC's financial mechanism. [Hyung Ju Kim, Republic of Korea]	Noted. No literature was suggested on this.
5237	66	54	72	2	Regarding the strengthening of policy instruments, a pledge and review framework to raise ambition of Paris agreement objectives, based on several indicators, was proposed in Akimoto, K., Sano, F. & Shoai-Tehrani, B. Evolut Inst Econ Rev (2016). doi:10.1007/s40844-016-0049-y [Bianka SHOAi-TEHRANI, Japan]	Rejected - outside the scope of the chapter of this section that is devoted to the triggering face of the transition
3698	67	7			Command and control' is normative language, whereas "price signals" sounds neutral. Suggest using more neutral language, such as regulatory and economic instruments (or pricing instruments, if you prefer). [Harald Winkler, South Africa]	Accepted, change made.
7353	67	11	67	12	Delete the text "the effective use and design of 'price signals', various forms of 'market-based instruments', along with". [Eleni Kaditi, Austria]	Rejected not supported by the peer-reviewed published literature that, to the contrary, is very rich about market based instruments
778	67	15	67	15	This looks like a subheading. If it is, it needs to be numbered [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, change made.
17684	67	15	67	15	The section rightly includes "equity" in the heading. However, it does not define it or refer to the large literature on equity and climate change. See the references above on the nature of a just transition to a decarbonised society - especially Simon Caney 'Just Emissions', Philosophy & Public Affairs, vol.40 no.4 (2012), 255-300; Simon Caney '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 'Cosmopolitan Justice, Responsibility, and Global Climate Change', Leiden Journal of International Law, vol.18 no.4 (2005), 747-775. For an overview see Caney 'Climate Change and Distributive Justice' in The Oxford Handbook of Distributive Justice (Oxford: Oxford University Press, in press), edited by S. Olsaretti . [Simon Caney, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - covered in Chapter 5
14110	67	15	67	15	This is a different heading/subheading style than in the rest of this chapter. [Elvira Poloczanska, Germany]	Accepted, change made.
19758	67	15	67	15	Section on costs and equity: relevant to this section is i) the need to ensure that the burdens and benefits of climate change and its responses are shared equitably. This is a Principle of Climate Justice. See for example Shue. H. essay : Essay by Henry Shue for the Mary Robinson Foundation. Share Benefits and Burdens Equitably. 2015. Online at http://www.mrfcj.org/wp-content/uploads/2015/09/Sharing-the-Benefits-and-Burdens.pdf [Tara Shine, Ireland]	Rejected - The idea is fine, but the indicated literature is not peer-reviewed. This correction is treated in Chapter 5.
19759	67	15	67	15	ii) also relevant is the need to share the benefits of climate change responses equitably from green transport to sustainable energy. A key startegy for ensuring that the benefits of sustainable energy reach the pooreste is the use of social protection systesm to deliver access for the poorest. See The Role of Social Protection in Ending Energy Poverty: Making Zero Carbon, Zero Poverty the Climate Justice Way a Reality. 2016. Online at http://www.mrfcj.org/wp-content/uploads/2016/09/The-Role-of-Social-Protection-in-Ending-Energy-Poverty.pdf [Tara Shine, Ireland]	Rejected - The idea is fine, but the indicated literature is not peer-reviewed. This correction is treated in Chapter 5.
7354	67	17	67	18	Delete the text "owing to off-setting existing infrastructure lock-ins and making a transition out of climate incompatible path dependencies". [Eleni Kaditi, Austria]	Rejected - our mandate is to examine the ways of going out of carbon-intensive lock-ins; to explore how/whether this is possible or not so cannot delete this piece of text
7356	67	22	67	22	Delete the text "before they are more cost-effective than conventional fossil energy". [Eleni Kaditi, Austria]	Rejected - our mandate is to examine the ways of going out of carbon-intensive lock-ins; to explore how/whether this is possible or not so cannot delete this piece of text
7921	67	23	67	24	The order of magnitude envelope for the worldwide marginal abatement costs for a 2°C target in AR5 was: 24 35-60 $ t-1 in 2020, 62-140 $ t-1 in 2030 and 140-260 $ t-1 in 2050. Clarification - does this mean that all abatement options less that $60/t would need to be deployed by 2020 or that only those options costing less than $60/t would need to be deployed? [Westphal Michael, United States of America]	Accepted - The following version will clarify this point
13076	67	23	67	27	This part is too week and general and should be better connected to Chapter 2 [Caserini Stefano, Italy]	Rejected - This is indeed only an introductory section meant to introduce literature that is not in Ch2.
11193	67	23	67	27	Lower bounds of estimates for marginal abatement costs for a 2°C target are described as relying on optimistic technical assumptions coming from models - while these assumptions of least-cost planning and no market imperfections are optimistic, are the costs of energy used (and the rates at which these fall) also optimistic? Some real-world examples have shown costs to drop at higher rates than projected by models, and the rates of change are so fast that models may be starting at a higher cost than present real-world costs. [Michiel Schaeffer, Netherlands]	Accepted - the remark and will better qualify the notion of 'optimistic' in the SOD. One problem is that cut in cost of certain technologies does not translate mechanically in homothetic in the whole energy system.
4698	67	24			Use US$ curency format [Radim Tolasz, Czech Republic]	Accepted, change made.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
3699	67	28	67	37	Good discussion of energy transitions. Consider adding a point that the relative prices of renewable energy compared to fossil fuels (esp for electricity generation) have decreased dramatically in the last few years. New wind is now cheaper (in $ / kW installed capacity) than new coal in many countries. That means there is no 'incremental cost' to mitigation in this respect. Much literature: e.g. recently - OECD (Organisation for Economic Co-operation and Development) 2017. Investing in climate, investing in growth. Paris, OECD. http://www.oecd.org/environment/investing-in-climate-investing-in-growth-9789264273528-en.htm; as well as IRENA REMAP reports [Harald Winkler, South Africa]	Accepted - we will clarify the links between cost of specific techniques, marginal cost of a system and welfare cost. The cut in some technological segments does not translate homothetic into cuts for the system and for the society
14292	67	30	67	31	The German energy transition is taking no-emission nuclear off the grid in favour of renewables, it's important and burning coal to do this. I don't believe that this is a success story from a climate change perspective. [Jason Donev, Canada]	Rejected - We do not say that this is a success story, we simply say this led to higher consumer prices in Germany (Not Europe as it says now. JC makes change)
14293	67	30	67	31	The prices are an interesting story, can this be cited? [Jason Donev, Canada]	Accepted - we will add a reference.
3092	67	30	67	32	weird comma placement after "transition" [Christopher Bataille, Canada]	Accepted, change made.
779	67	38	67	38	Wider line margin than usual paragraph [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
1918	67	39	67	48	I would suggest inserting a paragraph on the distributions of non-market benefits of climate change mitigation (and renewable energy policy). Empirical evidence predominantly shows that lower income households have a higher willingness to pay for non-marketed benefits from ecosystem services (Drupp 2016; Jacobsen and Hanley 2009). This suggests that benefits from environmental improvements are distributed in favor of the poor (Baumgärtner et al. 2017; Ebert 2003). As such the benefits from climate change mitigation for ecosystem functioning and resilience are generally falling over proportionally to lower income groups. By the same token non-marketed cost of environmental degradation happens over-proportionally at the expense of the poorer households. In general, even if the direct costs of climate policies are distributed regressively, non-marketed benefits might favor the poor and thus support more stringent climate policies also from an equity perspective. Economic analysis (Baumgärtner et al. 2017; Ebert 2003) in combination with empirical data from environmental valuation studies show that most ecosystem services benefit over-proportionally to lower incomes. As such the net distributional effect of climate policies might be less regressive than analysis of the cost suggest, once a holistic assessment is done. In addition to the here suggested implementation of compensation measures, policy maker could communicate the positive effects on social equity of the non-marked benefits from climate policy to build public support. References: Baumgärtner, S., Drupp, M.A., Munz, J.M., Meya, J.N., Quaas, M.F. (2017): Income inequality and willingness to pay for environmental public goods. Journal of Environmental Economics and Management, 85: 35–61. Drupp, M.A. (2016). Limits to Substitution between Ecosystem Services and Manufactured Goods and Implications for Social Discounting, Environmental and Resource Economics, forthcoming. Ebert, U. (2003). Environmental goods and the distribution of income, Environmental and Resource Economics 25(4): 435-459. Jacobsen, J. and N. Hanley (2009): Are there income effects on global willingness to pay for biodiversity conservation? Environmental and Resource Economics, 43(2): 137-160. [Jasper Meya, Germany]	Taken into account and text will be modified accordingly
14136	67	43	67	43	Formatting needed for these citations [Elvira Poloczanska, Germany]	Accepted, change made.
18585	67	43	67	43	Proose, et al. 1995, Barker et al. 1998 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made.
780	67	44	67	44	Problem with citation formatting [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, change made.
9291	67	49			See Reckien et al., 2018 (In Press) for equity issues [Cynthia Rosenzweig, United States of America]	Accepted - reference added
3093	67	50	68	6	Some authors make a strong case Pareto optimality is from equalization of marginal welfare impacts, not equimarignal production and consumption carbon pricing, which is a narrower test of productive efficiency that mandates pratically infeasible transfers, leading to differential carbon prices by jurisdiction depending on the social welfare function. Chichilnisky, G., and G.M. Heal. 2000. Environmental markets. Equity and Efficiency. Columbia University Press. New York. Sheeran, K.A. 2006. « Who Should Abate Carbon Emissions? A Note ». Environmental and Resource Economics 35 (2): 89-98. [Christopher Bataille, Canada]	Accepted, good point. We can insert the discussion.
18379	67	53	67	53	TSU needs a copy of Demailly et al. (2009) - unclear which report is referred to. Is it this one?:http://www.iddri.org/Evenements/Interventions/070622_workshopberlin_Competitiveness_interim_report.pdf [Wilfran Moufouma Okia, France]	Accepted - we will insert the reference
18586	68	4	68	4	Branger et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made.
18587	68	10	68	10	Pfeiifer et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made.
3700	68	13			the case for pricing carbon gets stronger if there is a link to a key devleopmental goal, namely poverty eradication. One mechanism would be to use the revenues from carbon pricing to fund reduction in poverty. I have looked at this in context of South Africa: Winkler, H 2017 in press. Reducing energy poverty through carbon tax revenues in South Africa. Journal of Energy in Southern Africa 28 (3): 1-15. http://dx.doi.org/10.17159/2413-3051/2017/v28i3a2332 Not importnat whehter you cite or not; importnat to add the carbon price-poverty reduction link - and possibly call for further work on this (if you agree) [Harald Winkler, South Africa]	Taken into account - but this will be inserted in the next section.
18588	68	14	68	14	Jakob and Hilare 2015; McGlade and Ekins 2015 need Mendeley links [Wilfran Moufouma Okia, France]	Accepted, change made.
18589	68	19	68	19	IPCC TAR, AR4 and AR5 need Mendeley links [Wilfran Moufouma Okia, France]	Accepted, change made.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
6590	68	19	69	24	Most of the policy statements provided in this section 4.4.7.1. (and also in page 80, lines 20-38) are based on conclusions generated from macroeconomics General Equilibrium models which are based on behavioural assumptions of the existence a single rational actor, with full information and pursuing maximisation of utility. These models also take public policy, and in particular climate policy as a cost (impacting welfare), and as a deviation from a single equilibria -instead of a source of green growth and greater welfare. Such assumptions are at odds with the more nuanced understanding of heterogeneous agency and behavioural rules and dynamics being currently developed in more complexity and Agent-Based Modelling which at the same time consider some of the actual 'behaviour anomalies' stated in the report in section 4.4.5.3. So I would reccomend to unveil the origin of such arguments and allow for a more open discussion of which models and assumptions are used for such sweeping statements about the costs of transition -as they may not be true. For a discussion see (although not a comprehensive one at all): Tinch R., Schoumacher C., Grasso M., Grasso M.E., Mandel A., Lamperti F., Napoletano M., Roventini A., Sapio A. , Jäger J., Tàbara, J. D. 2015. Evaluation of economic approaches under high-end scenarios. IMPRESSIONS project Deliverable D5.1. http://www.impressions-project.eu/documents ; and Tàbara, J. D., Mangalagiu, D., Kupers, R., Jaeger, C. C., Mandel, A., Paroussos, L. 2013. Transformative targets in sustainability policy-making: the case of the 30% EU mitigation goal. Journal of Environmental Planning and Management, 56(8): 1180 -1191. http://dx.doi.org/10.1080/09640568.2012.716365 [J. David Tabara, Spain]	Rejected - outside the scope of the section. There is a misunderstanding here, we do not discuss the findings of the General Equilibrium models in this section. The discussion about how the various modeling approaches change the assessment of mitigation policies should be conducted in Chapter 2.
4699	68	22			Change "$ 10 ton-1" to " US$ 10 t-1" [Radim Tolasz, Czech Republic]	Accepted, change made.
18590	68	22	68	22	World Bank 2016 needs Mendeley links [Wilfran Moufouma Okia, France]	Accepted, change made.
7922	68	30	68	31	In principle, this implies that: (1) that marginal costs of abatement are equated across all sources of emissions. I am not sure I understand this point. The marginal costs of abatement vary considerably across sectors and actions now. Are you referring to a long-term equilibrium point after all the cheap options within each sector are exploited? [Westphal Michael, United States of America]	Rejected - this is a basic principle in economics that all the abatement cost of each sector / activity should be equated to minimize total cost. Because of space constraints it's difficult to explain better
3094	68	33	68	35	with very little attention [Christopher Bataille, Canada]	Editorial
7923	68	37	68	37	explicit carbon prices equal to marginal abatement costs. See above. Are you referring to a long-term equilibrium? Because in the short-term, marginal costs vary acros actions and sectors, some of which are higher or lower than any carbon price. [Westphal Michael, United States of America]	Rejected- same response as above. To clarify we will change 'in principle' by 'in theory' to suggest the distance with the real world.
18836	68	47	68	49	Carbon pricing and offset mechanisms should be used to fund agroforestry and sustainable energy acceleration, including sustainable nuclear fission. Currently, nuclear power has been left out of offset mechanisms, while some coal power plants are being funded by the Green Climate Fund: this does not make any sense in the context of the Paris Agreement (max. +1.5°C to +2°C global warming). This is particularly important to enable leapfrog schemes in developing countries. Otherwise, they will remain on the BAU pathway (using coal and hydrocarbons). [Stephan Savarese, France]	Accepted - a specific box will be added on a world of nuclear
1919	69	5	69	7	At least in Germany poor hoseholds often do not pay (or only very little) income taxes, due to tax exeption limits. They would more strongly benefit from investment in public infrastructure, lower contributions to health care and pensions, or a reduction of VAT. [Jasper Meya, Germany]	Accepted, without referring specifically to Germany, we will pay attention to this type of policy that is conducted in some countries within the context of co-benefits of climate policies of tax reforms.
18591	69	11	69	11	Combet et al. 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made. Note is 2010, not 2015
4757	69	12	69	12	You may combine Combet et al. 2010 Combet et al 2015 into Combet et al 2010, 2015 [Valentino Piana, Italy]	Accepted, change made.
14294	69	18	69	18	'maay' should be 'may' [Jason Donev, Canada]	Accepted, change made.
4160	69	18	69	21	The author correctly underlines the double dividend of recycling carbon tax revenues. A further relevant bibliographical entry, confirming this thesis, is Piana, V., 2011: Exploring Economic and Political Drivers for the Introduction of Innovative Mitigation Policies. In: Leal Filho W. (eds) The Economic, Social and Political Elements of Climate Change. Climate Change Management. Springer, Berlin, Heidelberg, doi:10.1007/978-3-642-14776-0_26. The text then becomes: "Therefore, recycling carbon tax revenues may lead to a double dividend of fostering the decarbonization transition while simultaneously promoting economic growth and social development (Combet et al. 2015; Grottera, William, and La Rovere 2016; La Rovere et al. 2017; Goulder 1995; Piana, 2011)". [Valentino Piana, Italy]	Taken into account, by adding the references in the list of references of the report. For this type of topics that is covered a very dense literature, we have to restrict to a few papers published in peer-reviewed economic journals, unless a contribution published in a book brings totally new insight.
10902	69	25	69	25	Market mechanisms like the Clean Development Mechanism (CDM) can be an important element of the toolbox to reach a 1.5°C target, There is ample literature to show that the CDM has massively mobilized mitigation in developing countries and reduced mitigation cost. I thus suggest to add the following text after line 24: "Market mechanisms for mitigation like the Clean Development Mechanism under the Kyoto Protocol are crucial to mobilize low cost mitigation (Castro and Michaelowa 2010). The CDM has been instrumental in mobilizing mitigation in developing countries, especially from renewable energy (see overview of CDM-related literature in Michaelowa 2015, Stavins et al. 2014, and specific country studies, e.g. for China: Lewis 2010). After initial teething troubles, the rulebook for determination of project additionality has been improved, so the mitigation contribution of projects became more robust (Michaelowa 2009). If demand of emission credits increased in the future, market mechanisms like the CDM could play an important role in reducing mitigation cost, thus leading to higer ambition and an increased likelihood to reach the 1.5°C target of the Paris Agreement (Bodnar et al. 2017)". References: Bodnar, Paul; Edwards, Rupert; Hoch, Stephan; McGlynn, Emily; Ott, Caroline; Wagner, Gernot (2017): Underwriting 1.5?C: Competitive Approaches to Financing Accelerated Climate Change Mitigation, in: Climate Policy, accepted Sep. 9, 2017, forthcoming; Castro, Paula; Michaelowa, Axel (2010): The impact of CER discounting on the competitiveness of different CDM host countries, in: Ecological Economics, 70, p. 34–42; Lewis, Joanna (2010): The evolving role of carbon finance in promoting renewable energy development in China, in: Energy Policy, 38, p. 2875–86; Michaelowa, Axel (2015): Opportunities for and Alternatives to Global Climate Regimes Post-Kyoto, in: Annual Review of Environment and Resources, 40, p. 395-418; Michaelowa, Axel (2009): Interpreting the additionality of CDM projects. Changes in additionality definitions and regulatory practices over time, in: Streck, Charlotte (ed.). Legal aspects of carbon trading, Oxford University Press, Oxford, United Kingdom, p. 248–271; Stavins, Robert, Zou Ji, Brewer, Thomas; Conte Grand, Mariana; den Elzen, Michel; Finus, Michael; Gupta, Joyeeta; Höhne, Niklas; Lee, Myung-Kun; Michaelowa, Axel; Paterson, Matthew; Ramakrishna, Krishnan; Wen Gang, Wiener, Jonathan; Winkler, Harald; Bodansky, Daniel; Chan, Gabriel ; Engels, Anita; Jaffe, Adam; Jakob, Michael Jayaraman, T.; Leiva, Jorge; Lessmann, Kai; Newell, Richard; Olmstead, Sheila; Pizer, William; Stowe, Robert; Vinluan, Marlene (2014): International Cooperation: Agreements and Instruments, in: Edenhofer, Ottmar; Pichs-Madruga, Ramon; Sokona, Youba; Farahani, Ellie; Kadner, Susanne; Seyboth, Kristin; Adler, Anna; Baum, Ina; Brunner, Steffen; Eickemeier, Patrick; Kriemann, Benjamin; Savolainen, Jussi; Schlömer, Steffen; von Stechow, Christoph; Zwickel, Tim; Minx, Jan (eds.): Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, p. 1001-1082 [Axel Michaelowa, Switzerland]	Taken into account - covered in section 4.4.8.2
18592	69	30	69	30	Greening et al. 2000; Sorrel et al. 2009 need Mendeley links [Wilfran Moufouma Okia, France]	Accepted, change made
18593	69	39	69	39	Lampin et al. 2013 needs a Mendeley links [Wilfran Moufouma Okia, France]	Accepted, change made
18594	69	45	69	45	Dreze and Stern 1990 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made
18595	69	47	69	47	Fell et al 2012; Wood et al 2011; Fuss et al 2017 need Mendeley links [Wilfran Moufouma Okia, France]	Accepted, change made

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7358	69	49	69	54	Reference to "inefficient" fossil fuels subsidies that encourage wasteful consumption by removing market distortions in accordance with national circumstances should be made. [Eleni Kaditi, Austria]	Accepted, change made
7924	69	50	69	51	Fossil fuel subsidies. In lieu of the removal of fossil fuel subsidies, there is an argument to be made that RE needs to be subsidized, as it is done in effect with RE fiscal and regulatory polices. [Westphal Michael, United States of America]	Taken into account - this point is made in many sections and chapters of the report
18596	69	54	69	54	Jakob et al. 2015; Zeng et al 2016 need Mendeley links [Wilfran Moufouma Okia, France]	Accepted, change made
17702	70	26	70	27	Regulation and standards have been effectively used in the transport sector, for light and heavy-duty vehicles by imposing efficiency requirements (e.g. miles/gallon or level of CO2 emission per km). This is incorrect. Only 4 countries are currently applying fuele conomy standards for heavy duty vehicles. [Pierpaolo Cazzola, France]	Accepted, change made
7359	70	41	70	42	Delete the text "to avoid the lock-in effect of new poorly performing buildings remaining in use for the next 50-100 years". [Eleni Kaditi, Austria]	Rejected - because this point is supported by literature
7925	70	44	70	45	Section 4.3.4 does not mention zero energy buildings at all. [Westphal Michael, United States of America]	Taken into account - this section will mention the zero energy buildings
1973	70	51	70	53	R and D research on nuclear power has almost always been carried out in public laboratories, with eventual support and participation of electricity companies. [Herve Nifenecker, France]	Accepted, change made.
13077	70	52	70	54	Actually, most of the subsidies goes to fossil fuels, this should be mentioned. Based on data from the OECD and IEA, in 2014, G20 countries provided over US$ 230 billion subsidies to coal, oil and gas. See Bast, E., Doukas, A., Pickard, S., van der Burg, L., Whitley, S. (2015): “Empty Promises. G20 subsidies to Oil, Gas and Coal Production.”, https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9958.pdf [Caserini Stefano, Italy]	taken into account - this remark is made earlier in the text
1001	71	7		8	Change "by energy saving resulting from efficiency improvements and/or energy conservation 'negawatts'" to "on energy saving resulting from efficiency improvements and/or energy conservation". [Stephen Wiel, United States of America]	Accepted, change made
7360	71	7	71	8	Delete the text "and/or energy conservation 'negawatts". [Eleni Kaditi, Austria]	taken into account - we will clarify, because we have to talk of negawatts because is a notion utilized in literature
7141	71	11	71	17	The vast majority of public-facing campaigns on energy and climate change have been delivered through mass-media channels, and advertising-based approaches (Corner & Randall, 2011; Doyle, 2011). However there is huge potential in more participatory approaches to public engagement, that are based on conversation and interaction, rather than ‘messaging’ and learning from other contentious societal issues such as HIV/Aids, GM crops or the MMR vaccine controversy in the UK supports the conclusion that 'broadcast' communications need to be accompanied by discursive approaches. Suggestion add to line 17: "evidence from other social issues suggests that longer-term results can be obtained through interpersonal or community-based initiatives" References: Petts, J. and Niemeyer, S. (2004). Health risk communication and amplification: learning from the MMR vaccination controversy. Health, Risk & Society, 6(1), pp.7-23., Mahoney, J. (2010). Strategic communication and anti-smoking campaigns. Public Communication Review 1, 33-48., Shaw, C & Corner, A. Using Narrative Workshops to socialise the climate debate: Lessons from two case studies – centre-right audiences and the Scottish public. Energy Research & Social Science Volume 31, September 2017, Pages 273-283 Corner, A. & Clarke, J. (2016). Talking Climate: From Research to Practice in Public Engagement. Oxford: Palgrave, [Jamie Clarke, United Kingdom (of Great Britain and Northern Ireland)]	taken into account - text will be modified
4700	71	28			Change "a, important" to "an important" [Radim Tolasz, Czech Republic]	editorial
9349	71	28	71	28	The extra punctuation in the phrase "make a, important" may be deleted [Siir KILKIS, Turkey]	editorial
13078	71	28	71	31	A reference is needed to support the statement that voluntary actions could make an important contribution" to 1.5°C target. There is a huge gap between many commitments and actual actions implemented, [Caserini Stefano, Italy]	accepted - we will quote published literature on this point
9350	71	30	71	31	The important statement on "Mayors in the EU and the US, where many cities have committed to long-term targets of 60% to 80% emissions reductions, some becoming carbon-neutral by 2050 (Kona et al. 2017)" may be supported by additional information. For example, "Signatories to the Covenant of Mayors initiative have already achieved an overall reduction of 23% in CO2 emissions from baseline years. Such a reduction received the greatest contribution from the building sector" may be indicated based on "Kona, A., Melica, G., Koffi, B., Iancu, A., Zancanella, P., Calvete, S., Bertoldi, P., Janssens- Maenhout, G., Monforti-Ferrario, F., Covenant of Mayors: Greenhouse Gas Emissions Achievements and Projections, JRC Science for Policy Report 2016, EUR 28155 EN, 2016." In addition, The climate neutrality target of Copenhagen has been analyzed in a recent publication by "Tue Damsø*, Tyge Kjær, Thomas Budde Christensen, Implementation of local climate action plans: Copenhagen - Towards a carbon-neutral capital, Journal of Cleaner Production 167 (2017) 406-415 <http://dx.doi.org/10.1016/j.jclepro.2017.08.156>" This reference will be useful to support related statements on climate neutrality targets in cities in which Copenhagen aims to be climate neutral by the year 2025. Furthermore, the Global Covenant of Mayors for Climate and Energy should be represented in the text based on the global framework for climate action by cities <http://www.globalcovenantofmayors.org/> [Siir KILKIS, Turkey]	Accepted - we will insert some of the material suggested here
18597	71	34	71	34	Lecuyer and Quirion 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made.
3095	71	42	71	42	do NOT have the … [Christopher Bataille, Canada]	editorial
4758	71	42	71	42	It seems that the author means "France, but do not yet have the volume". [Valentino Piana, Italy]	Editorial
18598	71	42	71	42	Shukla et al (2017) needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made.
3096	71	43	71	43	reference for Shukla et al 2017 is missing, could not find anything on Google Scholar [Christopher Bataille, Canada]	Editorial; has been corrected.
18387	71	43	71	43	Shukla et al. (2017) not linked to Mendeley. Also, TSU needs the status of this reference - in press, submitted? [Wilfran Moufouma Okia, France]	Accepted, change made.
781	71	44	71	44	article 108 should be Article 108 [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	accepted - we will correct it
4759	71	44	71	44	The Paris Agreement does not have an article 108. May you be quoting the CP.1 Decision to which the Agreement is annexed? [Valentino Piana, Italy]	accepted - we will correct it
5610	71	44	71	44	There is no article 108 in the Paris Agreement [YUJI MIZUNO, Japan]	accepted - we will correct it
17307	71	44	71	45	the reference should be to paragraph 108 of decision 1/CP.21, not to article 108 of the PA [Christian Holz, Canada]	accepted - we will correct it
3097	71	50	71	50	werid comma placement again [Christopher Bataille, Canada]	editorial
18599	71	52	71	52	Paris Agreement, Art. 2 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made.
18600	71	53	71	53	Laffont and Tirole, 1993 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, change made.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
956	72	3	73	12	Box 4.10 focuses on the concept of peak car in emerging cities. My comments above are valid for this section. Most of the content is based on work that has not been published in a peer-reviewed journal. Figure 1 shows that private vehicles accounted for approximately 30% of daily trips in Beijing between 2005 and 2014. This might be a sign of a plateau that is related to the introduction of new transit options and congestion, however, I would not feel comfortable claiming that it is a peak phenomenon as there are other studies that discuss large increases in automobile ownership within China. Using data for the end of 2015, Li and Zhao (2017) report a 137% increase in the number of private cars based on the 2010 level. Wang et al (2017) also found a large increase in plug-in electric vehicles. Rather than focusing on peak car, I would recommend that this box focus on the success of mass transit options within China and other countries. Here are the papers I refer to: Li, S., & Zhao, P. (2017). Exploring car ownership and car use in neighborhoods near metro stations in Beijing: Does the neighborhood built environment matter?. Transportation Research Part D: Transport and Environment, 56, 1-17; Wang, Y., Sperling, D., Tal, G., & Fang, H. (2017). China's electric car surge. Energy Policy, 102, 486-490. [Thomas Longden, Australia]	Rejected - the idea of the box is to demonstrate that emerging cities can manage the growth of car use which is the important parameter for GHG mitigation, rather than car ownership. The idea of changing a Box to cover all trends in transit is not going to work as Boxes are for specific case studies that reveal an important trend or process. The main text shows that car ownership is rising.
14137	72	4	72	4	Define peak car [Elvira Poloczanska, Germany]	Rejected - the text already defines it as 'decreasing per capita car use'
7361	72	4	72	9	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 (Millard? Ball and Schipper 2011; Goodwin and Van Dender 2013; 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 [ref]". [Eleni Kaditi, Austria]	Rejected - because this point is supported by literature
18601	72	17	72	17	Move "Gao et al" into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted - paper has been accepted for journal of Urban Planning
782	72	18	72	23	Justified centre. It should be left justified [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - formatting easily corrected.
1378	73	14	75	5	The writing practice of putting a paragraph for each project can create disorder in the argumental lines, instead I would suggest to cite the projects in a topic-wise narrative based on the knowledge that these interesting projects provide. [Roger Cremades, Germany]	Accepted - the project output has now been aligned with the storyline, which makes for a better flow, indeed. Thanks.
19760	73	15	67	15	Box 4.11 : deep decarbonisation strategies must be designed with equity and human rights in mind if they are to secure broadbased buy in and if they are to be effective in their implementation. [Tara Shine, Ireland]	Noted - however, the box can only assess the cases published in the literature, which do not cover the human rights dimension in this case, although nobody would disagree that human rights are important.
3098	73	26	73	26	Reference for Bataille et al. 2016 missing from the reference list. There are two: the first is a special issue editorial, the second a synthesis article - I suspect the reference is for the latter synthesis article. Bataille, C., H. Waisman, M. Colombier, L. Segafredo, and J. Williams (2016) The need for national deep decarbonization pathways for effective climate policy, Climate Policy, 16:sup1, S1-S6. DOI: 10.1080/14693062.2016.1179620. 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: http://dx.doi.org/10.1080/14693062.2016.1173005 [Christopher Bataille, Canada]	Taken into account - the other article was meant and the reference list has been updated accordingly.
18603	73	26	73	26	Bataille et al. (2016) needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18604	73	28	73	28	DDPP Network 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18605	73	32	73	32	Pahle et al. (under review) needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18606	74	1	74	1	Shukla et al., 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
3099	74	6	74	6	Reference for Bataille et al 2015 missing from reference list. "Bataille, C., Sawyer, D. & Melton, N. Pathways to deep decarbonization in Canada. The Deep Decarbonization Pathways Project: www.deepdecarbonization.org (2015). Available at: http://deepdecarbonization.org/wp-content/uploads/2015/09/DDPP_CAN.pdf." [Christopher Bataille, Canada]	Editorial.
18607	74	6	74	6	Bataille et al. 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18608	74	12	74	12	Spencer under review needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18609	74	17	74	17	Pahle et al. under review needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18610	74	21	74	21	Waisman et al. 2012 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
3100	74	22	74	22	A reference for Altieri et al 2016 is missing. Katye E. Altieri, Hilton Trollip, Tara Caetano, Alison Hughes, Bruno Merven & Harald Winkler (2016) Achieving development and mitigation objectives through a decarbonization development pathway in South Africa, Climate Policy, 16:sup1, S78-S91, DOI: 10.1080/14693062.2016.1150250 [Christopher Bataille, Canada]	Editorial.
18611	74	22	74	22	Altieri et al, 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18612	74	23	74	23	La Rovere et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
20836	74	25	74	27	This sentence appears to be incomplete [Alison Smith, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - "But" changed to "However"
3101	74	27	74	27	Reference missing for Oshiro, K., Kainuma, M., & Masui, T. (2016). Assessing decarbonisation pathways and their implications for energy security policies in Japan. Climate Policy 16(sup1) .doi: 10.1080/14693062.2016.1155042 [Christopher Bataille, Canada]	Editorial, has been corrected.
18613	74	27	74	27	Oshiro et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
3102	74	32	74	32	Reference missing for 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]	Editorial, has been corrected.
18614	74	32	74	32	Mathy et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
4223	74	32	74	34	Note that the phasing out of nuclear in Germany has resulted in an increase in using coal power plants and thus an increase in the CO2 emissions. This article by the Institute for Energy Research notes the problems with intermittent renewable energy and the building of new coal fired power plants to provide electricity in Germany. http://instituteforenergyresearch.org/analysis/france-germany-turn-coal/ Of interest might also be the consequences of nuclear phase out and replacing nuclear power plants with coal, see for example a study published in Nature Energy examining the substitution of nuclear power with coal in the USA and possible subsequent health impact among the population: https://www.nature.com/articles/nenergy201751 [Jessica Callen, Austria]	Noted - however, the German Energy Transition is only serving as an example here for sustaining a policy despite changing objectives. No claim is made with respect to the cost of the policy or its success in reducing emissions.
18837	74	32	74	36	it is surprising to see Germany taken as an example, given the complete failure of the Energiewende, since both the nuclear and fossil energy phase out have stalled far from completion. Nuclear power is still used in Germany, because closing the remaining 9.6 GW of nuclear power plants would create a CO2 emission jump of over 20 million tons of CO2 per year. Furthermore, emissions have not been decreasing for the past 5 years. Therefore, taking Germany as an example is both a misrepresentation of reality, and a factor of risk for misled policy makers. In fact, Germany's flexibility to adjust to new objectives is just hiding the fact that renewable subsidies are not helpful for deep decarbonation pathways. in fact, experience shows that reducing GHG emissions in industrialized countries requires aggressive CO2/GHG pricing (because Exchange and Trading Systems are much too slow or can be blocked by governments). [Stephan Savarese, France]	Noted - however, the German Energy Transition is only serving as an example here for sustaining a policy despite changing objectives. No claim is made with respect to the cost of the policy or its success in reducing emissions.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1974	74	32	74	36	It is already apparent that the German transition has severe difficulties since the very expansive development of intermittent renewable electricity has not resulted in a significant reduction of CO2 emissions. In 2007 the ratio CO2/TPES was 2.36 tCO2/toe for Germany (1.41 for France) while in 2016 the ratio of CO2/TPES was unchanged at 2.36 tCO2/toe for Germany,while that of France decreased to 1.18. Using the indicator CO2/pop the 2007 value was 9.87 for Germany and 6.19 for France while, for 2016, it was 8.93 tCO2/pop for Germany and 4.32 for France. The decrease was 9% for Germany and 30% for France [Herve Nifenecker, France]	Noted - however, the German Energy Transition is only serving as an example here for sustaining a policy despite changing objectives. No claim is made with respect to the cost of the policy or its success in reducing emissions.
14295	74	33	74	33	If the claim is being made that 'renewable energy' has made, or even will make, Germany's GHG emissions go down, that needs to be cited. I don't believe that they've actually reduced their emissions in any real way. [Jason Donev, Canada]	Noted - however, the German Energy Transition is only serving as an example here for sustaining a policy despite changing objectives. No claim is made with respect to the cost of the policy or its success in reducing emissions.
18615	74	40	74	40	Silveira and Johnson 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18616	74	43	74	43	Pahle et al. under review needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
3103	74	45	74	45	concern, not "concerns" [Christopher Bataille, Canada]	Editorial
18617	74	49	74	49	Koch et al. 2014, 2016. Hoch 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
11186	74	50	75	4	The OECD "Investing in climate, investing in growth" report could be cited here, with their findings that investing in climate resilient growth would only add 10% onto infrastructure investment needs over the next 15 years. [Michiel Schaeffer, Netherlands]	Noted - however, we cannot cite non-peer-reviewed literature here.
11187	74	50	75	4	Some parts of this finance section are difficult for a non-finance expert to understand. e.g. "the notion of incremenental costs is not relevant in a below 2deg world because the first priority is to reduce the funding gap for low-carbon, climate resilient infrastructures in many developing countries". [Michiel Schaeffer, Netherlands]	Rejected - could not find this sentence
5613	74	53			The report should mention as lessons of market mechanisms stated in the Study prepared for DG LIMA of European Comissions, https://ec.europa.eu/clima/sites/clima/files/ets/docs/clean_dev_mechanism_en.pdf. That is the CDM still has fundamental flaws in terms of overall environmental integrity. [YUJI MIZUNO, Japan]	Noted - however, we cannot cite non-peer-reviewed literature here.
18618	74	54	74	54	Pahle et al. under review needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
17531	75		75		Needs broader discussion of enabling environments and their role in directing, attracting, or impeding capital flows. For instance, the ExecSum highlights the potential role of public guarantees, without a discussion of the different nature of underlying risk, of which political and regulatory risks are a significant factor, and recognition that addressing the root cause of some of these risks (e.g., FC risk) would reduce the need for public guarantees and insurance and thus also be a potential way forward. [Farhan Akhtar, United States of America]	Taken into account
9292	75	8			Cite: Schwarze, R., Meyer, P. B., Markandya, A., Kedia, S., Maleki, D., Román de Lara, M. V., Sudo, T., and Surminski, S. (2018). Economics, finance, and the private sector. In C. Rosenzweig, W. Solecki, P. Romero-Lankao, S. Mehrotra, S. Dhakal, and S. Ali Ibrahim (eds.), Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network. Cambridge University Press. In Press. [Cynthia Rosenzweig, United States of America]	Taken into account below in the text
18777	75	8			Entire chapter "climate finance": the chapter misses out almost completely on aspects related to the UN climate finance architecture and related discussions to generate financial revenues to assist climate action (in particular in developing countries) at the scale of hundreds of billions, which could be a significant element in accelerating the required transition. The chapter could e.g. quote and discuss reports which investigated the potential revenues that could be raised through instruments such as levies from international aviation and maritime transport, carbon major's levy etc., see e.g.: Durand, A et al., 2016: Financing Options for Loss and Damage: a Review and Roadmap; or others [Sven Harmeling, Germany]	Taken into account
19761	75	8	67	15	Section on Climate Finance : Development requires energy but not carbon emissions. the right to development of people in developing countries requires that they have access to alternative sources of energy to develop and lift themselves out of poverty. it is unreasonable to expect developing countries to reduce emissions on their own at an equivalent stage of development to when rich countries were drastically increasing theirs. the only feasible way to achieve this is through the provision of support, both financial and technological, from those countries with greatest capacity. Only with this support will the phase out be achieved on a timescale which avoids dangerous climate change. From Zero Carbon, Zero Poverty the Climate Justice way. Mary Robinson Foundatilon Climate Justice. [Tara Shine, Ireland]	Taken into account - We will make sure this is adequately discussed while writing in the next iteration to reinforce the point
17528	75	10	75	19	Would be helpful to point out that these challenges are not novel to climate finance, and indeed many of the issues and literature raised pre-date and extend well beyond what we now call "climate finance." Could usefully discuss the abundance of capital held by long-term, institutional investors that can also play a role in longer-term investment. [Farhan Akhtar, United States of America]	Taken into account - We will make sure this is adequately discussed while writing in the next iteration to reinforce the point
15041	75	10	75	19	Unclear what bias is being referred to here. [Farhan Akhtar, United States of America]	Taken into account - we will explain better
1921	75	10	78	33	In generally I miss a subsection or paragraph on how to account for the 1.5 degrees target in public decision making and project appraisal, e.g. in cost-benefit analysis on public infrastructure investments. Among other I would suggest to highlight the following points: (i) Higher figures for marginal abatement cost in social CBA, (ii) limited substitutability and the need for dual discounting (e.g. Drupp 2016), (iii) account for the distribution of the increased abatement cost over income groups, e.g. through distributional weights (Adler 2016; Fleurbaey and Abi-Rafeh 2016) or direct adjustment of willingness to pay (Baumgärtner et al. 2017). References: Adler, M.D. (2016). Benefit–cost analysis and distributional weights: An overview. Review of Environmental Economics and Policy, 10(2), 264-285. Baumgärtner, S., Drupp, M.A., Munz, J.M., Meya, J.N., Quaas, M.F. (2017): Income inequality and willingness to pay for environmental public goods. Journal of Environmental Economics and Management, 85: 35–61. Drupp, M.A. (2016). Limits to Substitution between Ecosystem Services and Manufactured Goods and Implications for Social Discounting, Environmental and Resource Economics, forthcoming. Fleurbaey, M. and Abi-Rafeh, R. (2016). The use of distributional weights in benefit–cost analysis: Insights from welfare economics. Review of Environmental Economics and Policy, 10(2), 286-307. [Jasper Meya, Germany]	Taken into account but in other section of the chapter 4 and in chapter 2
3104	75	17	75	17	comma again after therefore [Christopher Bataille, Canada]	Editorial
17529	75	23	75	36	Should bring in baseline comparisons, which would show that while projected costs of global infrastructure are very large, incremental costs of making this infrastructure compatible with 2deg pathway are relatively small. For instance, the work by the New Climate Economy and OECD. [Farhan Akhtar, United States of America]	Taken into account. We will clarify which infrastructures are taken into account in this assessment and make a clear distinction between additional investments and redirected investments. We will do that in a technical box in the last version of the report to put some order in a many assessment that are currently circulated
4701	75	24			Use US$ curency format [Radim Tolasz, Czech Republic]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
20325	75	24	75	24	Which sectors are included under "infrastructure"? [Marine Gorner, France]	Taken into account. We will clarify which infrastructures are taken into account in this assessment and make a clear distinction between additional investments and redirected investments. We will do that in a technical box in the last version of the report to put some order in a many assessment that are currently circulated
2758	75	24	75	26	These figures do not appear to include the necessary adaptation costs - it would be important to include these. [Penny Urquhart, South Africa]	Taken into account - final report
18787	75	25	75	26	The reference to the report by the Global Commission on Economy & Climate, Better Growth, Better Climate, miscontrues the findings. The report finds that approx. $90 trillion in infrastructure spending is needed globally from 2015-2030, but that is not specifically low-carbon investment. It calculates that only an additional $4 trillion is required to make those infrastructure investments compatible with low-carbon pathways, even before accounting for savings from fossil fuel-use reduction (see, for example, page 39 of the 'global report' version of the report). [David Waskow, United States of America]	Taken into account. We will clarify which infrastructures are taken into account in this assessment and make a clear distinction between additional investments and redirected investments. We will do that in a technical box in the last version of the report to put some order in a many assessment that are currently circulated
18820	75	25	75	26	The reference to the report by the Global Commission on Economy & Climate, Better Growth, Better Climate, miscontrues the findings. The report finds that approx. $90 trillion in infrastructure spending is needed globally from 2015-2030, but that is not specifically low-carbon investment. It calculates that only an additional $4 trillion is required to make those infrastructure investments compatible with low-carbon pathways, even before accounting for savings from fossil fuel-use reduction (see, for example, page 39 of the 'global report' version of the report). [David Waskow, United States of America]	Taken into account. We will clarify which infrastructures are taken into account in this assessment and make a clear distinction between additional investments and redirected investments. We will do that in a technical box in the last version of the report to put some order in a many assessment that are currently circulated
4702	75	26			Use US$ curency format [Radim Tolasz, Czech Republic]	Accepted
4703	75	28			Use US$ curency format [Radim Tolasz, Czech Republic]	Accepted
18619	75	28	75	28	Wolf et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
4704	75	32			Use US$ curency format [Radim Tolasz, Czech Republic]	Accepted
4705	75	33			Use US$ curency format [Radim Tolasz, Czech Republic]	Accepted
1920	75	40	75	40	these figures: the reference could be more clear [Jasper Meya, Germany]	Taken into account
16447	75	50	75	50	I don't understand--climate models do not estimate financial flows. What does this sentence mean? If referring to integrated assessment models, say so, and make clear that these are no climate mocels (though they may have a climate change component). [Michael MacCracken, United States of America]	Accepted - we will correct it
17241	75	50	75	50	insert 'be' between 'to' and 'significant' to make it 'seem to be significant' [Himangana Gupta, India]	Editorial
9351	75	50	75	50	There is a missing word "be" in the phrase "seem to (be) more significant" [Siir KILKIS, Turkey]	Editorial
3105	75	50	75	52	than instead of "that". Climate models are not a great source of investment requirements; do you mean the IAMs with simple climate models in them? Please clarify first two sentences; these are important "up-front investment costs are 1.9-3.2-fold higher than estimates relying on levelized costs "????. [Christopher Bataille, Canada]	Taken into account - we will rewrite
3106	75	50	76	4	Whole paragraph needs more context and elaborate. If the media got a hold of this as is it would be extremely easy to misinterpret. [Christopher Bataille, Canada]	Taken into account - we will rewrite
18620	75	54	75	54	Move "Aglietta et al." into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted
17530	76	1	76	10	Not clear why notion of incremental "costs" are irrelevant in a below 2deg scenario. Could be clarified/tested further. [Farhan Akhtar, United States of America]	Accepted - there was totally unclear sentence
5236	76	12	77	31	On de-resiking low carbon investments, the following references may be useful to this report: Dafermos Y, Nikolaidi M, Galanis G (2017) A stock-flow-fund ecological macroeconomic model. Ecol Econ 131:191–207. doi: 10.1016/j.ecolecon.2016.08.013 Pollitt H, Mercure J-F (2017) The role of money and the financial sector in energy-economy models used for assessing climate and energy policy. Clim Policy 0:1–14. doi: 10.1080/14693062.2016.1277685 Polzin F (2017) Mobilizing private finance for low-carbon innovation – A systematic review of barriers and solutions. Renew Sustain Energy Rev 77:525–535. doi: 10.1016/j.rser.2017.04.007 [Bianka SHOAi-TEHRANI, Japan]	Taken into account
3107	76	13	76	13	attention to [Christopher Bataille, Canada]	Editorial
18621	76	21	76	21	Move "UNEP-Inquiry" into grey shaded Mendeley field with "2017" [Wilfran Moufouma Okia, France]	Accepted
18622	76	21	76	21	G20 Green Finance Study Group and the Financial Stability Board (2015) needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18623	76	23	76	23	Article 173 in its 2015 Energy Transition Law needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18377	76	36	76	36	Kelly and Reynolds - Does this refer to the Unhedgeable Risk report by University of Cambridge CISL [Wilfran Moufouma Okia, France]	Accepted - we will include the reference
10257	76	39	76	43	Ethnical investment, that has been around for a decade, offers one path. [Mendas Zrinka, United Kingdom (of Great Britain and Northern Ireland)]	Accepted - we will address
7362	76	39	76	43	Delete the text "The voluntary disclosure approach may be a first step to encourage financial actors to stop investing in fossil fuels (Ayling and Gunningham 2017; Platinga and Scholtens 2016). In the absence of structural incentives, asset managers might not resist the attractiveness of carbon-intensive investments in many regions. Decarbonizing an investment portfolio is not synonymous with investing in a low-carbon development path.". [Eleni Kaditi, Austria]	Rejected - because this is under discussion. In the SOD, we will address more directly the question of stranded assets and how financial devices can handle that for activities, regions and countries that are carbon-intensive.
7926	76	47	76	49	Climate finance leverage ratios. It would be good to cite more recent literature. The leverage ratios may be too high for climate finance at least. See the latest MDB Joint Report on Climate Finance (2016). MDBs committed US$ 27.4B in climate finance in 2016. Private sector co-finance was $15.7B. [Westphal Michael, United States of America]	Taken into account - Thank you for the reference
18624	76	51	76	51	In-text citation for Berle and Means; Roe 2001 has two uncited references also linked (Jakob; Xiong) [Wilfran Moufouma Okia, France]	Accepted
18625	76	53	76	53	Aglietta 2015; Froud et al. 2000 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
7927	77		78		The implicit focus of this section is on international finance, but domestic finance is even more important. See Climate Policy Initiative's Global Landscape of Climate Finance. In the 2015 report, about 74% of total climate finance flows, and up to 92% of private investments were raised and spent within the same country. This section needs to have more on domestic resource mobilization, particularly in the developing world. And there is nothing about urban finance and issues around lack of creditworthiness that constrains cities in the developing world. Potential financial instruments at the city-level for low carbon, climate-resilient development such as land value capture could be mentioned. [Westphal Michael, United States of America]	Accepted, very good point. We will place more attention on articulation between domestic and international finance. James will give some text on adaptation.
18626	77	9	77	9	La Rovere et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18627	77	13	77	13	Studar & Gallagher, 2015; Emin et al. need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18378	77	13	77	13	TSU needs a copy of the De Gouvello and Zelenko reference - hard to find [Wilfran Moufouma Okia, France]	Accepted

Comment No	From Page	From Line	To Page	To Line	Comment	Response
17532	77	14	77	15	Is this referring to MRV systems around mitigation outcomes (e.g., CO2eq avoided)? If so, it seems to place an undue emphasis on the impact that these systems have in reducing underlying regulatory, technology, and governance risk that guarantees and insurance are typically meant to hedge against. [Farhan Akhtar, United States of America]	Accepted - will do
18628	77	18	77	18	Move "Hirth and Steckel (2016)" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Accepted
7363	77	29	77	31	Delete the text "which may need overseas development assistance, innovative removal of fossil fuel subsidies (Jakob 2016) and introduction of carbon taxes (Jakob 2016)". [Eleni Kaditi, Austria]	Rejected - We don't understand why we should delete text about overseas assistance.
18629	77	30	77	30	Jakob 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18630	77	31	77	31	Jakob 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
19762	77	34	67	15	Section on public commitments : needs to address the role of ODA. For an assesment of the role of development and climate finance in supporting climate action in developing countries see Shine, T. & Campillo, G. (2016) The Role of Development Finance in Climate Action Post-2015. OECD DAC working paper. Online at http://www.oecd-ilibrary.org/docserver/download/18a859bf-en.pdf?expires=1506093646&id=id&accname=guest&checksum=608F1EC8B8DF365308420A5AE1F7BA51 [Tara Shine, Ireland]	Taken into account - This paper will be put in the references
7364	77	48	77	48	Delete the text "including the increase of their domestic carbon prices". [Eleni Kaditi, Austria]	Taken into account - we will amend at the margin the text but we cannot delete because we have supporting literature. Although Article 136 of Paris Agreement puts carbon prices outside the negotiation process, it flags its importance as a domestic policy. Cf. at 136 of Paris agreement
18631	77	48	77	48	Edenhofer et al. 2015; Stern-Stiglitz 2017 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18632	77	53	77	53	Venables 2016; Ross 2015 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18633	78	5	78	5	Cartwright 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18634	78	15	78	15	Annicchiarico and Di Dio, 2015; Annicchiarico and Di Dio, 2016 Nikiforos and Zezza 2017 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18635	78	19	78	19	Rozengerg et al., 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18636	78	20	78	20	Sirkis 2015; Stua 2017 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18637	78	23	78	23	NCE 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18638	78	23	78	23	GCED 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18639	78	24	78	24	Pollitt and Mercure, 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
18640	78	25	78	25	IMF, 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
7365	78	26	78	28	Delete the text "This could, if managed appropriately, assist managing the dangerous waters between stranded assets and green financial bubbles (Safarzynska and Van den Bergh, 2017)". [Eleni Kaditi, Austria]	Taken into account - We will adapt the wording
18641	78	28	78	28	Safarzynskya and Van den Bergh, 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
2636	78	30	78	33	is there any literature on aligning the SDGs with 1.5 deg instead which can be reviewed here? [Zoha Shawoo, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account - we will search for literature published on this
18642	78	33	78	33	Rajan 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted
9293	78	36	78	48	Cite: Rosenzweig et al., 2015 [Cynthia Rosenzweig, United States of America]	Reject. The reviewer does not argue why, nor does she give a complete reference. Moreover, generally the knowledge gaps sections in IPCC reports are based on the chapter and the literature cited therein, not on new literature.
7684	78	36	80	11	My previous comments on Ch 4 indicate important knowledge gaps summarized in Lovins (2017, 2018) but not mentioned, notably designing energy efficiency in all sectors for expanding not diminishing returns, more than doubling its potential while reducing its cost; modern grid integration (Lovins & RMI 2011 and dozens of studies in a dozen-page summary, being submitted to El.J. and available on request from amory@rmi.org); and integrated mobility reforms (Lovins 2018, ERI 2017, and India Leaps Ahead (cited in my comment on p 4-28). [Amory Lovins, United States of America]	Noted. Section 4.5.1 indicates knowledge gaps in addressing the "how" of realising energy efficiency. But this could be expanded further.
7685	78	36	80	11	A 22 Sep 2017 Policy Forum by Geels et al. (Science 357(6357):1242–1244) provides an important synthesis of sociotechnical with other tools and perspectives needed for deep decarbonization, and merits discussion here. [Amory Lovins, United States of America]	Taken into account. We refer to Geels et al in the same volume (not a Policy Forum piece) in other sections related to socio-technical transitions. We generally don't refer to literature in the Knowledge Gaps section as it's based on the chapter.
7831	78	36	80	11	My previous comments on Ch 4 indicate important knowledge gaps summarized in Lovins (2017, 2018) but not mentioned, notably designing energy efficiency in all sectors for expanding not diminishing returns, more than doubling its potential while reducing its cost; modern grid integration (Lovins & RMI 2011 and dozens of studies in a dozen-page summary, being submitted to El.J. and available on request from amory@rmi.org); and integrated mobility reforms (Lovins 2018, ERI 2017, and India Leaps Ahead (cited in my comment on p 4-28). [Amory Lovins, United States of America]	Noted. Section 4.5.1 indicates knowledge gaps in addressing the "how" of realising energy efficiency. But this could be expanded further.
7832	78	36	80	11	A 22 Sep 2017 Policy Forum by Geels et al. (Science 357(6357):1242–1244) provides an important synthesis of sociotechnical with other tools and perspectives needed for deep decarbonization, and merits discussion here. [Amory Lovins, United States of America]	Taken into account. We refer to Geels et al in the same volume (not a Policy Forum piece) in other sections related to socio-technical transitions. We generally don't refer to literature in the Knowledge Gaps section as it's based on the chapter.
20664	78	36	81	15	The authors can consider aligning the information in this subsection with the four pathway types introduced in chapter 1. that would be especially helpful to draw out the knowns and unknowns, uncertainties that give more nuance to the pathway options. This would serve the reader well and increase the clarity of the narrative of chapter 4 and the overall report. [Koko Warner, Germany]	See response to comment 20662
10563	78	36	81	28	This section is fundamental to the report, but it looks incomplete and fragmented. You need to consolidate it better. [Jose Antonio Puppim de Oliveira, Brazil]	Accept. Next version will be more concise and focussed.
11171	78	38			Research into integrated systems with RE and NETs (e.g. combination of DAC with renewable energy generation and electrified transport / smart grids) is needed. [Michiel Schaeffer, Netherlands]	Accepted - this has been added to the text.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
7686	78	38	80	11	Lovins (2017, 2018) sketches a thought-experiment, in course of submission to Science, that this section could usefully reflect: two exceptionally detailed, rigorous, and empirically grounded syntheses—the on-track US (Lovins & RMI 2011) and officially adopted Chinese (ERI 2017) Reinventing Fire studies, both summarized in my comments on Ch 4's 5:14–5:19—plus an analogous EU study (European Climate Foundation 2010), can be extrapolated to the world by using the US as a surrogate for other non-EU OECD countries and China for non-OECD countries. Prorating on those categories' IEA-projected GDPs (extended from 2040 to 2050) then suggests the world could achieve a ~2 C? global climate trajectory, providing the same energy services as business-as-usual, at a ~$18 trillion lower net present value private internal cost. Partial reinvestment in natural-systems carbon removal—biologically informed farming, forestry, grazing, wetlands and rainforest management, etc. (e.g. Griscom et al. 2017, Abramczik et al. 2017)—could then probably achieve a ~1.5 C? trajectory, still with trillions of dollars left over. Of course, this global extrapolation could be conservative or unconservative in different countries, especially with regard to potential adoption lags in some and the accelerating pace of renewable power adoption in many (e.g. Creutig et al. 2017). But though speculative at the global scale, the analytic basis is sufficiently solid and aligned with actual progress for half the world that the global extrapolation offers both hope and a worthy direction to consider. Lovins (2017) points out that though these analyses do not use complex models except for simulating power-grid integration (where they used the best available models), their simpler engineering/economic methodologies have shown superior predictive power both over the past 40 years and since these specific US and Chinese Reinventing Fire studies were published. [Amory Lovins, United States of America]	Noted - but beyond the scope of this section and not clear whether the expected submission might be in the scope of e.g. 4.4.6.
7833	78	38	80	11	Lovins (2017, 2018) sketches a thought-experiment, in course of submission to Science, that this section could usefully reflect: two exceptionally detailed, rigorous, and empirically grounded syntheses—the on-track US (Lovins & RMI 2011) and officially adopted Chinese (ERI 2017) Reinventing Fire studies, both summarized in my comments on Ch 4's 5:14–5:19—plus an analogous EU study (European Climate Foundation 2010), can be extrapolated to the world by using the US as a surrogate for other non-EU OECD countries and China for non-OECD countries. Prorating on those categories' IEA-projected GDPs (extended from 2040 to 2050) then suggests the world could achieve a ~2 C? global climate trajectory, providing the same energy services as business-as-usual, at a ~$18 trillion lower net present value private internal cost. Partial reinvestment in natural-systems carbon removal—biologically informed farming, forestry, grazing, wetlands and rainforest management, etc. (e.g. Griscom et al. 2017, Abramczik et al. 2017)—could then probably achieve a ~1.5 C? trajectory, still with trillions of dollars left over. Of course, this global extrapolation could be conservative or unconservative in different countries, especially with regard to potential adoption lags in some and the accelerating pace of renewable power adoption in many (e.g. Creutig et al. 2017). But though speculative at the global scale, the analytic basis is sufficiently solid and aligned with actual progress for half the world that the global extrapolation offers both hope and a worthy direction to consider. Lovins (2017) points out that though these analyses do not use complex models except for simulating power-grid integration (where they used the best available models), their simpler engineering/economic methodologies have shown superior predictive power both over the past 40 years and since these specific US and Chinese Reinventing Fire studies were published. [Amory Lovins, United States of America]	Noted - but beyond the scope of this section and not clear whether the expected submission might be in the scope of e.g. 4.4.6.
9352	79	2	79	2	There is a missing word "of" in the phrase "that will not allow any sort (of) meaningful" [Siir KILKIS, Turkey]	Accepted - this has been added to the text.
7687	79	2	79	3	missing words [Amory Lovins, United States of America]	Accepted - missing word added
7834	79	2	79	3	missing words [Amory Lovins, United States of America]	Accepted - missing word added
19763	79	5	79	8	Agree and analysis is needed of the human rights impacts of adaptation actions as well as reference here to the value of rights based approaches to adaptation. [Tara Shine, Ireland]	Noted - but beyond the scope of chapter 4. Human rights as part of equity is discussed in chapter 5.
14138	79	10	79	10	Worth reiterating what the three main systems are [Elvira Poloczanska, Germany]	Accepted - "energy, land and urban" has been added to the sentence in parentheses.
15047	79	15	79	16	Climate justice does not have an agreed upon meaning, and as I have noted elsewhere in these comments, it should not be included within the scope of IPCC products. [Farhan Akhtar, United States of America]	Noted - as it is beyond the scope of this section to open this debate, this sentence has been rephrased to say more clearly what exactly is missing from the literature.
19764	79	15	79	20	There is an emerging literature on climate justice that can be called on here. See for example Shue, H. Climate Justice 2014. Oxford University press and Rosner, D. & Seidel, C. (2017) Climate Justice. [Tara Shine, Ireland]	Noted - but beyond the scope of this section
19765	79	15	79	20	Further work is needed on assessing the differential impacts of 1.5. and 2 degrees from the perspective of rights. This should be flagged an an important area for future work. [Tara Shine, Ireland]	Noted - but beyond the scope of chapter 4
6591	79	16	79	16	About the possibiity of a new urban science. This is in fact part of the ambition of the emerging global systems science, in which such possible new 'urban systems science' would be but only part of the 'systems of global systems' which characterise the contemporary world. GSS can be understood as the science to look for interlinked global solution to global problems (www.gsdp.eu/about/global-systems-science/) [J. David Tabara, Spain]	Noted - but beyond the scope of this section to assess new science branches.
9353	79	16	79	17	The statement "Furthermore, the possibility of a new city/urban science that bridges disciplinary boundaries and practices a mix of approaches to create an evidence base for action should be explored" may be supported by additional statements on composite indicators. Composite indicators are suitable for combining multiple indicators to benchmark more than one entry in a common framework with numerous other entries and are suitable to support the "science of cities." The Expert Reviewer proposes the insertion of a new information Box on composite indicators in support of a science of cities. Examples include the Sustainable Development of Energy, Water and Environment Systems (SDEWES) Index. References for the SDEWES Index include K?lk??, ?. Composite index for benchmarking local energy systems of Mediterranean port cities, Energy 92 (2015) 622-638 <http://dx.doi.org/10.1016/j.energy.2015.06.093> ; K?lk?s, S., Sustainable development of energy, water and environment systems index for Southeast European cities, Journal of Cleaner Production 130 (2016) 222-234 <http://dx.doi.org/10.1016/j.jclepro.2015.07.121> ; K?lk??, ?., Sustainable Development of Energy, Water and Environment Systems (SDEWES) Index for policy learning in cities, Int. J. Innovation and Sustainable Development (Article in Press) ; K?lk??, ?., Benchmarking South East European Cities with the Sustainable Development of Energy, Water and Environment Systems Index, Journal of Sustainable Development of Energy, Water and Environment Systems <DOI: http://dx.doi.org/10.13044/j.sdewes.d5.0179> [Siir KILKIS, Turkey]	Noted - but beyond the scope of this section, which should highlight knowledge gaps.
7647	79	24			This may not be a section to which you wish to add further citations. However, I note that a key, recent publication on the 'political economy of climate adaptation' (mentioned in the text) is not in the list of references. That citation is Javeline, D., 2014. The Most Important Topic Political Scientists Are Not Studying: Adapting to Climate Change. Perspectives on Politics, 12, 420–434. [Conor Little, Denmark]	Noted – however, the literature is assessed in other parts of chapter 4. In this section we indeed only take stock of the gaps and don't assess further literature.
11172	79	25	79	27	This section on knowledge gaps in urban environments should also consider loss and damage, and related concepts, including barriers and limits to adaptation. Also finance flows for adaptation are relevant here. [Michiel Schaeffer, Netherlands]	Taken into account - There is now a separate box on loss and damage.
3985	79	27			considerable knowldege being built up by UN Habitat case studies and the Asian Development Bank - reference - ADB, 2017, A Region at Risk- the human dimensions of climate change in Asia and the Pacific'. [Barbara Norman, Australia]	Noted - but beyond the scope of the knowledge gap section to assess this emerging work.
11173	79	29	79	35	On land systems, more information on examples of successful policy implementation related to land-based mitigation (that have led to co-benefits for adaptation, development etc.) is needed. E.g. see Creuzig et al. 2015 [Michiel Schaeffer, Netherlands]	Accepted - has been added to the text

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11170	79	37	79	39	energy demand has very little scope for further growth, while at the same time providing universal access to energy, as many people still suffer from no access or energy poverty at least - how about if renewable energy (e.g. solar home systems) is used to increase energy access? [Michiel Schaeffer, Netherlands]	Rejected - the assessed pathways (see chapter 2) take into account that additional energy supply will have to come from renewables, but despite that demand needs to be controlled for 1.5°C to remain within reach.
6592	79	37	79	39	Consider to refer not to 'energy demand' but to 'fossil-fuel energy demand'; in fact there is a 'lot of scope' for the demand or renewable non-GHG emitting energy... [J. David Tabara, Spain]	Rejected - see reply to comment 11170
6593	79	37	79	54	Consider to introduce a more clear assessment about how much fossil fuel can still be taken out of the ground and on the potential of global / national fossil-fuel demand control policies and instruments. [J. David Tabara, Spain]	Noted - but beyond the scope of the knowledge gaps section, which does not do any new assessment.
7688	79	42	79	44	No country is reaching, or (says the preponderance of literature, including virtual consensus among the deepest students and practitioners of this subject) is likely to reach short of 70–90+% variable renewable generation, “levels where large scale energy storage systems are required to enable resilient grid systems.” IPCC should not perpetuate this pervasive misconception about how grids work, contradicted by extensive literature I’d be glad to supply (just ask me at amory@rmi.org). The correct term is also “variable” not “intermittent” renewables: “intermittent” is best reserved for unpredictable forced outages (characteristic of large thermal plants), while the variability of “variable” renewables—the PV and windpower that produced half the world’s 2016 modern renewable energy—is highly predictable, generally more accurately than electricity demand itself. The two concepts are different and should not be confused. [Amory Lovins, United States of America]	Taken into account - It is an old myth that grids cannot be 100% supported by renewables and there is much literature we will use to support not only the need but the practicality of enabling 100%. We have changed the text accordingly to replace ‘intermittent’ with ‘variable’ and to show that a resilient and reliable grid can be 100% renewable through smart systems and storage.
7835	79	42	79	44	No country is reaching, or (says the preponderance of literature, including virtual consensus among the deepest students and practitioners of this subject) is likely to reach short of 70–90+% variable renewable generation, “levels where large scale energy storage systems are required to enable resilient grid systems.” IPCC should not perpetuate this pervasive misconception about how grids work, contradicted by extensive literature I’d be glad to supply (just ask me at amory@rmi.org). The correct term is also “variable” not “intermittent” renewables: “intermittent” is best reserved for unpredictable forced outages (characteristic of large thermal plants), while the variability of “variable” renewables—the PV and windpower that produced half the world’s 2016 modern renewable energy—is highly predictable, generally more accurately than electricity demand itself. The two concepts are different and should not be confused. [Amory Lovins, United States of America]	Taken into account - It is an old myth that grids cannot be 100% supported by renewables and there is much literature we will use to support not only the need but the practicality of enabling 100%. We have changed the text accordingly to replace ‘intermittent’ with ‘variable’ and to show that a resilient and reliable grid can be 100% renewable through smart systems and storage.
20326	79	43	79	43	Besides storage, also other flexibility options, such as demand response or larger balancing areas through transmission lines. [Marine Gorner, France]	Accepted - added "and other flexibility options" after storage
9458	79	46	79	46	Add one sentence on CCS after 'is also needed'. [Isabelle Czernichowski-Lauriol, France]	Accepted - added "Carbon capture and storage (CCS) suffers mostly from uncertainty about the feasibility of timely upscaling, in particular in terms of safely storing the CO2."
21189	79	47	79	52	This sentence is problematic in several respects.(1)ocean fertilization should not be considerd in same category. Experimentsin this area must be carried out in accordance with London Convention. (2) BECCS and AR have been assessed,but significance of iluc remains contested. [David Cooper, Canada]	Noted - but the text "Carbon capture and storage (CCS) suffers mostly from uncertainty about the feasibility of timely upscaling, in particular in terms of safely storing the CO2." has been removed.
11174	80	3	80	11	Reducing Short-Lived Climate Pollutants (SLCPs) could be one way to reduce the reliance on negative emissions in a 1.5°C pathway - this is truly misleading and should be deleted. Reducing SLCPs can reduce peak temperatures, but it is the total CO2 that determines the long-term temperature rise. See Rogelj et al. 2015: "Over longer timescales and for the same global warming in 2100, cases with larger CO2 budgets and more stringent CH4 abatement have more committed, irreversible long-term warming, than cases with lower CO2 budgets and higher CH4." This should be made clear. This section is particularly misleading because it starts to lump SLCPs together, but then singles out Black Carbon in line 10, while it is clear that particularly BC is ineffective for long-term warming and even peak warming: much of Black Carbon is co-emitted with CO2 and in 1.5 and 2°C scenarios it will have disappeared along with CO2 emissions long before peak warming. (Rogelj et al 2014 "Disentangling the effects of CO2 and short-lived climate forcer mitigation", PNAS) Further, if completely reqritten to be acceptable (in a which form I cannot see), it must be made clear that a pulse in CO2 emissions (e.g. single year of emissions) equates to a sustained emissions of SLCP (see chapter 2), meaning that sustained negative CO2 emissions, i.e. at a fixed annual level, equate to sustained CONTINUOUSLY DECREASING SLCPs emissions, which is impossibly beyond the zero point of SLCP emissions. [Michiel Schaeffer, Netherlands]	Accept this comment. However, because of an omission on our side, we have not implemented these comments in the SOD. Our apologies. It will be included in the FD.
10678	80	3	80	11	SLCPs have proven technologies and methods for reducing emissions (Shindell et al 2012); as such, implementation will benefit from top-down support, especially in those avenues that elicit co-benefits. [Kristin Campbell, United States of America]	Noted. We are citing but the rest of the comment is unclear. If “top-down support” means policy interventions by an international organisation, taking the comment into account may be perceived as policy-prescriptive, especially without a reference.
11175	80	13	80	18	This paragraph on SRM implies that SRM is an option that is being seriously considered as a feasible option, and underplays the risks. E.g. "how to construct a compensation system of SRM" - this makes the assumption that the risks would be acceptable (if compensated for). Suggest reframing. [Michiel Schaeffer, Netherlands]	Taken into account - This paragraph was rewritten. Sentence about "compensation system of SRM" deleted.
3108	80	14	80	14	in spite not "on spite" [Christopher Bataille, Canada]	Accepted - has been changed
17242	80	14	80	14	Change to 'in spite of' instead of 'on spite of' [Himangana Gupta, India]	Accepted - see reply to comment 3108
14111	80	29	80	30	“These aspects continue to limit our understanding and treatment of behavioural change and the potential effects of related policies in ambitious mitigation pathways in specific contexts”. AR5 WGII p198: “decisions require context-appropriate decision-support processes and tools.” [Elvira Poloczanska, Germany]	Accepted - rephrased as: "From a modelling point of view, a paramount challenge is to what extent a representation of (empirically estimated) determinants of mitigation behaviour, including technology choice or adoption, is actually feasible in detailed process IAMs, particularly since mitigation behaviour is influenced by a wide range of factors that differ across individuals and contexts (Chapter 2)."
2759	80	42	80	42	Every adaptation programme funded by ODA - as well as other sources of finance - undergoes evaluation. There is a lot of information in the grey literature on this. But of course, assessing effectiveness of adaptation is essentially a long-term affair - hence the lack of solid evaluation at this stage. There is, however, a lot of evaluation of whether interventions are effective in promoting adaptation to current climate variabilty / climatic conditions. [Penny Urquhart, South Africa]	Noted - however, more unbiased impact evaluations would be needed in order to drop this from the knowledge gaps list
2796	81		85		Box 4.12 is very good. This information needs to be a key part of the Technical Summary and SPM of the report. This report is an input to the 2018 facilitative dialogue to take stock of the collective efforts of parties in relation to progress toward the long term goal of the Paris Agreement. Since the long term goal is to hold the temperature increase to wel,below 2oC and pursue efforts to limit the increase to 1.5oC the box should discuss 2oC as well as 1.5oC. [Erik Haites, Canada]	Partly accepted (with thanks) but rejected. The Special Report is about 1.5C, not about 2.0 C, but some references to 2 C are included
9826	81	1	83	12	Please check some references, for example, van Dyck et al. is not about equity pricinples. There is also literature cited that assesses the NDCs based on many criteria that go beyond equity priciples, and alternative metrics, like Hohne et al, but her I would also cite: Aldy et al. 2016, climate policy [Michel den Elzen, Netherlands]	Accepted references have been checked

Comment No	From Page	From Line	To Page	To Line	Comment	Response
19766	81	7	81	14	Important to compare risks to human rights from climate impacts to risk to human roights from climate action. Mary Robinson Foundation report on Zero Carbon, Zero Poverty finds that • Impacts of climate change pose greater and more insurmountable risks to human rights than those arising from rapid climate action and • Zero carbon is compatible with achieving the right to development, with a shift to Sustainable Development, poverty eradication and a more equitable and inclusive model of development if; a) All countries are enabled to participate in the transition on the same time scale b) Human rights and gender equality inform all climate and sustainable development actions [Tara Shine, Ireland]	Noted - but beyond the scope of chapter 4, see reply to comment 19763.
7366	81	14	81	15	Delete the text "and the risks of lock-in to options that produce unforeseen negative consequences". [Eleni Kaditi, Austria]	Rejected - there is now more research on the risks of lock-in, but many uncertainties remain.
5741	81	18			The sections starting from 4.5.2 are mostly not complete. They basically just contain several long Boxs. Some of the text in these boxes should be in the main body. [Hong Yang, Switzerland]	Taken into account. These sections, obviously, still need to get written. The boxes are separate and not part of the sections in 4.5.
9627	81	18	81	28	add the content,there is only title, [Jianguo Wu, China]	Taken into account. These sections, obviously, still need to get written.
1221	81	18	81	28	Not clear what would be covered under 4.5.2 - 4.5.4 in the SOD. [Petra Tschakert, Australia]	Taken into account. These sections, obviously, still need to get written.
10564	81	31	100	55	There are too many boxes, some without much important (4.13), and others (4.12) that could be incorporated into the text. [Jose Antonio Puppim de Oliveira, Brazil]	Taken into account; the Cross-Chapter boxes have appeared as additional boxes at the end of the chapter as 4.12, 4.13, 4.14 and 4.15. For the SOD they are named correctly. However, case studies in the boxes are per approved plenary outline.
19767	81	31	81	31	for additional case studies with a focus on human rights and climate change see those presented in Rights for Action and on those of the Business and Human Rights resource centre. [Tara Shine, Ireland]	Noted. Not peer-reviewed literature though.
19768	81	31	81	31	Rights for Action Putting People at the Centre of Action on Climate Change (Nov 2015) Online at http://www.mrfcj.org/wp-content/uploads/2015/11/MRFCJ-Rights-for-Action-edition-2.pdf [Tara Shine, Ireland]	Noted. Not peer-reviewed literature though.
19769	81	31	81	31	Human Rights and Buiness Resource Centre: https://business-humanrights.org/en/case-studies-renewable-energy [Tara Shine, Ireland]	Noted. Not peer-reviewed literature though.
19770	81	31	81	31	Box on the Caribbean : add a reference to Antigua's legal provision for consultation with local communities on all aspects of environmental action http://laws.gov.ag/acts/2015/a2015-11.pdf [Tara Shine, Ireland]	Taken into account, case study has been redefined
12289	81	31	83	24	Millar et al. 2017 (Nature Geo) may also be relevant for box 4.12. [Jan Fuglestvedt, Norway]	Rejected, paper by Millar is not relevant for the box, could be considered for TOD
12290	81	31	83	24	Box 4.12 may also mention that the Paris Agreement does not indicate which metrics and time horizon that should be used in the calculations of CO2-equivalent emissions. And further how this may affect the weighting of gases in mitigation efforts. A reference may be given to Allen et al., 2016 (NCC) [Jan Fuglestvedt, Norway]	Accepted, text added and paper by Allen cited
5738	81	31	85	11	Box 12. The elaboration of consistency between NDCs and 1.5 scenarios is a key point in this report. It should be in the main body of the chapter. Also important is to address the difference in adaptions to NDCs and 1.5 scenarios. Figure 1 in Box 4.12 needs a title. [Hong Yang, Switzerland]	Noted and partly accepted The Box is in Ch. 4 but it is shared with all the other chapters given its importance in the Report. Title added.
10358	81	42	81	51	A number of developing countries define their NDC targets as a percentwise reduction relative to reference-scenario emission-forecasts. The NDCs of Mexico, Ghana and Vietnam, among many other countries, are examples of this. The uncertainty associated with reference-scenario emission-forecasts can be extremely large (Puig et al. 2017). As a result, the actual emission reduction levels that those NDC targets amount to are highly uncertain. This has obvious implications for the 'emissions gap', defined here as the difference between the emission levels associated with a 'full NDC implementation' scenario in 2030, and the emission levels in this same year that are consistent with a 1.5 C scenario. You may want to reflect this element – the uncertainty around reference-scenario emission-forecasts, and how it affects calculations of the 'emissions gap' – in the report. Puig, D., Morales-Nápoles, O., Bakhtiari, F. & Landa, G. (2017). The accountability imperative for quantifying the uncertainty of emission forecasts: evidence from Mexico. Climate Policy. DOI: 10.1080/14693062.2017.1373623 [Daniel Puig, Denmark]	Accepted, reference added and short text as suggested is added.
10359	81	42	81	51	Emission reductions assumed to be delivered by non-state actor actions have now entered the calculations of the 'emissions gap', defined here as the difference between the emission levels associated with a 'full NDC implementation' scenario in 2030, and the emission levels in this same year that are consistent with a 1.5 C scenario. Estimates of the additional emission reductions potential associated with non-state actor actions are scarce ('additional' here refers to emission reductions that are not accounted for as resulting from NDC implementation). Two assessments (one by PBL and one commissioned by UNEP to Ecofys) report moderate emission reduction potentials. The PBL assessment further suggests that double counting (between emission reductions attributed to non-state actor action, and those attributed to state actors, through NDC implementation) may be large. A third study reports far more optimistic estimates. A recent peer-reviewed paper synthesises these and other estimates, and concludes that caution is warranted, not least because of the scant evidence of actual delivery by non-state actor actions (Bakhtiari 2017). You may want to highlight these concerns – the need for caution, and the extent to which high estimates are robust – in the report. Bakhtiari, F. (2017). International cooperative initiatives and the United Nations Framework Convention on Climate Change. Climate Policy. DOI: 10.1080/14693062.2017.1321522 [Daniel Puig, Denmark]	Accepted, text on role of NSAs and suggested reference added
9354	81	50	81	50	There is a missing word "as" in the phrase "as well (as) 'common..." [Siir KILKIS, Turkey]	Accepted, editorial
2666	81	54	81	55	It is misleading to state that all countries contribute to mitigation, since 1) not all countries signed the Paris Agreement and 2) some countries pledged to grow their emissions by 2030. An alternative phrasing could read: "… all signatory countries committed to contributing to global emissions mitigation." or "... all signatory countries committed to limiting their emissions." [Yann Robiou du Pont, Australia]	Accepted, phrase changed as suggested
9819	81	58	82	1	The literature cited here does nto always shows that NDCs have contributed to climate mitigation. I would only present the key literature here: Rogelj et al., 2016; Lyer et al. are one of the first,but for exaple, Pan et al. are not key. Please check. [Michel den Elzen, Netherlands]	Accepted only key included
9818	81	58	83	18	Thi part needs quite some revisions, as it is not clear what is the objective, and what are the questions you want to address. The literature cited is OK, but all has a different objective (cost-effective pathways to 1.5C, assessing of NDCs by comparing these with effort sharing regimes based on equity principles, etc.). I think you need to cluster the literature that have a particular objective. [Michel den Elzen, Netherlands]	Accepted Box reorganised
17308	82	2	82	3	this finding is also supported by Holz, C., Kartha, S. & Athanasiou, T. Int Environ Agreements (2017). https://doi.org/10.1007/s10784-017-9371-z [Christian Holz, Canada]	Accepted, reference added

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9820	82	3	82	3	A comparison with no policy BAU is ok, as a reference, but from the UNEP report we know it is much more interested to compared NDCs with current policies scenarios. This has been done in den Elzen et al., 2016, as cited here, and is also done in UNEP (2015-2017). The current policies scenarios are based on multiple studies, including IEA, Climate Action Tracker, PBL IMAGE and POLES model, but also on national studies. I would include a few sentences on the literature that compare the NDCs with current polciies scenarios. I would delete Hof et al (2017), and keep Rogelj et al. in, if if you want to compare BAUs with NDCs. [Michel den Elzen, Netherlands]	Accepted, text modified accordingly
9821	82	3	82	4	Wrong. For INDCs it is ok, for NDCs, it still changes, if parties ratify, their INDCs become a NDC [Michel den Elzen, Netherlands]	Accepted text modified
20416	82	4	82	8	Can you elaborate on the lower end of the range? Under which conditions does the Paris agreement takes us on 2.2°C warming by 2100? Does this assume a low climate sensitivity or a very rapid decarbonisation after 2030? [Olivier Boucher, France]	Rejected the report is focused on 1.5C not 2.2 C, and we do not have the space in the report to elaborate how to get with the PA to 2.2. C
11048	82	6	82	6	2.2 degrees is far outside the literature range and should not be reported here. When using a probability of 66%, all estimates are above 3 degrees (see Rogelj et al. 2016). Therefore, probabilities should be reported here as well [Oliver Geden, Germany]	Accepted, probably added
2667	82	8	82	8	A reference to a recent publication looking at the likely 2100 warming under current policies and projections would be useful here: "Raftery et al. (2017), Nature Climate Change, doi:10.1038/nclimate3352". The median warming and range identified here are less optimistic than that of the UNEP currently mentioned in the text. [Yann Robiou du Pont, Australia]	Rejected, reference not relevant (perhaps could be reconsidered for TOD)
17309	82	10	82	12	an additional study that estimates global emission levels achieved under the NDCs is: Holz, C., Kartha, S. & Athanasiou, T. Int Environ Agreements (2017). https://doi.org/10.1007/s10784-017-9371-z [Christian Holz, Canada]	Accepted, reference added
9824	82	11	82	11	Replace Hof et al 2017 by den Elzen et al. 2016, as Hof et al. does not analyse the impact of NDCs in detail, it uses the information of den Elzen et al. Both publications are from the same authors. [Michel den Elzen, Netherlands]	Accepted, Hof removed, den Elzen added
7013	82	14	82	55	Inconsistency rather than "Consistency" is more appropriate for the title of Box 4.12 since the assessment here shows that the NDCs are not in line with the 1.5 C pathways. Suggest to clearly state that there is little or no hope to keep warming below 1.5C with the pledges agreed in the Paris Agreement. [Sai Ming Lee, China]	Noted, text agrees with comment but not possible to change Box title
17243	82	17	82	17	Please take into account the fact that the US has pulled out of the Paris Agreement [Himangana Gupta, India]	Accepted US removed
9822	82	21	82	23	Check if the authors have ealy run integrated asessment models. Again only cite the relevant literature. [Michel den Elzen, Netherlands]	Accepted: we changed the text to indicated that some authors have run IAMs some have used IAMs or compared with IAMs
11176	82	21	82	23	Several authors (Rogelj et al. 2016; Robiou du Pont et al. 2016; Vandyck et al. 2016; Hof et al. 2017; Iyer et al. 2015; Fujimori et al. 2016) have run integrated assessment models to assess the contribution of NDCs to achieve the 1.5°C targets in the Paris agreement - not all authors listed have done this. Some have compared NDC pathways with emissions pathways produced by IAMs. [Michiel Schaeffer, Netherlands]	Accepted: we changed the text to indicated that some authors have run IAMs some have used IAMs or compared with IAMs
2668	82	22	82	22	Not all of the mentioned authors have run models. Some have simply used the existing modelling for their analysis. I suggest using "used" instead of "run". [Yann Robiou du Pont, Australia]	Accepted: this will also take care of the two above comments
2669	82	24	82	24	Grammar mistake, "assumption" should be plural and read "assumptions". [Yann Robiou du Pont, Australia]	Accepted Editorial
2670	82	24	82	25	Imprecise language on "that have looked into this question". There is no clearly laid-out question in the lines above. [Yann Robiou du Pont, Australia]	Accepted text deleted, therefore comment not more relevant
9823	82	25	82	27	I would also cite the UNEP Gap report, as this is an assessment of existing litertaure that have analyse the aggregated effect of NDCs. [Michel den Elzen, Netherlands]	Accepted, Gap Report added
2671	82	26	82	27	A reference to (Robiou du Pont et al. 2016) could be added: "Robiou du Pont et al. (2016), Nature Climate Change, doi:10.1038/nclimate3186". [Yann Robiou du Pont, Australia]	Accepted, reference added
2672	82	33	82	33	The word "regions" seems imprecise. Within specific regions, some countries may over-deliver while others under-deliver. Using "countries" would be more precise. [Yann Robiou du Pont, Australia]	Accepted, text changed
2673	82	37	82	37	Additionally to Figure 2.10 of section 2.3.3, a reference to Figure 4.14, which is included in the same Box 4.12 in this draft, would clearly highlight this statement. [Yann Robiou du Pont, Australia]	Accepted
17244	82	47	82	48	Change 'NCDs' to 'NDCs' and 'will results is' to 'will result in' [Himangana Gupta, India]	Accepted Editorial
2674	82	49	82	49	Delaying emissions mitigation would also increase the risks of overshooting the warming threshold and the risk of adverse climate impacts. Since the next sentence discusses this more in depth, it would be useful to mention it here. A suggestion is: "resulting in higher costs, a higher effort of negative emissions and a higher risk of overshooting or missing the warming thresholds." [Yann Robiou du Pont, Australia]	Rejected, no space to add this sentence (to be reconsidered in TOD)
2675	82	51	82	51	A comparison point is lacking in the use of the word "deeper". A suggestion is: "Implementing more ambitious emissions reduction than current NDCs imply by 2030. [Yann Robiou du Pont, Australia]	Noted, but text is already implying what suggested
17245	82	52	82	52	Change 'this risks' to 'the risks' [Himangana Gupta, India]	Accepted Editorial
17596	83	1	83	12	It is stipulated that the Second Order Draft will elaborate on how NDCs comply with various equity principles. This is an important issue, and there is a large variation in the extant literature. A recent contribution, Holz, C. et al., Int. Environ Agreements (2017), https://doi.org/10.1007/s10784-017-9371-z , finds results very different from e.g. Robiou du Pont et al. (2017) which is cited in the FOD. A comprehensive critique of Robiou du Pont et al. is under review for Nature Clim Change (Kartha, S. et al., https://ssrn.com/abstract=3022357). Irrespective of the specific critique of Robiou du Pont et al., a few points from Kartha et al. are particularly important to consider for the SOD text on this issue. In particular, the "six equity principles" used in many studies (e.g. Pan et al., Höhne et al.) are derived from the AR5 categorization of existing quantifications of equity principles in the literature, rather than being anchored in specific understandings of equity drawn from ethics or normative theory. This leads to some unfortunate results, where (e.g. in Robiou du Pont et al.) some version of "grandfathering" is included as an equity principle and/or built into the application of several principles, despite the fact that the principle has no support as an equity principle in the literature (cf. Kartha et al. in review). Moreover, it purports to be a comprehensive categorization of equity principles whereas the AR5 explicitly states that it was not meant as such. It would be unfortunate if SR1.5 reproduced a distorted picture of what the AR5 actually said about this. In the discussion on the relationship between NDCs and equity principles, it will be important to recognize that different interpretations of equity principles lead to different conclusions, and that there are inherently political conflicts over values and interests that makes it difficult to present aggregated results (either in the form of averages or summaries across categories) for the equity implications of NDCs. This is more thoroughly discussed in Lahn, B., Int. Environ Agreements (2017), https://doi.org/10.1007/s10784-017-9375-8L as well as Lahn, B. & G. Sundqvist, Environ Sci. Pol. (2017), http://dx.doi.org/10.1016/j.envsci.2016.11.001 . [Bård Lahn, Norway]	Accepted, added discussion on the different equity principles as proposed by the comment and new references added

Comment No	From Page	From Line	To Page	To Line	Comment	Response
2676	83	2	83	5	Additionally, other studies inform on the compliance of NDCs with equity principles for the Second Order Draft. The study (Robiou du Pont et al. 2016) provides assessments of the consistency of NDCs, at the national or regional levels, with the Paris Agreement warming thresholds of 1.5 °C and 2 °C and the net-zero emissions goal under the five effort-sharing categories quantified in the IPCC-AR5 (in Figure 6.28): "Robiou du Pont et al. (2016), Nature Climate Change, doi:10.1038/nclimate3186". Additionally, the study of Pan et al. (2017) provides assessments of the consistency of NDCs at the national level under global emissions pathways leading to 2 °C or 1.5 °C for a range of effort sharing approaches (DOI: 10.1016/j.envsci.2017.04.020). [Yann Robiou du Pont, Australia]	Accepted , the references added
29	83	4	83	12	Please refer to R Herrala and R.K. Goel (2016), Sharing the emission reduction burden in an uneven world, Energy Policy 94, 29-39. They present an emission assessment framework where fairness is interpreted in an original way as meaning that countries with similar levels of GDP have the same emission benchmark. [Risto Herrala, United States of America]	Accepted Reference and text added
2677	83	5	83	6	The statement "Most of the authors agree on a multi-criteria assessment framework based on six equity principles of effort-sharing" is vague or incorrect. Should that statement refer to a sub-selection of the authors mentioned in the previous sentence, there is an inconsistency in the authors' names. Should this statement refer to all authors in the field of equity modelling, this sentence seems incorrect. In that literature, many (if not most) authors have suggested single-criterium assessments. Furthermore, amongst the cited authors, Höhne et al. (2017) uses the effort-sharing approaches of Höhne et al. (2014 DOI: 10.1080/14693062.2014.849452), which is also the multi-criteria assessment used in the IPCC-AR5 (Figure 6.28). This assessment only refers to five categories based on notions of equity. The additional 'equal marginal abatement costs' assessment based on cost-effectiveness is not based on equity and the author includes it "as a reference". The IPCC-AR5 describes the 'equal marginal abatement costs' category as a representation of the initial allocation that would emerge from a global price on carbon and uses it "as a reference against which to compare the implications of other regimes". The other study mentioned here Pan et al. (2017) , does include six effort-sharing approaches including the five approaches of Höhne et al. (2014) covered in the IPCC-AR5. The additional approach named 'responsibility', not 'equal marginal abatement costs' approach. The effort sharing approaches used by Höhne et al. (2017) and Pan et al. (2017) are different, and it is misleading to declare an agreement across most authors. Fundamentally, the effort-sharing approaches included in the references mentioned here, as well as others (Robiou du Pont et al. 2016), are based on a combination of only three principles of equity as described in Höhne et al. (2014) and IPCC-AR (table 6.5): equality, responsibility, capability-need. A suggestion is: "In accordance with the IPCC-AR5, several authors modelled multi-criteria assessment frameworks based on three principles of equitable effort-sharing (Höhne et al. 2017, Pan et al. 2017 and Robiou du Pont et al. 2016) ..." [Yann Robiou du Pont, Australia]	Accepted, text changed
2678	83	6	83	6	The study by Jiang et al. 2017 does not seem relevant here. This study does not model or discuss the inclusion of effort-sharing principles. This study reviews the existing assessments and simply describes the seven (and not six as stated) effort-sharing indicators used by an online assessment tool, which is not peer-reviewed. [Yann Robiou du Pont, Australia]	Rejected reference left because relevant
17310	83	6	83	7	it is unclear what the phrase "six equity principles of effort sharing" refers to. I assume it refers to the work in chapter 6 of the WG3 contribution to AR5, specifically, table 6.5. A reference to that work should be given, but it should also be pointed out that table 6.5 lists six effort sharing "categories" (not "principles") and that the underlying "principles" are "responsibility," "capability," and "equality" as listed in the header of table 6.5. It should further be noted that the AR5 WG3 report does not claim that these categories should be understood as some authoritative and ethically-robust set of equity approaches, but rather that they merely reflect what's been quantified in the literature. AR5 WG4, notes other ethical issues that bear on emissions allocations including: "the relative moral relevance of consumption-based emissions as opposed to production-based emissions, survival emissions as opposed to luxury emissions, progressive as opposed to regressive allocation of mitigation costs, prioritarianism as opposed to egalitarianism, and the right to development and the critical ethical importance of the eradication of poverty." (Kartha et al, under review) It is important that discussion of equity approaches in SR1.5 does not unduly emphazise certain approaches over others as this might be seen as bestowing higher degree of legitimacy, just because they happen to have been quantified. Hence "principles" should be replaced with "categories," a reference to the AR5 WG3 included, and a brief explanation provided that these are not the only plausible equity approaches and that further criteria exist (a Commentary by Kartha et al that makes this point is currently under review with Nature Climate Change and can be added as a reference once out) [Christian Holz, Canada]	Accepted, text modified as suggested
2679	83	7	83	7	The study of Pan et al. (2017) actually states the opposite: "The analysis shows that most countries need to adopt more ambitious reduction targets by 2030 to meet 2 °C, and even more for 1.5 °C. In the context of 2 °C, the NDCs of the United States of America and the European Union lack ambition with respect to the approaches that emphasize responsibility; China's NDC projection falls short of satisfying any approach in 2030. In the context of 1.5 °C, only India, by implementing its most ambitious efforts by 2030, could be in line with most equity principles." Additionally, the study presents conclusions for major emitting countries, but not for all countries. [Yann Robiou du Pont, Australia]	Noted, but not relevant as this section as been removed
17311	83	7	83	7	the phrase "most of the NDCs are ambitious apart India" doesn't seem to connect to the other parts of the sentence… [Christian Holz, Canada]	Accepted sentence removed
2680	83	8	83	10	The study of Robiou du Pont et al. (2016) does not state that all NDCs fail on some equity principles. Many African countries' NDCs are actually more ambitious than each equity principle: http://paris-equity-check.org/ . This study finds that, at the regional level "Only the aggregated (I)NDCs of the Middle East and Africa are consistent with some 1.5?°C allocations." [Yann Robiou du Pont, Australia]	Noted, but not relevant as this section as been removed
18643	83	8	83	8	Move "Robiou du Pontl (2016)" into grey shaded Mendeley field with "2016" [Wilfran Moufouma Okia, France]	Editorial
2682	83	10	83	12	This sentence does not read well. The study of Vandyck at al. (2016) allocates emissions allowances of a 2?°C pathway across countries through the cost-optimal implementation using a differentiated carbon price for countries. The study of Robiou du Pont et al. (2016) allocated emissions allowances of both a 2?°C pathway and a 1.5?°C pathway to countries following the effort-sharing approaches described earlier in the text. [Yann Robiou du Pont, Australia]	Noted, but not relevant as this section as been removed
2681	83	11	83	11	Grammar mistake, "allowance" should be plural and read "allowances". [Yann Robiou du Pont, Australia]	Noted, but not relevant as this section as been removed
17312	83	12	83	12	Since the FOD, another study became available that, based on three different equity parameterization, contrasts countries' NDCs with their allocation under these equity benchmarks and finds that all "wealthier" countries, as a group as well as individually, fall short, while "poorer" countries, as a group as well as individually in many cases, meet or exceed at least one of the benchmarks. (NB: "poorer" and "wealthier" categorization in that study does not follow the typical developing/developed or Annexl/non-Annexl categories) Holz, C., Kartha, S. & Athanasiou, T. Int Environ Agreements (2017). https://doi.org/10.1007/s10784-017-9371-z [Christian Holz, Canada]	Noted, but not relevant as this section as been removed
2683	83	14	83	14	The term "In any case" sounds vague and not appropriate in this context. [Yann Robiou du Pont, Australia]	Accepted, text modified
17597	83	14	83	18	While NDCs may increase the transparency in certain respects, there are still significant shortcomings when it comes to assessing the fairness and equity implications of NDCs (as per the above point). In part, this relates to a lack of information being provided on countries' own assessment of the fairness of their NDCs. This point is discussed by Winkler, H. et al., Int. Environ Agreements (under review), and would be good to highlight in the report. [Bård Lahn, Norway]	Accepted, reference added and text

Comment No	From Page	From Line	To Page	To Line	Comment	Response
21194	83	14	93	32	this section isinadequate.for a comprehensive discussion of regulatory frameworks for SRM see: Bodle, R., with Homan, G., Schiele, S., and E. Tedsen (2012). The Regulatory Framework for Climate-Related Geoengineering Relevant to the Convention on Biological Diversity. Part II 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. ;and: 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; [David Cooper, Canada]	Noted. Decisions of Convention on Biological Diversity is addressed in 4.3.9
17313	83	18	83	18	Suggest to add something along the lines of "Furthermore, the usefulness of conditional NDCs as a potential mechanism to facilitate international mitigation cooperation and thus enable greater global ambition has also been highlighted in the literature (Holz et al. 2017)" Holz, C., Kartha, S. & Athanasiou, T. Int Environ Agreements (2017). https://doi.org/10.1007/s10784-017-9371-z [Christian Holz, Canada]	Accepted text and reference added
17314	83	20	83	24	It is currently unclear why the figure is there --- it is not mentioned or discussed in the text; a reference to it could be added to p.82 line 12 [Christian Holz, Canada]	Accepted a reference to the figure is added
9825	83	20	83	24	Figure 1 in Box 4.12. This Figure from the study Ropou du Pont does not assess the impact of NDCs and a comparison of 1.5C and 2C. This study uses the old least-cost pathways of IPCC AR5, assuming least costs reductions starting in 2010. This is not realistic anymore (given the rise in GHG emissions), and therefore the UNEP started already in 2014 to compare the NDCs with delayed patways (limited action by 2020 (2020 pledges), and cost-optimal reduction starting from 2020 to meet 1.5 C and 2C). I would delete this figure as NOT CONSISTENT with the pathways of Chapter 2, which mainly assume these delayed pathways. The authors may want to include the Figure of the UNEP Gap report, that shows the difference between the 1.5C pathways of Chapter 2 and the NDC emission scenarios (conditional and unconditional). It further also shows the baseline scenario (no policy), and current policies scenario. I think this figure would better fit here. The figure is based on the assessment of the most recent literture that is also cited in this Box. [Michel den Elzen, Netherlands]	Accepted new figure inserted in the box
9355	84	1	84	1	The phrase "At national the level" may read instead as "At the national level" [Siir KILKIS, Turkey]	Taken into account. The adaptation section of this box is being rewritten for SOD
4760	84	19	84	19	This table is a great way to summarise key information. Thanks for inserting it. Meanwhile its title should explicit mention adaptation (while a corresponding table on mitigation should well be inserted earlier). For instance the title of this table might become "Sectors of adaptation covered by NDCs". [Valentino Piana, Italy]	Noted, although the focus of the box is on NDC's, NAP's are mentioned because of their role.
12947	85		93		Box 4.13. Is on SRM , there is section 4.3.7 on SRM. Is not that too much focus on one single option. [Joyashree Roy, India]	Noted. The most discussion about SRM is focused in the SRM box and the section 4.3.7. is significantly shorten
2760	85	3	85	4	It is not just the NAPs that need to be looked at - many countries are developing National Climate Change Strategies and Action Plans - these usually include both adaptation and mitigation. [Penny Urquhart, South Africa]	Noted, but not included in the Box as the Box deals only with NDCs. In Section 4.4.1 the comment is addressed and National Climate Change Strategies and Action Plans are mentioned
3109	85	13	93	33	Box 4.13 on SRM is well written and very effective in scaring the liver out of me [Christopher Bataille, Canada]	Noted. Thank you!
19328	85	13	93	33	Why such a large amount of space devoted to SRM? Isn't that out of balance with respect to other parts of the report? [Marco Mazzotti, Switzerland]	Taken into account, Box and 4.3.9 have been shortened
11177	85	14			This box 4.13 on SRM methods, effectiveness and technical feasibility is not always consistent in the picture of SRM presented. Some parts treat SRM as a feasible option (e.g. "SRM should only be used in combination with emission reduction and CDR" - line 47) while others identify the very high risks and uncertainties ("risks of SAI deployment for global food security and ecosystem health would outweigh the benefits..."). The state of knowledge on SRM is still clear that the risks are too high, and this should be clearly stated consistently throughout the box. It might be useful to reorder the box, so that some of the risks and governance issues (which are very relevant to policy makers) are highlighted before the technological feasibility. [Michiel Schaeffer, Netherlands]	Noted. Box restructured significantly in order to be consistent with all Report. While we assessing balance of literature, we should mention different points of view
17246	85	14	85	14	Box4.12 could be shifted to section 4.3.7 [Himangana Gupta, India]	Noted. This is Cross-chapter Box, and does not belongs to chapter 4 only
10223	85	14	85	30	Ocean albedo missing from this list, e.g Crook et al. doi/10.1002/2015JD024201/ [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	taken into account, reference added
12291	85	14	93	32	I find Box 4.13 on SRM very useful. If possible (given the limited literature as pointed to on p 90 line 18) some more emphasis on assessment would be good. [Jan Fuglestvedt, Norway]	Taken into account. Assessment added. Thank you!
11094	85	14	93	32	Box 4.13 discusses SRM through injection of sulfate aerosol precursors. It does not mention semi-direct injection of sulfate particles produced by release of condensable H2SO4 vapor into an aircraft plume (Pierce et al., 2010). The efficiency and side-effects of this scheme are compared with SO2 injection in Weisenstein et al. (2015). Advantages are better control of sulfate particle size, maintaining a distribution closer to optimal for radiative properties and minimizing sedimentation and non-linearity of RF response to injection magnitude. [Jeffrey R. Pierce, Debra K. Weisenstein, Patricia Heckendorn, Thomas Peter, David W. Keith, “Efficient Formation of Stratospheric Aerosol for Climate Engineering by Emission of Condensible Vapor from Aircraft,” Geophysical Research Letters 37 (2010), doi: 10.1029/2010GL043975; D.K. Weisenstein, D.W. Keith, and J.A. Dykema, “Solar Geoengineering Using Solid Aerosol in the Stratosphere,” Atmospheric Chemistry and Physics 15 (2015): 11835-11859] [Joshua Horton, United States of America]	taken into account, but we are limited in space and cannot have a long discussion about proposed issue
10226	85	14	93	32	Generally this box is a bit electic in the literature it cites. It is too much of a broad review. Literature is not always complete or uptodate and relies to heavily on a submitted paper by MacMartin as its primary reference source. Most importanlty most of the box is only tangentially related to 1.5C and for me you could just refer to past assessments for mnost of this discussion and only provide an update. It needs to do a far more consice assessment in a balanced way and be less of a review [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	taken into account, Box is significantly rewritten
783	85	14	93	33	Some of the citations are not listed in the References [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial
5739	85	14	93	33	The text in Box 4.13 is too long. It should be simplified and shortened. [Hong Yang, Switzerland]	Taken into account, Box have been shortened and rewritten
11876	85	17	93	32	Thanks for all your hard work on this report. [David Morrow, United States of America]	Noted, thank you!
11874	85	17	93	32	I submitted this same comment on §3.7.3, from which much of the text on pp. 88–89 is drawn, but it's worth repeating: Although this section attempts to distinguish between extreme and moderate uses of SRM, I think it needs to do so more clearly and to convey more effectively the rationale for modeling "extreme" deployment. Identifying something as "an effect of SRM" without specifying the intensity of SRM required to get that effect is akin to identifying the slowdown of the AMOC or a massive Amazonian die-off as "an effect of climate change." It's absolutely worth highlighting the serious impacts associated with intense SRM, such as potential interference with the Asian monsoon, but it is equally important to specify that they result from intense deployment. [David Morrow, United States of America]	Taken into account, Box is rewritten to be relevant to 1.5, and will discuss only overshoot scenario
13411	85	18			Here I would suggest saying " … several SRM and related technologies have been proposed…", since you are also including cirrus cloud thinning in the list below, which aims at increasing outgoing longwave raditation and not limiting incoming solar radiation at the surface. [Helene Muri, Norway]	Accepted, text revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
13412	85	21			injecting of sulphates or other reflecting particles injecting of sulphates or other reflecting particles sulphates or other reflecting particles " should be cahnged to : " sulphates or other reflecting particles, or gaseous particle pre-cursors " [Helene Muri, Norway]	Accepted, text revised
18644	85	23	85	23	Alterskjaer et al. 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18645	85	25	85	25	Ahlm et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
20496	85	26	85	26	Cirrus cloud thinning is not a form of SRM. It may be convenient ot treat it in the same section, but I think that should be made clear [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. We propose to rename SRM to be RMM- Radiation Modification Measures, thus CCT can be included
11867	85	26	85	28	The classification of cirrus cloud thinning (CCT) as a type of SRM is problematic. While they are often discussed together, CCT targets outgoing infrared radiation rather than incoming solar radiation. So it's not technically SRM. Some researchers (e.g., Hubert & Reichwein 2015) class them together under the heading of "radiation management," but this is conceptually problematic, too. I don't have a real solution for you, except maybe to add a sentence pointing out that while this isn't technically *solar* radiation management, it is often discussed alongside SRM techniques. [David Morrow, United States of America]	Taken into account. We propose to rename SRM to be RMM- Radiation Modification Measures, thus CCT can be included
16448	85	29	85	30	The original reference for a potential implementation of this approach should be listed. It is: Early, J. T., 1989: Space-based solar screen to offset the greenhouse effect, Journal of the British Interplanetary Society 42, 567-569 [Michael MacCracken, United States of America]	Noted. Box restructured significantly and this sentence was deleted
11868	85	29	85	30	I don't think sunshade geoengineering deserves a place in the bulleted list. You might mention at the end of the following paragraph that space mirrors have been proposed, and that modelers sometimes simulate them for convenience, but that they are not feasible and so not a serious option. [David Morrow, United States of America]	Noted. Since SG is one of proposed measures described (and often modeled) in the literature we should mention it.
18646	85	30	85	30	Gaidos 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18647	85	33	85	33	Irvine et al. 2011, Seneviratne et al submitted needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
10224	85	33	85	33	Coork et al. also looked at different albedo mods and maybe useful as it compares different schemes in one model doi: 10.1002/2015JD023269 [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, reference added
18648	85	36	85	36	Davin et al. 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
18649	85	36	85	36	Seidel et al., 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial
1615	85	37	85	37	change "sheeting" to "sheeting or brightening the ocean surface (Gabriel et al., 2017)" Gabriel, Corey J., Alan Robock, Lili Xia, Brian Zambri, and Ben Kravitz, 2017: The G4Foam experiment: Global climate impacts of regional ocean albedo modification. Atmos. Chem. Phys., 17, 595-613, doi:10.5194/acp-17-595-2017. [Alan Robock, United States of America]	Accepted, reference added
1616	85	42	85	42	Change "CO2" to "CO2" [Alan Robock, United States of America]	Editorial comment. Corrected
16449	85	42	85	44	I don't think this statement is justified--most simulations come back surpisingly close to the original state. It seems to me that to justify this statement a metric must be used indicating for example how close the returned state is to the original in terms of normalized deviations--that is, within how many standard deviations of natural variability. In any case, the real question to be evaluated is whether elevated GHG with SRM is closer to the original state and preferable as compared to elevated GHG without SRM--that is the question that matters, and the sentence here simply is not about the comparison that is what matters. [Michael MacCracken, United States of America]	Taken into account. The discussion about SRM impacts is totally moved to the SRM Box.
20417	85	42	85	44	This is only true if you're talking a large amount (ie typically several °C) of SRM. I doubt that a 2°C world with 0.5°C SRM cooling is "climatologically speaking" very different from a 1.5°C world. [Olivier Boucher, France]	Taken into account. The discussion about SRM impacts is totally moved to the SRM Box.
13413	85	44	85	46	We have found in our paper currently under review in Journal of Climate, that cirrus cloud thinnig could also possibly contribute significantly towards the Paris Agreement's targets. Muri, H., Tjiputra, J. Otterå, O. H., Adakudlu, M., Lauvset, S. K., Grini, A., Schulz, M., and Kristjansson, J. E. (2017). Climate response to aerosol injection geoengineering: a multi-method comparison. Journal of climate (under review), doi: 10.1175/JCLI-D-17-0620.1. [Helene Muri, Norway]	Taken into account. Reference is added
10225	85	44	85	47	Ocean albedo in fact works better than anything at giving a uniform cooling Crook et al. doi/10.1002/2015JD024201/ [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Reference is added
15696	85	45	85	46	There is a great uncertainty on the effectivy of MCB. See eg Joyce Penner discussions. http://clasp-research.engin.umich.edu/faculty/penner/publications.php. MCB should not be included as "an effective" measure. Also stated in Table 1. [Elenita Daño, Philippines]	Noted. The uncertainty of the effectivity of MCB is discussed in the Box
15448	85	45	85	46	There is a great uncertainty on the effectivy of MCB. See eg Joyce Penner discussions. http://clasp-research.engin.umich.edu/faculty/penner/publications.php. MCB should not be included as "an effective" measure. Also stated in Table 1. [Elenita Daño, Philippines]	Noted. The uncertainty of the effectivity of MCB is discussed in the Box
4397	85	47	85	47	Probably better to add adjectives "unlikely to be economically feasible. It is almost certainly feasible in a strict technical sense of the word". [Douglas MacMartin, United States of America]	Noted. The Box is restructured and this sentence is deleted.
16450	85	47	85	47	Statement needs a bit of rewriting. Such an approach is liely technically feasible, but the costs would be much greater than other approaches (including greater mitigation and other SRM approaches)--thus it should be said is not economically feasible, even though it would likely have smaller unintended side effects than other SRM approaches (such as aerosol scattering that would affect the ratio of diffuse to direct radiation). [Michael MacCracken, United States of America]	Noted. Box is restructured significantly and this sentence is deleted
1617	85	51	85	51	Budyko (1974, 2013) not in ref. list And it is impossible to have a Budyko (2013) ref as he was no longer alive then. [Alan Robock, United States of America]	Noted. 2013 is a data of on-line publication in the Wiley Online Library, but this reference is deleted after the box restructuring.
18650	85	51	85	51	Budkyko (1974, 2013) needs a Mendeley link [Wilfran Moufouma Okia, France]	Noted. The Box is restructured and this sentence is deleted.
20497	85	52	85	52	Seminal though the Crutzen 2006 paper is, I don't think it is truly a development: Crutzen reopened the debate. The best reference for "further development" would probably be NAS 1992 [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text is corrected
1618	85	52	85	52	change "aerosols injection is an" to " aerosol injection would be an" [Alan Robock, United States of America]	Editorial. Noted
18651	85	52	85	52	Crutzen (2006) needs a Mendeley link [Wilfran Moufouma Okia, France]	Taken into account. The Mendeley link is created.
1619	85	53	85	53	change "increase" to "would increase" [Alan Robock, United States of America]	Editorial. Text is revised
1620	86	1	86	1	Should include Robock (2014, 2016): Robock, Alan, 2014: Stratospheric aerosol geoengineering, Issues Env. Sci. Tech. (special issue "Geoengineering of the Climate System"), 38, 162-185. Robock, Alan, 2016: Albedo enhancement by stratospheric sulfur injection: More research needed. Earth's Future, 4, 644-648, doi:10.1002/2016EF000407. [Alan Robock, United States of America]	Taken into account. The suggested references will be considered.
1622	86	1	86	1	Visioni et.al. (2017) not in reference list. [Alan Robock, United States of America]	Taken into account. Will be included

Comment No	From Page	From Line	To Page	To Line	Comment	Response
4398	86	1	86	2	An additional useful reference would be MacMartin, D. G., K. L. Ricke, and D. W. Keith, “Solar Geoengineering as part of an overall strategy for meeting the 1.5°C Paris target”, submitted, Phil. Trans. Royal Soc. A. Also note that Peter Irvine's last name is mis-spelled twice. [Douglas MacMartin, United States of America]	Taken into account. The suggested reference will be considered. The spelling is corrected
13414	86	2			Irvin should be "Irvine" in both cases. [Helene Muri, Norway]	Editorial. Corrected
1621	86	2	86	2	change "Irvin (2016) and Irvin" to "Irvine (2016), and Irvine" [Alan Robock, United States of America]	Editorial. Corrected
11869	86	2	86	2	Peter Irvine's last name is misspelled twice here (as 'Irvin'), though it is spelled correctly in the reference list. [David Morrow, United States of America]	Editorial. Corrected
20418	86	2	86	2	Irvine [Olivier Boucher, France]	Editorial. Corrected
18652	86	2	86	2	Visioni et al. (2017) and the three other references need a Mendeley link [Wilfran Moufouma Okia, France]	Taken into account. The Mendeley link will be created.
13415	86	4			Rephrase to: "The most often considered SAI approach", since this has not been in use yet - other than in models. [Helene Muri, Norway]	Taken into account. The text will be corrected
21190	86	4	81	4	used ismisleading.better:"the techniquemost often considered inmodelsis SAI …. [David Cooper, Canada]	Taken into account. The text will be corrected
4399	86	4	86	4	Most often simulated, not most often used! [Douglas MacMartin, United States of America]	Taken into account. The text will be corrected
15697	86	4	86	4	Penner also question the measures about the effects of the Mount Pinatuno eruption in 1991. This statement needs to be nuanced. [Elenita Daño, Philippines]	Taken into account. The text will be corrected
1623	86	4	86	4	change "used" to "suggested" Don't leave room for misinterpretation by chemtrails folks. [Alan Robock, United States of America]	Noted. The text is edited as following - The most often simulated
15449	86	4	86	4	Penner also question the measures about the effects of the Mount Pinatuno eruption in 1991. This statement needs to be nuanced. [Elenita Daño, Philippines]	Taken into account. The text will be corrected
11870	86	4	86	4	It is inappropriate to refer to sulfate aerosols as the "most often used SAI approach," since no SAI approaches are actually used. Perhaps "the most studied" or "most often discussed" would work instead? [David Morrow, United States of America]	Taken into account. The text will be corrected
4706	86	5			Use "Gt" instead of "Tg". [Radim Tolasz, Czech Republic]	Noted. This sentence is deleted from the final text
18653	86	7	86	7	Visioni et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Taken into account. The Mendeley link is created
20419	86	10	86	13	It can be shown (Boucher et al., GRL, submitted) that the combination of SAI and MCB results in a forcing that could be more homogeneous in space and in time. [Olivier Boucher, France]	Taken into account. The suggested reference was considered.
18654	86	13	86	13	Latham et al. 2012 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial. The Mendeley link is created
1624	86	16	86	16	change "on G3" to "on the G3" [Alan Robock, United States of America]	Editorial. Corrected
18655	86	16	86	16	Kravitiz et al. 2011; Niemeier et al. 2013 [Wilfran Moufouma Okia, France]	Editorial. The Mendeley link is created
4400	86	17	86	17	The 60% is specific to a particular amount of geoengineering deployed; not a characteristic of the method itself; this is a choice. Sentence needs to be made clearer about what was assumed. [Douglas MacMartin, United States of America]	Noted. This sentence is deleted from the final text
1625	86	17	86	17	change "reduce" to "would reduce" [Alan Robock, United States of America]	Editorial. Corrected
1626	86	17	86	17	by about 60% globally This is incorrect. The G3 experiment required a 100% compensation of the warming. [Alan Robock, United States of America]	Noted. This sentence is deleted from the final text
18656	86	17	86	17	Aswathy et al. (2015) needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial. The Mendeley link is created
4401	86	18	86	19	As noted in comments for chapter 3, the residual warming in the Arctic is also a consequence of how the approaches are deployed in the simulation, and not a property of SAI or MCB per se; see e.g. MacMartin et al 2017 and Kravitz et al 2017. (Full reference: (1) Kravitz, B., D. G. MacMartin, M. J. Mills, J. H. Richter, S. Tilmes, J.-F. Lamarque, J. J. Tribbia and F. Vitt, “First simulations of designing stratospheric sulfate aerosol geoengineering to meet multiple simultaneous climate objectives”, submitted, J. Geophys. Res. A. and (2) MacMartin, D.G., B. Kravitz, S. Tilmes, J. Richter, M. Mills, J.-F. Lamarque, J.J. Tribbia, and F. Vitt, “The climate response to stratospheric aerosol geoengineering can be tailored using multiple injection locations” to appear, J. Geophys. Res. A.) [Douglas MacMartin, United States of America]	Taken into account. The suggested references are considered
1627	86	19	86	23	Delete. Why is so much space given to the details of one paper, which is not particularly better than any others? [Alan Robock, United States of America]	Noted. This sentence is deleted from the final text
13425	86	20	86	22	You may also wish to cite Stjern et al. (2017) here (Stjern, C. W., Muri, H., Ahlm, L., Boucher, O., Cole, J. N. S., Ji, D., Jones, A., Haywood, J. M., Kravitz, B., Lenton, A., Moore, J. C., Niemeier, U., Phipps, S. J., Schmidt, H., Watanabe, S., and Kristjánsson, J. E. (2017). Response to marine cloud brightening in a multi-model ensemble. Atmospheric Chemistry and Physics Discussions. doi: 10.5194/acp-2017-629.). [Helene Muri, Norway]	Taken into account. The suggested reference was considered
18657	86	27	86	27	Kravitiz et al. (2013) needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial. The Mendeley link is created
1628	86	27	86	28	What does "technique and level and aerosols injection area." mean? Level in vertical? What differences in technique? [Alan Robock, United States of America]	Noted. This sentence is deleted from the final text
13420	86	28			Replace "ocean" by "marine cloud". [Helene Muri, Norway]	Editorial. Text is revised
1629	86	28	86	28	ocean albedo increase is not MCB. [Alan Robock, United States of America]	Editorial. The Mendeley link is created
13421	86	30	86	33	Rewrite " The sea salt injection technique under RCP4.5 forcing, starting in 2021, needs a uniform distribution of about 212 Tg a-1 dry sea-salt aerosol emissions in the marine boundary layer between 30°S and 30°N by, to produce a global-mean effective radiative forcing (ERF) of -2.0Wm-2 33 (Kravitz et al. 2013)." to "To achieve a radiative cooling of -2 W m-2, sea salt emissions over the latitude band 30°S and 30°N would need to be increased by 266 and 560 Tg per year (Ahlm et al. 2017).". [Helene Muri, Norway]	Noted. Text is significantly revised
21191	86	31	86	31	starting in 2021 specify that this is a scenario! [David Cooper, Canada]	Noted. This sentence is deleted from the final text
1630	86	32	86	32	delete "by," [Alan Robock, United States of America]	Editorial. Revised
18658	86	33	86	33	Kravitiz et al. (2013) needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial. The Mendeley link is created
13422	86	34			Add at the end of the sentence: ", as that is where the most susceptible clouds tend to be and where the incoming solar radiation is the strongest.". [Helene Muri, Norway]	Noted. This sentence is deleted from the final text
13416	86	36			Add "less" before "well". There are fewer studies on CCT than MSB and SAI, by quite a bit. [Helene Muri, Norway]	Taken into account. Misprint error. The text is revised
20498	86	36	86	36	My impression from eg this summer's Gordon Research Conference is that the word "not" is missing from "Cirrus could thinning is well studied". Cirrus cliud thinning is not well studied. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account. Misprint error. The text is revised
1631	86	36	86	36	Cirrus thinning is NOT well studied. There are major doubts about the ability of climate models to simulate cirrus in the current climate, let alone the effects of particle injection. [Alan Robock, United States of America]	Taken into account. Misprint error. The text is revised
11871	86	36	86	36	I'm surprised to read that cirrus cloud thinning is "well studied." My impression is that there are relatively few studies. That was the case a few years ago, and I don't think it's changed. I hope that the physical scientists reviewing this section will comment on that. [David Morrow, United States of America]	taken into account. Misprint error. The text is revised

Comment No	From Page	From Line	To Page	To Line	Comment	Response
15698	86	36	86	38	This is not well studied. See Penner again. Very biased sentence, should be deleted. Uncertainty even stated in Table 1â [Elenita Daño, Philippines]	taken into account. Misprint error. The text is revised
15450	86	36	86	38	This is not well studied. See Penner again. Very biased sentence, should be deleted. Uncertainty even stated in Table 1â [Elenita Daño, Philippines]	taken into account. Misprint error. The text is revised
20420	86	36	86	38	I am not sure cirrus cloud thinning is "well studied". Most importantly there is not much evidence of its feasibility. SAI and MCB have leverage : SAI has leverage because the lifetime of the stratospheric aerosols is relatively long, MCB has leverage because it is "relatively" easy to spray large quantities of sea water at the ocean surface. For cloud thinning, the amount of material needed might be small but it would need to be sprayed everywhere all the time. [Olivier Boucher, France]	Taken into account. Misprint error. The text is revised
13418	86	37			The degree of cooling from cirrus cloud thinning also depends on the location and purity of the ice clouds and the time of day/ time of year. I.e. the method is most effective during night-time and polar winter (Muri et al., 2014: Muri, H., Kristjánsson, J. E., Storelvmo, T. and Pfeffer, M. A. (2014). The climatic effects of modifying cirrus clouds in a climate engineering framework. Journal of Geophysical Research - Atmospheres. 119, 4174 - 4191. doi: 10.1002/2013JD021063). [Helene Muri, Norway]	taken into account. The suggested reference was considered
13419	86	37			Schmidt can be replaced by "Muri". [Helene Muri, Norway]	Taken into account. The reference is revised
13417	86	37	86	38	We have found a maximum cooling of -2 °C from cirrus cloud thinning in our study: Muri, H., Tjiputra, J. Otterå, O. H., Adakudlu, M., Lauvset, S. K., Grini, A., Schulz, M., and Kristjansson, J. E. (2017). Climate response to aerosol injection geoengineering: a multi-method comparison. Journal of climate (under review), doi: 10.1175/JCLI-D-17-0620.1. I will send it to you. [Helene Muri, Norway]	Taken into account. The value is revised and the suggested article is considered
18659	86	38	86	38	Crook et al. 2015; Muri et al. 2014; Storelvmo et al. 2014 need Mendeley links [Wilfran Moufouma Okia, France]	Editorial. The Mendeley link is created
18660	86	41	86	41	MacMartin et al., 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial. The Mendeley link is created
4707	87				Box 4.13, Tab 1, row 2-7, column 5 - Use "Gt" instead of "Tg" [Radim Tolasz, Czech Republic]	Editorial comment. Corrected
4708	87				Box 4.13, Tab 1, row 6-7, column 5 - Use "yr-1" instead of "a-1" [Radim Tolasz, Czech Republic]	Editorial comment. Corrected
20421	87		87		Why is stratospheric heating a disadvantage of SAI? Stratospheric heating increases the emission of LW radiation, hence would contribute to enhance the effective radiative forcing of SAI. [Olivier Boucher, France]	taken into account. The table is significantly revised in the SOD. The section on cirrus thinning is also revised.
21192	87		87		2nd column heading is potentially misleading:itisonly the global avergae temeperature that is stabilizaed [David Cooper, Canada]	taken into account. The table is significantly revised in the SOD.
21193	87		87		clarify that this table adresses only technical considerations [David Cooper, Canada]	taken into account. The table is significantly revised in the SOD.
20143	87		93		Chapter 4 authors should delete this box, and Table 1 in Box 4.13 in particular - it is clearly written by geoengineering/SRM proponents who aim to understate SRM manifold profound risks. Why does this table only look at technical and cost "disadvantages"? This is excessively unbalanced. It is also repetitive - why have an additional box at all if SRM is covered in the main body of the chapter? [Lili Fuhr, Germany]	taken into account. The SRM is considered mainly in the SRM box to avoid repetition. Also the table is revised in the SOD
16451	87	1	87	2	Regarding the heading of the second column, the wording does not seem optimal. Given that other changes will be going on, such as continued ice sheet mass loss and sea level rise, and ongoing adjustment due to thermal inertia and the removal of sulfates, etc., it seems to me that a better heading would be "Ability to bring global temperature back toward its baseline state"--I just don't think stabilization is really the word to be using. [Michael MacCracken, United States of America]	taken into account. The table is significantly revised
16452	87	1	87	2	On SAI disadvantages, the real limitation is being able to create longitudinal distributions; it is possible to achieve some variation of latitudinal, hemispheric, and temporal distributions by adjusting injections latitude, altitude and timing. With regard to the illustrative climatic responses shown, all are for very large amount and quite high RCP scenarios--typically much greater than has been discussed in this report. [Michael MacCracken, United States of America]	taken into account. The climate response is much more discussed in aspect of 1.5 degree in the SOD
16453	87	1	87	2	It would seem that the examples and citing for MCB should include the proposers of the approach and not just Kravitz et al., 2013. [Michael MacCracken, United States of America]	taken into account. The table is significantly revised in the SOD as well as additional references on MCB are considered
16454	87	1	87	2	Regarding the row on cirrus thinning, the text at page 86, lines 36-38 indicates this approach has bee "well studied" and yet the entry here is very sparse. This is a rather obvious mismatch. [Michael MacCracken, United States of America]	taken into account. Misprint error. The text is revised
11109	87	1	87	3	The authors have modified a table from MacMartin, Ricke, and Keith (forthcoming) making the table incoherent. The authors added columns for "application burden" and "climatic response", I believe the intention was to add specific examples that demonstrated the general claims made in the first three columns (the original table), however the modification is incoherent. One cannot determine why specific examples were chosen because no conclusions are drawn from the examples presented. We do not see how simply choosing better examples can solve the basic design problem that there is not a clear relationship between the claims in the original MacMartin, Ricke, and Keith table and these additional examples. Suggest that examples be integrated in the text if they serve a useful function but that these new columns be eliminated from the table. [Douglas G. MacMartin, Katharine L. Ricke, and David W. Keith, “Solar Geoengineering as Part of an Overall Strategy for Meeting the 1.5°C Paris Target,” Philosophical Transactions A (forthcoming)] [Joshua Horton, United States of America]	taken into account. The table is significantly revised
18661	87	1	90	54	Box 4.13, Table 1 - all references need Mendeley links [Wilfran Moufouma Okia, France]	taken into account. The Mendeley links are created
13423	87	2			In the table regarding the MCB information, column 2: " no system-level analysis of cost of deployment". This is confusing, since the deployment costs are discussed on page 40. [Helene Muri, Norway]	taken into account. The table is significantly revised in the SOD
13424	87	2			Baseline – RCP4.5; start in 2020; 212 Tg a-1 dry sea-salt aerosol emissions in the marine boundary layer 30°S - 30°N: the emission strengths here should be 212 - 560 Tg a-1, and Ahlm et al. (2017) should be cited in addition to Kravitz et al. (2013). [Helene Muri, Norway]	taken into account. The table is significantly revised in the SOD, additional suggested reference are considered
4402	87	2	87	2	Kravitz et al (in the previous comment) is another more recent reference to add to the table. [Douglas MacMartin, United States of America]	taken into account. The table is significantly revised in the SOD as well as additional references are considered
1632	87	2	87	2	In Box 4.13, Table 1, "Disadvantages" column heading needs a footnote that says, "disadvantages listed here are direct effects of each specific proposed scheme, but there are many other disadvantages to SRM in general, discussed in the text." [Alan Robock, United States of America]	taken into account. The table is significantly revised in the SOD. The section on disadvantages is not included in the final SOD version.
1633	87	2	87	2	In Box 4.13, Table 1, MCB, Advantages box: "Can also be used in clear-sky conditions" You can inject aerosols into the troposphere without clouds, but this is NOT MCB. [Alan Robock, United States of America]	taken into account. The table is significantly revised in the SOD. The section on MCB is also revision.
1634	87	2	87	2	In Box 4.13, Table 1, Cirrus thinning, Advantages box: Change "compensation" to "compensation, may not reduce precipitation like SAI" [Alan Robock, United States of America]	taken into account. The table is significantly revised in the SOD. The section on cirrus thinning is also revised.
1635	87	2	87	2	In Box 4.13, Table 1, Cirrus thinning, References box: There are several references that can be listed here. [Alan Robock, United States of America]	taken into account. The table is significantly revised in the SOD. The section on cirrus thinning is also revised.
11872	87	3	87	3	In Table 1, again, I don't think space mirrors deserve a seat at the table. [David Morrow, United States of America]	taken into account. The table is significantly revised in the SOD.
1636	88	1	88	1	change "SR" to "SRM" [Alan Robock, United States of America]	Editorial comment. Corrected
1637	88	4	88	4	Change "et.al." to "et al." twice in this line, change "Irvin" to "Irvine" [Alan Robock, United States of America]	Editorial comment. Corrected
1638	88	9	88	9	Change "et.al." to "et al." [Alan Robock, United States of America]	Editorial comment. Corrected

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1639	88	14	88	16	Discussion of lifetime here is wrong. You have to define "lifetime." The typical metric is "e-folding lifetime," which fpr the 1991 Pinatubo aerosols was one year. [Also, "Pinatubo" means nothing unless you give the year of eruption, as it has erupted many times.] [Alan Robock, United States of America]	Noted. This sentence is deleted from the final text
20422	88	16	88	16	How do you define lifetime? For volcanic eruptions, it is more common to talk about e-folding time. And it is much shorter than 4 years. You may also look at Kleinschmitt et al., ACPD, 2017, and Niemeir's papers. [Olivier Boucher, France]	Noted. This sentence is deleted from the final text
10227	88	18	88	27	Why do you need the paragraph on G4, not relevant to 1.5C [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	taken into account. The SOD is more related to the 1.5C discussion.
6189	88	18	88	27	A review of the available literature on SAI studies was made by Visioni et al. (2017). There a summary is presented of the direct and indirect effects from the injected stratospheric aerosols. For this reason, I would suggest to discuss in a bit more detail the separation of these effects. In particular, I believe that Figure 4 in this review article could be included as it is in the box, since it has been structured in a fashion suitable for IPCC usage. Maybe with an appropriate caption, similar to the one in the original article. The importance of this figure is that it allows to highlight the quantitative role of the indirect radiative effects, pointing out to the possibility of a smaller SAI deployment in order to reach the desired radiative target. It should also be considered that all literature studies cited in the IPCC report only focus on the direct radiative impact of SAI. [Giovanni Pitari, Italy]	taken into account. Thank you. The suggested reference and figure are considered
4709	88	20			Use "Gt" instead of "Tg". [Radim Tolasz, Czech Republic]	Editorial. Corrected
4710	88	25			Use "Gt" instead of "Tg". [Radim Tolasz, Czech Republic]	Editorial. Corrected
20499	88	29	88	29	I don't think it is reasonable to call these studies proposals: "has been discussed" would be more accurate [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. Corrected
16455	88	29	88	34	Indeed, most of the discussion has been about invoking SRM as a large emergency response--and there are all sorts of problems that arise if this is the planned approach, including that the proposed emergency situation (e.g., sudden collapse of the West Antarctic ice sheet) are simply not reversible by SRM; in addition, the shock to the system of a large and sudden application of SRM would likely have its own quite large consequences, and not necessarily beneficial in the near term plus requiring this large level of intervention be continued even if there are problems. A much more sensible scenario and application of SRM would be a gradual phasing in to offset the temperature overshoot that has been raised as the concern in this report. This type of approach really needs to be discussed, particularly because the types of complications would be much smaller and the gradual phasing up would allow iterative adjustments and learning while doing. [Michael MacCracken, United States of America]	Taken into account Overshoot scenarios and peak-shaving SRM approach are discussed in the SOD
20500	88	31	88	31	Irvin should be "Irvine" (this error is repeated elsewhere) [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. Corrected
20501	88	38	88	38	missing word: "most feasible methods are" [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Editorial. Corrected
20502	88	47	90	22	These paragraphs are almost verbatim the same as those found in Chapter 3, {3.7.3} I think they should go in o. ne place or the other -- probably here. For comments on the material in these paragraphs please see my comments 13-26 referring to Chapter 3 pp119-121 [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The text in Chapter 3 has been strongly shortened since this box is now a cross-chapter box.
13426	88	48	89	51	This text is duplicate from Chapter 3 and may be cut. [Helene Muri, Norway]	Noted. The text in Chapter 3 has been strongly shortened since this box is now a cross-chapter box.
11873	88	48	89	6	The explicit contrast between "sunshade geoengineering" (SG) and SAI seems unwarranted. SG is total science fiction; it's not going to happen. Modelers study it only because it is a convenient approximation for more plausible implementations of SRM. I'm not sure the difference between studies that turn down the solar constant and studies with more detailed simulations needs to be drawn here. But if it is drawn, I would recommend simply pointing out that different studies model SRM at different levels of detail. [David Morrow, United States of America]	Accepted. The text now does not discuss SG, but focusing at the most feasible options
4403	88	51	88	54	The statement that SG and SAI are "designed to offset some fraction of the global mean warming"... is not true; the fraction is a choice (that any particular simulation has to make), not a property of SRM per se. Similarly L54, any particular simulation might be set up to balance a radiative forcing, but SG and SAI most unequivocally are not. [Douglas MacMartin, United States of America]	Noted. This text has been removed.
1640	88	53	88	54	Robock (2014) not in reference list. Should be: Robock, Alan, 2014: Stratospheric aerosol geoengineering, Issues Env. Sci. Tech. (special issue "Geoengineering of the Climate System"), 38, 162-185. [Alan Robock, United States of America]	Noted. Text have been shorten significantly and this reference was deleted
4404	89	1	89	1	Add citation to the most recent literature (so recent it hasn't yet appeared, so you couldn't have known about it): Tilmes, S., J. H. Richter, M. M. Mills, B. Kravitz, D. G. MacMartin, F. Vitt, J. Tribbia, and J.-F. Lamarque, "Sensitivity of aerosol distribution and climate response to stratospheric SO2 injection locations", submitted, J. Geophys. Res. A. [Douglas MacMartin, United States of America]	Noted. Could be included in next draft if published by then.
20503	89	9	89	9	after "most in regions" the phrase "with expected greatest warming under elevated GHG conditions (i.e. high-latitudes)" is missing (cf chapter 3 p120) [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted. The corresponding text has been deleted. However, this notion has been included a the beginning of the new cross-chapter box: "It should be noted that approaches modifying global albedo (SAI, SG) do not offset well greenhouse gas forcing, since the largest effects are in regions with high solar radiations (tropics), while greenhouse gas warming is most pronounced in the high-latitudes.".
4405	89	10	89	55	Several paragraphs here are identical to the text in chapter 3; see comments there. (For example, the statement on lines 10 and 12 is not a property of SAI per se, it is a property of a particular choice for the latitudes at which to deploy it; see Kravitz et al 2017). (I presume it is not necessary to cut and paste the same comments for the identical text!) [Douglas MacMartin, United States of America]	Noted. The text in Chapter 3 has been strongly shortened since this box is now a cross-chapter box.
16456	89	10	89	10	It would be helpful to indicate how much overcooling and how significant this is. Generally these departures are pretty small as compared to the amount of the adjustment that is being made, so that there would nonetheless be a significant benefit to the overall change. And were this not the case, a slightly reduced SRM intervention could be done. In addition, this is the case for simulations where the forcing is uniform in season and latitude, which is not required. Basically, as I have said elsewhere, there has yet to be engineering of the geoengineering--that is optimization of the result by injecting aerosols so it might have less aerosol at low latitudes and a bit more at higher latitudes. Thus, the criticism here is really not an inherent problem with SRM--just with the model simulations that have been done to date. The next several lines similarly may be criticisms of the particular simulation, but are not inherent shortcomings of SRM. [Michael MacCracken, United States of America]	Noted. Cannot be addressed because of shorter text.
16457	89	13	89	16	This criticism is really inappropriate. Of course, SRM reduces the intensity of the hydrological cycle compared to 4 times CO2--that is the whole intent given that the 4 times CO2 has greatly increased the intensity of the hydrological cycle. What matters is how the intensity of the cycle compares to the baseline case, and whether the 4XCO2 case without SRM is a worse or better situation as compared to 4XCO2 with SRM. Basically, the comparison here is the wrong one to be concerned about. [Michael MacCracken, United States of America]	Rejected. The impacts on the water cycle are relevant since they correspond to novel climate conditions.
16458	89	16	89	18	Again, the comparison is not the one to be making--what is of concern is how the case of elevated GHG without SRM compares to the case for elevated GHG with SRM. [Michael MacCracken, United States of America]	Rejected. The important point is that SAI does not restore pre-industrial conditions but creates novel climate conditions.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16459	89	27	89	28	But how different, and how different compared to the situation without SRM. Of course it would be better to do greater mitigation, but SRM is not being proposed as a substitute for mitigation, but as a supplement to it. Thus, the comparison given here is just not the appropriate one. [Michael MacCracken, United States of America]	Rejected. The important point is that SAI does not restore pre-industrial conditions but creates novel climate conditions.
16460	89	29	89	35	Line 29 is a very general conclusion to draw here--it may not be perfect, but how bad would it be. Such a simplified dismissal is just not justified. And again, what matters is the comparison to the situation without SRM, not to a situation assuming additional mitigaton. And this comment applies also to subsequent sentences in this paragraph. These sentences are roughly saying that one should not use a tourniquet because it does not perfectly heal the bleeding limb; of course, not, but it is far better than bleeding to death. It is really essential to be reframing a lot of the present SRM discussion. [Michael MacCracken, United States of America]	Rejected. The important point is that SAI does not restore pre-industrial conditions but creates novel climate conditions.
16461	89	37	89	39	Well, hooray for considering an alternative to a massive alternative application of SRM. [Michael MacCracken, United States of America]	Noted. Moderate SRM and "peak-shaving" approaches are now mentioned more prominently at the start of the cross-chapter box.
12292	89	37	89	41	Some nuances regarding possibilities for using SRM to reduce risk, duration and magnitude of overshoot could be included. [Jan Fuglestvedt, Norway]	Noted. Moderate SRM and "peak-shaving" approaches are now mentioned more prominently at the start of the cross-chapter box.
20426	89	37	89	41	This is a key point in the context of this report, but seems to be lost in this very long box. Many of the side effects of SRM would be lost in the noise if you're talking about a small SRM effort to shave a 2°C or 2.5°C warming. There would still be many issues, but the fact that some SRM disadvantages are function of the SRM magnitude while others are not should come out better from this report. [Olivier Boucher, France]	Noted. Moderate SRM and "peak-shaving" approaches are now mentioned more prominently at the start of the cross-chapter box.
16462	89	39	89	41	This alleged lack or potential regional specificity really mainly applies to stratospheric aerosol injection, and even this approach has the potential for achieving some regional objectives (e.g., see MacCracken, M. C., H-J. Shin, K. Caldeira, and G. Ban-Weiss, 2013: Climate response to solar insolation reductions in high latitudes, Earth Systems Dynamics, 4, 301-315, 2013; www.earth-syst-dynam.net/4/301/2013/; doi:10.5194/esd-4-301-2013). This criticism simply should not be generalized to other SRM approaches; for example it is simply not appropriate for Marine Cloud Brightening (or for clear sky brightening by aerosol injection into the troposphere), nor for some other approaches that might be used locally such as using nanobubbles to brighten relatively small water bodies. We know that existing sulfate and tropospheric ozone RF are distributed regionally and exert regional influences and so exerting regional influences is clearly possible--and these also indicate what the limits are to exerting regional influences and would be good case studies for considering how MCB might be applied. So, this sentence is simply not justified. [Michael MacCracken, United States of America]	Rejected. SAI is the main approach considered in the literature. Due to space limitation the discussion about possibility for some regional optimization was deleted
11095	89	39	89	41	The report states that “traditionally considered SRM implementations such as SAI do not have scope for regional adjustment of the applied radiative forcing”. This statement is not accurate. The regional coverage of SAI depends strongly on injection methods. Depending on the injection location, regional localization of RF through aerosol can be achieved. Niemeier et al. [2011] showed that with equatorial injections, the resulting aerosol plumes exhibit different spatial distributions depending on injection locations. Robock et al. [2008] showed different aerosol spatial distributions depending on whether the injection was equatorial or polar. In an extreme case, it was shown that with injections at low altitudes, regional control of the aerosol plume down to state level was possible [Bernstein et al., 2013], albeit at a cost of low RF efficacy. [U. Niemeier, H. Schmidt, and C. Timmreck, “The Dependency of Geoengineered Sulfate Aerosol on the Emission Strategy,” Atmospheric Science Letters 12 (2011): 189-194); Alan Robock, Luke Oman, and Georgiy L. Stenchikov, “Regional Climate Responses to Geoengineering with Tropical and Arctic SO2 Injections,” Journal of Geophysical Research 113 (2008), doi: 10.1029/2008JD010050; D.N. Bernstein, J.D. Neelin, Q.B. Li, and D. Chen, “Could Aerosol Emissions Be Used for Regional Heat Wave Mitigation?,” Atmospheric Chemistry and Physics 13 (2013): 6373-6390] [Joshua Horton, United States of America]	Noted. Literature could not be included in detail because of space limits.
15700	89	43	89	51	There should be reference to technologies that produce "Changes in the albedo of agricultural land", which could include genetic engineering, synthetic biology, etc. especially as this relates to "regional SRM" which also needs to be expounded. This may imply a range or risks, including the use of synbio crops and GMOs, as well as other impacts on crops, vegetation and biodiversity. Additionally, the efficacy would be very low, as stated, so I suggest DELETION of this para. [Elenita Daño, Philippines]	Rejected. All of the box mentions that considered RM measures are generally untested and risky.
15452	89	43	89	51	There should be reference to technologies that produce "Changes in the albedo of agricultural land", which could include genetic engineering, synthetic biology, etc. especially as this relates to "regional SRM" which also needs to be expounded. This may imply a range or risks, including the use of synbio crops and GMOs, as well as other impacts on crops, vegetation and biodiversity. Additionally, the efficacy would be very low, as stated, so I suggest DELETION of this para. [Elenita Daño, Philippines]	Rejected. All of the box mentions that considered RM measures are generally untested and risky.
11092	89	53	89	55	The report asserts that "It is important to note that independently of any regional footprint of application, changes in temperature that result from changes in radiative forcing (such as with SAI-based SRM, but also land-based changes in surface albedo) do not address non-temperature impacts of greenhouse-gas concentrations, and in particular ocean acidification (see Chapter 3, Section 3.3.1.1, IPCC 2014)." This statement is misleading. Whilst SRM is not a substitute for emissions cuts it seems very likely to reduce the atmospheric carbon burden and the ocean carbon content compared to a scenario without SRM and this should be noted. SRM would lower temperatures reducing a number of positive carbon-climate feedbacks, specifically the loss of permafrost carbon and the projected loss of carbon stored in soils in a warmer world [Keith et al. 2017; Matthews et al. 2007; Tjiputra et al. 2016]. These results are noted in chapter 3 but should be referred to here as well. In addition, higher temperatures will increase demand for cooling and reduce the efficiency of thermal power plants [Keith et al. 2017]. [David W. Keith, Gernot Wagner, and Claire L. Zabel, “Solar Geoengineering Reduces Atmospheric Carbon Burden,” Nature Climate Change 7 (2017): 617-619; H. Damon Matthews and Ken Caldeira, “Transient Climate-Carbon Simulations of Planetary Geoengineering,” PNAS 104 (2007): 9949-9954; T.F. Tjiputra, A. Grini, and H. Lee, “Impact of Idealized Stratospheric Aerosol Injection on the Large-Scale Ocean and Land Carbon Cycles,” JGR Biogeosciences 121 (2016): 2-27] [Joshua Horton, United States of America]	Rejected. Albedo-based methods do indeed not directly counteract ocean acidification. Justification through carbon-cycle feedbacks is too far-fetched.
16463	89	55	90	1	How can this say only temperature is influenced by SRM--that is simply not the case as the text has indicated by saying that the hydrologic cycle is influenced--and so are all sorts of other climatic variables such as loss rate of glaciers, sea level rise (due to heat uptake and ice melting), precipitation, storm tracks, climate extremes and more. Indeed, I'm for mitigation as well to address ocean acidification, but suggesting one does not do SRM because it does not address ocean acidification is like saying to a person injured in an accident that one does not try to help on severe bleeding because the person also got a concussion and I cannot address that as well. [Michael MacCracken, United States of America]	Rejected. Lack of impact on ocean acidification needs to be mentioned.
15701	90	1			It is stated that it does not address ocean acidification. But sulfur particles that fall in SRM would have an effect to increase the acidifaction. This aspect must be included as an impact of SRM. [Elenita Daño, Philippines]	Noted. Please indicated a possible relevant reference on this point. Other publications that were suggested by another reviewer (number 13427) were added.
15453	90	1			It is stated that it does not address ocean acidification. But sulfur particles that fall in SRM would have an effect to increase the acidifaction. This aspect must be included as an impact of SRM. [Elenita Daño, Philippines]	Noted. Please indicated a possible relevant reference on this point. Other publications that were suggested by another reviewer (number 13427) were added.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
13427	90	1			With regards to SRM and ocean acidification, you might want to check Tjiputra et al.(2016) and Lauvset et al. (2017), showing that regionally, in particular in the North Atlantic, ocean acidification is worsened by the SRM. Lauvset, S. K., Tjiputra, J., and Muri, H. (2017). Climate engineering and the ocean: effects on biogeochemistry and primary production. Biogeosciences Discuss. doi: 10.5194/bg-2017-235. Tjiputra, J. F., Grini, A., and Lee, H.: Impact of idealized future stratospheric aerosol injection on the large scale ocean and land carbon cycles, Journal of Geophysical Research: Biogeosciences, 120, doi: 10.1002/2015jg003045, 2016. [Helene Muri, Norway]	Accepted, thanks. The references were added.
11100	90	3	90	3	The report notes "the lack of testing of proposed schemes" and cites Schäfer 2013. This is a valid and essential point to explore, however, the possibility for experimental research to reduce the scientific uncertainty in knowledge of the risks and efficacy of a potential deployment of geoengineering has advanced well beyond this early work. The discussion of this possibility has advanced both in terms of exploring the viability of research on natural analogs and deliberative perturbative experiments, and in the governance and ethics of such experimental proposals. Both national scientific institutions (National Research Council, 2015; Shepherd, 2009) and individual investigators (Keith et al. 2014; Robock et al. 2013; Lenferna et al. 2017) have contributed to this discussion. While there has been minimal activity to date in pursuing these experimental investigations, their discussion is significantly more advanced and richer than what is reflected in the current text. [National Research Council. (2015). Climate Intervention: Reflecting Sunlight to Cool Earth. National Academies Press; Shepherd, J. G. (2009). Geoengineering the climate: science, governance and uncertainty. Royal Society; Keith, D. W., Duren, R., & MacMartin, D. G. (2014). Field experiments on solar geoengineering: report of a workshop exploring a representative research portfolio. Phil. Trans. R. Soc. A, 372(2031), 20140175; Robock, A., MacMartin, D. G., Duren, R., & Christensen, M. W. (2013). Studying geoengineering with natural and anthropogenic analogs. Climatic Change, 121(3), 445-458; Lenferna, A., Russotto, R., Tan, A., Gardiner, S., & Ackerman, T. (2017). Relevant Climate Response Tests for Stratospheric Aerosol Injection: A Combined Ethical and Scientific Analysis. Earth's Future] [Joshua Horton, United States of America]	Rejected. As it is explicitly stated in the comment "... there has been minimal activity to date in pursuing these experimental investigations…". We thus do not further elaborate on this, besides please note that we are limited in space and had to shorten the text
11099	90	3	90	4	The report states that “risks of SAI include… depletion of stratospheric ozone (Tilmes et al, 2008) which remain very uncertain (Irvine et al, 2016)”. However, Irvine et al state that “despite these uncertainties in modeling studies to date, the projections of its effects are fairly consistent”. Since the 2008 paper, a study by Tilmes et al (2012) has projected that SAI could actually increase ozone burdens in some or all circumstances due to changing halogen burdens, a finding supported by Pitari et al’s multi-model assessment (2014). Pitari et al also state that the modeled increase “is negligible in terms of health effects”. This is all without considering the potential of non-sulfate aerosols to increase column ozone even under high-halogen conditions (Keith et al, 2016). [S. Tilmes, R. Müller, R. Salawitch, The sensitivity of polar ozone depletion to proposed geoengineering schemes. Science. 320, 1201–1204 (2008); P. J. Irvine, B. Kravitz, M. G. Lawrence, H. Muri, An overview of the Earth system science of solar geoengineering. WIREs Clim Change. 7, 815–833 (2016); S. Tilmes et al., Impact of very short-lived halogens on stratospheric ozone abundance and UV radiation in a geo-engineered atmosphere. Atmos. Chem. Phys. 12, 10945–10955 (2012); G. Pitari, V. Aquila, B. Kravitz, Stratospheric ozone response to sulfate geoengineering: Results from the Geoengineering Model Intercomparison Project (GeoMIP). Journal of Geophysical Research - Atmospheres, 2629–2653 (2014); D. W. Keith, D. K. Weisenstein, J. A. Dykema, F. N. Keutsch, Stratospheric solar geoengineering without ozone loss. Proc. Natl. Acad. Sci. U. S. A. 113, 14910–14914 (2016)] [Joshua Horton, United States of America]	Rejected. The comment itself shows that results are uncertain (supporting what we have already mentioned). The studies cited point to model uncertainties and cannot provide the full picture to assess impacts on ozone depletion robustly.
16464	90	3	90	8	Responses in turn: (1) Indeed, one cannot really test a sudden large scale SAI intervention, but large volcanic injections are quite analogous and if we improve our models by testing versus volcanic eruptions and conduct some small scale field experiments to better understand some particular processes like particle formation, we likely have a pretty good prediction system for what will happen, and if faced with the option of not addressing some large-scale emergency situation, I'd choose relying on the models. And for SRM implementation that is aimed at offsetting the overshoot temperature by gradual phasing in of SRM, we have small volcanic eruptions as analogous situations for testing our models, and the overall process can be iterative and adjusted as the phasing up goes on. Thus, I think the first risk is greatly overstated and not nearly streong enough to convince me that we do nothing more than mitigation (which I certainly prefer) to limit the large-scale global warming and associated very significant impacts. After all, based on our models, we have come to accept that we must change over our whole global energy system, so we do put considerable trust in our models regarding their representation of climatic states very unusual compared to the present as opposed to the GHG plus SRM simulations that have climatic conditions quite close to those we have and are quite experienced with and likely model well. (2) The recent papers on ozone interactions by Tilmes et al. do not show a large ozone influence--the reference needs to be updated--especially compared to the significant alleviation of harmful environmental and societal impacts that would be moderated. So, again, context is needed. (3) Of course SRM modifies the troposphere--that is the whole idea. What the model results show is that SRM brings the climate back much closer to the unperturbed state as compared to the situation without SRM. This is a vague and really strange criticism that needs to be evaluated in context of what is being accomplished. (4) Again, the question is whether the impacts on crops are worse or better for elevated GHG with or without SRM. The stuides I have seen suggest that the consequences of 4 times CO2 without SRM would be much, much worse than for 4 times CO2 with SRM--that is the comparison that matters. There are no proposals to replace mitigation by SRM and no proposal to do SRM in the absence of elevated CO2, so this criticism need reconsideration based on an appropriate comparions. Overall, this set of criticisms, while I agree it has been made out in the SRM community, is mistaken for the situation that the world faces and needs to be changed. [Michael MacCracken, United States of America]	Reject. The point of why SRM would not be able to address a climate emergency is elaborated in detail in Sillmann et al. 2015, NCC (cited in the new version of the SRM box).
15702	90	4			The associated of ozone layer is not "potential" if deployed, it´s certain, as the mentioned study affirms. Delete "potential" and the sentece that says "remains very uncertain". This is one of the clearest dangers of SRM. [Elenita Daño, Philippines]	Accepted. Rephrased.
15454	90	4			The associated of ozone layer is not "potential" if deployed, it´s certain, as the mentioned study affirms. Delete "potential" and the sentece that says "remains very uncertain". This is one of the clearest dangers of SRM. [Elenita Daño, Philippines]	Accepted. Rephrased.
16465	90	6	90	7	Indeed, the evaluation needs to be made considering the potential to meet other sustainable goals, and the impacts of 2 or 4 times CO2 or other high GHG levels are much less severe if SRM is used along with all possible mitigation than if only mitigation efforts are completed. [Michael MacCracken, United States of America]	Reject. Given the potential side effects of SRM, we don't know if the impacts will be less severe if SRM is used, particularly not in context of the Sustainable Development Goals.
14139	90	10	90	15	The continuation of ocean acidification and consequences for marine ecosystems needs to be included [Elvira Poloczanska, Germany]	Accepted. This point is included in the revised box.
16466	90	12	90	12	The phrase "in partiular with respect to the water cycle" I assume is drawn from the note that SRM reduces the hydrological cycle with respect to 4 times CO2. Well, of course, but how do the crops do with the climate of 4 times CO2 with the hydrological cycle intensified from the present. The assessment needed is more appropriately how agriculture and food production, etc. would do in a world with 4 times CO2 without SRM versus 4 times CO2 with SRM. It is really essential that a rewrite makes sure it is comparing what is appropriate to be comparing. [Michael MacCracken, United States of America]	Rejected. The important point is that SAI does not restore pre-industrial conditions but creates novel climate conditions.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16467	90	17	90	22	Again and again the wrong comparison seems to being done, at least when using SRM as a supplement to mitigation rather than an alternative to it (something no researcher in the area advocates, so just should not be the basis for the comparison unless it is clear this is what is being discussed). The appropriate comparison is elevated GHG with or without SRM, so a climate that is strongly perturbed versus a climate that is much less perturbed, if not quite perfectly the baseline case. [Michael MacCracken, United States of America]	Rejected. The important point is that SAI does not restore pre-industrial conditions but creates novel climate conditions.
11097	90	20	90	21	The report assigns “medium confidence (expert judgement)” to the statement that “the risks of SAI deployment for global food security and ecosystem health would outweigh the benefits”. This assignment gives a misleading impression of the state of knowledge about SRM’s impacts in these areas. According to IPCC’s guidance note for lead authors, “medium confidence” implies at least medium agreement with medium evidence regarding the issue [Mastrandrea et al., 2010]. However, due to the limited research results in this area and the lack of agreement on this topic (as reviewed above), these criteria do not appear to be satisfied. In addition, the use of the term “expert judgement” without further explanation or reference to existing studies undermines confidence in this characterization. We recommend more careful consideration in assigning this confidence level, and possibly removing it from the report. [Michael D. Mastrandrea et al., “Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties,” IPCC (2010)] [Joshua Horton, United States of America]	Noted. The summary statement on expert judgement was removed.
15703	90	20	90	47	As per the information available and reported in the same sentence, the expert judgement should be HIGH CONFIDENCE. It shows the bias of the author of the box to write "medium". For additional reference on termination shock" in SRM, see: Jones et al. (2013) The impact of abrupt suspension of solar radiation management (termination effect) in experiment G2 of the Geoengineering Model Intercomparison Project (GeoMIP), in: Journal of Geophysical Research. Also: Kelly E McCusker1, Kyle C Armour2, Cecilia M Bitz3 and David S Battisti3 (2014) Rapid and extensive warming following cessation of solar radiation management, in: Environmental Research Letters, http://iopscience.iop.org/article/10.1088/1748-9326/9/2/024005/pdf [Elenita Daño, Philippines]	Noted. This statement was removed.
15455	90	20	90	47	As per the information available and reported in the same sentence, the expert judgement should be HIGH CONFIDENCE. It shows the bias of the author of the box to write "medium". For additional reference on termination shock" in SRM, see: Jones et al. (2013) The impact of abrupt suspension of solar radiation management (termination effect) in experiment G2 of the Geoengineering Model Intercomparison Project (GeoMIP), in: Journal of Geophysical Research. Also: Kelly E McCusker1, Kyle C Armour2, Cecilia M Bitz3 and David S Battisti3 (2014) Rapid and extensive warming following cessation of solar radiation management, in: Environmental Research Letters, http://iopscience.iop.org/article/10.1088/1748-9326/9/2/024005/pdf [Elenita Daño, Philippines]	Noted. This statement was removed.
20504	90	24	90	37	See comment 16 above: The problem with the termination-shock argument is that if termination shock looks highly hazardous termination is unlikely (since the capacity for SRM is unlikely to be limited to one, or even a few, actors). There is I believe a forthcoming paper on this by Irvine and Parker which I hope will be published in time for the SOD [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted
13428	90	25	90	26	There are more papers that investigate the termination effect of SRM, including on MCB: Alterskjær et al. (2013), Stjern et al. (2017), Ahlm et al. (2017). Multi-method comparisons of serveral SRM techniques and termination: Aswathy et al. (2015), Lauvset et al. (2017), Muri et al. (2017). It might also be worth mentioning that the rate of change associatied with SRM termination when SRM is applied at large-scale, tends to be even more rapid than with global warming. [Helene Muri, Norway]	taken into account. References will be added
16468	90	25	90	37	It needs to be noted that this analysis applies to the use of SRM in a massive application to offset very serious impacts from quite high GHG levels. If instead SRM is used to just offset the overshoot warming resulting in spite of aggressive mitigation, then the situation is quite different. In addition, with this much reduced SRM implementation, it can be gradually phased out by enhanced CDR and the natural rates of removal of the excess GHG concentrations. This alternative view is covered in the next paragraph, but the type of implementation being referred to in this paragraph is not described, and needs to be. [Michael MacCracken, United States of America]	Taken into account. This Box will discuss only overshoot scenarios which are related to 1.5C
11875	90	25	90	47	The section on termination shock (p. 90) could be a bit better organized: First, the cause of the termination shock could be better explained, especially its connection to the continued accumulation of GHGs in the atmosphere during SRM deployment. Second, the second paragraph should be brought up to line 30, so as to clearly explain the conditions under which termination shock would occur and the ways that it could be avoided. Third, the second half of the first paragraph (beginning with "(Jones et al 2013) examine changes") should be moved to a separate paragraph. [David Morrow, United States of America]	taken into account, reorganised
15704	90	39	90	47	It is important to note that David Keith, whose work was referred to a few times in this section, have vested economic interests in demostrating that the SAI technology could be applied. This study is just a desperate theoretical speculation to try to find a way to mask the strong impacts of SRM depkloyment. This paragrah shows the biases in the box, thus should be deleted. [Elenita Daño, Philippines]	Noted. This paragraph supported by peer-reviewed literature. We can't ignore existence of these studies.
15456	90	39	90	47	It is important to note that David Keith, whose work was referred to a few times in this section, have vested economic interests in demostrating that the SAI technology could be applied. This study is just a desperate theoretical speculation to try to find a way to mask the strong impacts of SRM depkloyment. This paragrah shows the biases in the box, thus should be deleted. [Elenita Daño, Philippines]	Noted. This paragraph supported by peer-reviewed literature. We can't ignore existence of these studies.
20505	90	45	90	46	When SRM starts it exerts a high degree of cooling This is scenario specific -- it is not a necessary aspect of SRM [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Taken into account, text was significantly rewritten. Also note that text was shortened due to space limitations.
4406	90	45	90	47	Two problems here; one is the “when SRM starts, it exerts a high degree of cooling” (that is a choice, not a property of SRM), and the “cannot be stopped suddenly”… it certainly could be, it just would be a bad idea as it would cause sudden warming. In addition to Reynolds et al, could cite the more technical paper, MacMartin, D. G., K. Caldeira, and D. W. Keith, “Solar geoengineering to limit rates of change”, Phil. Trans. Royal Soc. A, 372(2031), 2014. doi:10.1098/rsta.2014.0134. [Douglas MacMartin, United States of America]	Taken into account, text was significantly rewritten. Also note that text was shortened due to space limitations. Paper cited in the Box
20506	90	47	90	47	and should be "and/or": one can imagine scenarios in which emissions are zero but SRM and CDR are both still being used. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted, but this sentence deleted
4407	90	50	90	52	For most recent simulation with water vapour and ozone see e.g. Richter, J.H., S. Tilmes, M. M. Mills, J. Tribbia, B. Kravitz, D. G. MacMartin, F. Vitt and J.-F. Lamarque, “Stratospheric dynamical response and ozone feedbacks in the presence of SO2 injections”, to appear, J. Geophys. Res. A. . For the cirrus there have been a couple of studies, but the results are based on suspect parameterizations of cirrus formation so better to simply list as an uncertainty (see e.g. MacMartin, D. G., B. Kravitz, J.C.S. Long, and P.J. Rasch, “Geoengineering with stratospheric aerosols: what do we not know after a decade of research?” Earth’s Future, 4, 543-548, 2016. doi: 10.1002/2016EF000418) [Douglas MacMartin, United States of America]	Noted; we accept the point but we have to be selective as to what literature to include to stay within the agreed page limit of the box
20507	91	2	91	47	This seemed an oddly long treatment of the issue to me. It also needs to take in the results in Keith, Wagner and Zabel “Solar geoengineering reduces atmospheric carbon burden.” Nature Climate Change, 7, Pp. 617–619. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	taken into account — the current section has been reduced and focussed accordingly on peak-shaving and overshoot scenario

Comment No	From Page	From Line	To Page	To Line	Comment	Response
16469	91	2	91	47	While this whole discussion is interesting, it is not mentioned that this is an analysis that is appropriate only for a very large and sudden implementatino of SRM rather than the peak-shaving type of implementation, for which the effects would be much smaller. So, this needs to be mentioned. In addition, the magnitude of these influences needs to be put in context--how large is this modification of the carbon cycle compared to what the modification would be without SRM--it is this that matters as we really are not talking about doing SRM in the absence of substantial uncounteracted GHG indued climate change and impacts, whereas the discussion here seems to be referenced to the baseline climate--which is just simply not an option that will be available. [Michael MacCracken, United States of America]	Taken into account, this Box now addresses SRM only in overshoot and related to 1.5C scenario
18662	91	28	91	28	Two separate grey shaded Mendeley fields for Xia and Mercardo; Eliseev - combine them [Wilfran Moufouma Okia, France]	taken into account
13429	91	39	91	47	In Muri et al. (2017) we show that the carbon cycle reverts quickly back to the baseline state after sudden termination of large-scale SRM (SAI, MCB and CCT). [Helene Muri, Norway]	taken into account
18663	91	45	91	45	Move "as documented in" out of grey shaded Mendeley field [Wilfran Moufouma Okia, France]	taken into account
13430	92	3			We have done the G4 experiment with NorESM too. If you want the data, please e-mail helene.muri@geo.uio.no. Or I can do the calculations for you. [Helene Muri, Norway]	taken into account
16470	92	3	92	3	I don't understand--SRM implementation is not so that there can be further emissions, it is intended to be a supplement to be invoked after all the mitigation is done that is possible. The intent of all of these efforts needs to be to return the global average temperature to less than 0.5 C or as close to unperturbed as possible (or near this)--not to stabilize at 1.5 C and emit additional CO2 to keep the temperature at this level. A lot of the problems I'm raising occur because there simply has not been an opening discussion of the various ways that SRM might be applied--explaining the difference between SRM as a substitute (not something advocated), as a late emergency step after large warming and other impacts, and as a peak shaving approach on top of aggressive mitigation. Pleae do make sure there is such a discussion. [Michael MacCracken, United States of America]	taken into account
10228	92	10	92	21	It is nice to have a paragraph all on one study I happen yo be an author of, but I think this is too much detail and not enough of an asessment to say how relevant to 1.5C. Many other paragraphs have a similar issue. Simply saying tha MCB will reduce PV by X% is irrelevant if you don't know the scenario. I just picked on this one example, but the rest of the box also has this problem [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, paragraph deleted
16471	92	11	92	11	This first sentence would be a more appropriate first sentence for the paragraph if it said that different SRM approaches would have different effects on generation of solar power at the surface and not suggest the whole paragraph is about SAI, which is not the case. [Michael MacCracken, United States of America]	noted, but paragraph deleted
18664	92	12	92	12	Robock et al. 2009 needs a Mendeley link [Wilfran Moufouma Okia, France]	Editorial, added
20508	92	12	92	13	This sentence does not make sense.Also, this paragraph should mention that other aerosols have different optical properties; some would lower the power output of solar systems considerably lesss [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	taken into account, text revised
4711	92	14			Use "Gt" instead of "Tg". [Radim Tolasz, Czech Republic]	Editorial
20509	92	15	92	15	The 4.5% figure does not seem to appear in Smith et al 2017. I think it should be made clear that the 5.9% figure is for CSP, not PVs: PV losses in Smith et al are considerably lower. I think it might be helpdul to readers to point out that global installed CSP capacity is around 5GW, while intsalled PV capacity is around 300GW. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, text revised
16472	92	16	92	18	It needs to be mentioned that MCB takes place over the ocean and not over the land--that is where marine stratus clouds are. So, there is virtually no gathering of solar power over the ocean, so there really is no important effect over land as the lifetimes of the injected CCN are very small--perhaps a couple of days if lucky, and so there will be virtually no effect for solar systems on land. [Michael MacCracken, United States of America]	Noted, thank you, but we deleted this sentence
15705	92	23	92	29	The first sentence in this paragraph that SRM would be beneficial to sustainable development is directly contradicted and undermined by the succeeding sentences that present the many potential risks and impacts of SRM, including inequality, captivity, ozone depletion, etc. The first sentence therefore needs to reformulated to state the risks posed by SRM on sustainable development, to be consistent and coherent with the rest of the paragraph. [Elenita Daño, Philippines]	Noted. Thank you but we are assessing the balance of the literature (not expressing our opinion) and while some scholars see SRM as possibly beneficial we then focus on all the negatives in the rest of the paragraph. We cannot ignore the scholarly literature that mentions benefits.
15457	92	23	92	29	The first sentence in this paragraph that SRM would be beneficial to sustainable development is directly contradicted and undermined by the succeeding sentences that present the many potential risks and impacts of SRM, including inequality, captivity, ozone depletion, etc. The first sentence therefore needs to reformulated to state the risks posed by SRM on sustainable development, to be consistent and coherent with the rest of the paragraph. [Elenita Daño, Philippines]	Noted. Thank you but we are assessing the balance of the literature (not expressing our opinion) and while some scholars see SRM as possibly beneficial we then focus on all the negatives in the rest of the paragraph. We cannot ignore the scholarly literature that mentions benefits.
16473	92	24	92	25	Please change "cheap" to "low-cost" or "inexpensive". Also note that SRM does not just bring down global temperatures, it reduces warming and other changes in climate over the whole Earth--at leat SAI aspires to do this. SRM counteracts climate change, not just temperature. [Michael MacCracken, United States of America]	accepted: replaced cheap with lower cost and lower impact compared to damages or costs of mitigation
16474	92	24	92	27	SRM also tends to reduce biodiversity loss, which is also important sustainable objective. [Michael MacCracken, United States of America]	Noted but we use the term ecosystems on line 26 to encompass biodiversity
11105	92	24	92	28	Second, the text appears to deemphasize the costs of climate change vis-a-vis the costs -- both direct and indirect -- of SRM. In short, SRM, in isolation, is costly. Direct costs might be cheap, even when calculated per tCO2e (Keith, Wagner, and Zabel 2017), but SRM is not free. Indirect costs might be high in absolute terms, but those absolute costs have to be seen in comparison to reference climate scenarios. Costs of RCP 8.5 and even 4.5 are vast. See e.g. Hsiang et al. 2017 for U.S. costs alone, or Hsiang, Burke, and Miguel 2013 for an example of non-monetary costs. SRM will not compensate any of these costs perfectly, but that is not the only relevant comparison. Absolute costs seen in isolation only mislead and confuse. [Keith, David W., Gernot Wagner, and Claire L. Zabel. “Solar geoengineering reduces atmospheric carbon burden.” Nature Climate Change 7: 617–619 (1 September 2017); Hsiang, S., Kopp, R., Jina, A., Rising, J., Delgado, M., Mohan, S., ... & Larsen, K. (2017). Estimating economic damage from climate change in the United States. Science, 356(6345), 1362-1369; Hsiang, Solomon M., Marshall Burke, and Edward Miguel. "Quantifying the influence of climate on human conflict." Science 341.6151 (2013): 1235367] [Joshua Horton, United States of America]	Noted. Comment now in 1.6
16475	92	28	93	12	Again, please provide context. The GHG with SRM likely causes much smaller impacts than elevated GHG without SRM, and this needs to be noted and used as the context here. As written here, the context is simply not appropriately explained. And, of course, not all SD problems are solved--the question is under which conditions (elevated GHG with or without SRM) would be more favorable/preferred [Michael MacCracken, United States of America]	Noted: see response above where we can refer to 'lower cost and impacts compared to higher temperatures"
20510	92	29	93	1	Not having an effect on ocean acidification is not an intrinsic "risk of SRM". It would be a problem with an SRM-ony strategy -- which no one is advocating. [Oliver Morton, United Kingdom (of Great Britain and Northern Ireland)]	Noted: but the literature does discuss that SRM does not solve acidification and other parts of the box and report are clear that SRM is proposed not as a single solution
1222	93				What will go in Box 4.14 that is different from the urban adaptation case study in the next box? Perhaps better to re-consider our initial (joint) idea to have an urban climate-resilient development pathway box, in Ch5? [Petra Tschakert, Australia]	Accepted. Urban cross-chapter box shifted to Chapter 5

Comment No	From Page	From Line	To Page	To Line	Comment	Response
1641	93	1	93	1	Robock (2012) not in reference list. Robock, Alan, 2012: Will geoengineering with solar radiation management ever be used? Ethics, Policy & Environment, 15, 202-205. [Alan Robock, United States of America]	Accepted: reference added
11098	93	6	93	8	The report does not accurately represent the state of knowledge regarding impacts of SAI on stratospheric ozone, or the implications for human health. The text states that “SAI ... may increase health effects of ozone depletion." This is misleading, and reflects a wider tendency for selective and incomplete literature review. [Joshua Horton, United States of America]	Noted: removed the part of the sentence on ozone and health
20939	93	14		32	The principle of intergenerational equity (Eq), the right to the future and the rights of future generations (human and non-human species, principle of interspecies justice) must be deeply analized considering the implications of possible solar radiation management (SRM) policies. [Erick Pajares, Peru]	Noted. Thank you: that is why we mention it but space constraints mean we cannot discuss in greater detail. Please NOTE that all discussion about "Governance, public perception and ethics of SRM" moved now to section 4.3.9. due to space limitations of the Box.
13431	93	15	93	32	With regards to the discussion on public perceptions, would it be worthwhile to mention that chemtrail conspiracies might become and issue for any SRM testing and deployment? I am not aware of any publications on this yet, but I think there might be a paper underway somewhere, which I can forward to you if it comes out in time. [Helene Muri, Norway]	Noted and thank you. At least one of the papers we cite mentions chemtrails but space constraints mean we cannot expand on it. Please NOTE that all discussion about "Governance, public perception and ethics of SRM" moved now to section 4.3.9. due to space limitations of the Box.
11016	93	16	93	17	The generalization that ?The literature mostly suggests that SRM requires multilateral governance because of the high costs and impact on the global commons? might be too generalizing or, at the least, needs to be extensively moored in peer reviewed literature. It fails to draw on the important literature cited above Stilgoe, J., et al. (2013). "Developing a framework for responsible innovation." Research Policy 42(9): 1568-1580; Owen, R. (2014). "Solar radiation management and the governance of hubris." Geoengineering of the Climate System 38: 212; Szerszynski, B., et al. (2013). "Why solar radiation management geoengineering and democracy won't mix." Environment and Planning A 45(12): 2809-2816. See also Macnaghten, P. and R. Owen (2011). "Environmental science: good governance for geoengineering." Nature 479(7373): 293-293 - work which questions the governability of the technology in democratic manner. The discussions in this literature of the the kind of socio-political systems that are compatible with SRM technology needs to be reviewed and engaged. [Michael Thompson, United States of America]	Accepted: added references as appropriate. Please NOTE that all discussion about "Governance, public perception and ethics of SRM" moved now to section 4.3.9. due to space limitations of the Box.
16476	93	16	93	21	This sentence is pretty clearly referring to the scenario with a large and sudden SRM intervention expected to go on a long time. I would first note that there is no indication that this would be expensive to do compared to other things that could be done. With respect to impact on the global commons, there is no mention that doing this would presumably greatly reduce the climate impacts from the highly elevated CO2/GHG concentrations that caused the SRM to be done in the first place--otherwise why would one do it? The notion that one actor could do something that would create greater harm to others than the impacts they are already experiencing due to the elevated CO2/GHG concentration is also not clear; it is the case that a single actor doing it might not provide as much benefit as a strategy designed to help everyone, but to assert if would lead to worse conditions that the very large impacts from climate change that led to its implementation is simply not clear--making comparisons to the difference from the baseline case is just not the right comparison to be making as CO2/GHG effects are growing greatly. With respect to sudden termination, well yes, if the world chooses to do something that would cause them great harm (such as continued high use of fossil fuels), there will be consequences. What this sentence seems to be totally missing, however, that such SRM might well be the only way to avoid utter catastrophe for society from the high CO2/GHG impacts that prompted the action. SRM is not a perfect solution, but the notion is that it is a lot less bad than the alternative. [Michael MacCracken, United States of America]	Noted: we are space constrained for a longer discussion but we now state "SRM like many other forms of climate response requires multilateral governance" . Please NOTE that all discussion about "Governance, public perception and ethics of SRM" moved now to section 4.3.9. due to space limitations of the Box.
16477	93	21	93	24	This is a fair criticism--that it will not end all consequences from the higher concentrations of CO2/GHGs and might instead be blamed for not doing everything. This is the same problem of applying a tourniquet to stop rapid bleeding--one may save a person's life but they may lose that arm or leg, and in that the the result from not using the tourniquet is not available to that person, they have to rely on the words of their doctor (i.e., experts) to convince them that this is the case. As I commented once (wryly) on this matter at a briefing on geoengineering at the Papal Academy of Science, the public's view might well be that with SRM there should no longer be any harmful acts (or events) attributable to God (or natural variability)--one a decision is made to move ahead with SRM, the public (mis)impression might well be that the climate engineers should be able to prevent all extreme conditions, and this, of course, would simply not be the case--at least certainly not the case for use of global SA. With much improved predictions, however, it might be possible, with considerable effort, to do a bit of moderation of seasonal extremes over large areas with, for example, marine cloud brightening and other approaches that are based on modifying tropospheric phenomena given the much shorter lifetimes of the injected materials that tend to enhance cloud brightness. With respect to the presentation of SRM, I think this issue deserves more coverage and discussion, with less distraction on what I consider the lesser issues covered in the preceding sentence. [Michael MacCracken, United States of America]	Noted: but we are unable to provide such extensive discussion in a short report. Perhaps AR6 can consider when there is more literature to cite. Please NOTE that all discussion about "Governance, public perception and ethics of SRM" moved now to section 4.3.9. due to space limitations of the Box.
11017	93	23	93	24	Current text about public participation and public perceptions here and elsewhere in the chapter is incomplete. It should not discuss only work that paints publics as ignorant and confused. Publics can also be productively engaged in governance - indeed, should be thus engaged to ensure more robust decision making (see Stilgoe et al. (2013). The text should refrain from characterization of an entire body of scholarship on the basis of relatively few works, especially when these fail to integrate highly relevant empirical social science literature, e.g. Stilgoe, J., et al. (2013). "Developing a framework for responsible innovation." Research Policy 42(9): 1568-1580; Macnaghten, P. and R. Owen (2011). "Environmental science: good governance for geoengineering." Nature 479(7373): 293-293. A way to approach revision might be to describe and cite the way sin which publics participated meaningfully in experiments and related governance around the SPEICed experiment (see work by Phil Macnaghten already cited). This literature contains empirical evidence from the SPICE experiment about how publics react to geoengineering. The integration of this literature needs to be more systematic throughout the chapter. [Michael Thompson, United States of America]	Accepted: Comment and references added. Please NOTE that all discussion about "Governance, public perception and ethics of SRM" moved now to section 4.3.9. due to space limitations of the Box.
16478	93	26	93	31	Good points, although I think the need for "compensation for negative effects" is a bit misconceived. As noted elsewhere, with a comparison of elevated GHG with and without SRM, model simulations indicate that (virtually?) everyone is better off with SRM. However, there are still differences among nations in the degree of impacts that will be experienced depending on the level chosen--indeed, there are differences in situation even were there no elevated GHG levels and no SRM, and the differing situations have contributed to different levels of development and to situations where particular nations need assistance. Thus, it seems to me that what needs to be said is that there will continue to be different climatic situations for different nations and so ongoing needs for assistance (not compensation) in dealing with the situation each nation faces, with those with better situations (as now) helping nations with worse climatic situations. Elevated CO2/GHG concentrations without SRM will make the situation worse for all (as the IPCC reports have been documenting); with SRM offsetting at least some of the adverse climatic impacts of elevated CO2/GHG concentrations, the overall projected situation should be better (otherwise why would SRM be done) but there will, as now and at any particular climatic level or situation, those less well off meriting assistance (not compensation). [Michael MacCracken, United States of America]	Noted: since nations experiencing intense climate changes and nations impacted negatively by SRM are not always the same the literature does suggest possible compensation claims. Did not find literature that addresses this comment. Please NOTE that all discussion about "Governance, public perception and ethics of SRM" moved now to section 4.3.9. due to space limitations of the Box.

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9635	93	35	93	37	Add the content in box 4.14 [Jianguo Wu, China]	Noted: but we are unable to provide such extensive discussion in a short report. Perhaps AR6 can consider when there is more literature to cite
9636	93	35	93	37	Add the content in box 4.14 [Jianguo Wu, China]	Noted: but we are unable to provide such extensive discussion in a short report. Perhaps AR6 can consider when there is more literature to cite
9356	93	35	93	37	Currently, "Box 4.14: Cities" requires additional collaboration. Statements that may be inserted include "Composite indicators are particularly well suited to address multi-disciplinary complex issues and are an emerging area for supporting the science of cities. Composite indicators that have focused on climate adaptation in cities include a recent study by Tapia et al. (2017) in which the cities with relatively high to medium sensitivities to climate vulnerabilities were put forth." Reference to Tapia et al. (2017) is: "Tapia, C., Abajo, B., Feliu, E., Mendizabal, M., Martinez, J., Fernández, J., Laburu, T., Lejarazu, A., (2017) Profiling urban vulnerabilities to climate change: An indicator-based vulnerability assessment for European cities, Ecological Indicators, Vol. 78, pp. 142-155" In addition, another statement may be, "Other examples of composite indicators include those that have benchmarked cities in aspects of energy, water and environment systems (K?lk??, 2016)." Reference to (K?lk??, 2016) is: "K?lk?s, S., Sustainable development of energy, water and environment systems index for Southeast European cities, Journal of Cleaner Production 130 (2016) 222-234 http://dx.doi.org/10.1016/j.jclepro.2015.07.121" [Siir KILKIS, Turkey]	Noted: we are space constrained for a longer discussion but we now state "SRM like many other forms of climate response requires multilateral governance"
3334	93	39	100	53	Box 4.15 should be more structurised for readers undertstanding while contents itself is very informative. You can add the number or subsection accoding to the area(Arctic, , Callibean, etc.) and theme (Adaptation measures, Adaptation mechanisms, etc) [Makoot Tamura, Japan]	Accepted: Comment and references added
1223	93	40	100	54	Discuss relevant references used in Box 4.15 with Ch5 (section 5.3) where we discuss adaptation measures, their impacts, and their respective trade-offs with the SDGs. [Petra Tschakert, Australia]	Noted: since nations experiencing intense climate changes and nations impacted negatively by SRM are not always the same the literature does suggest possible compensation claims. Did not find literature that addresses this comment
5740	93	40	93	40	Box 4.15 needs a complete title. [Hong Yang, Switzerland]	Accepted. A title has been added
18385	94	3	94	3	The bibliographic entry for IPCC, 2014 should have the title as just "Climate Change 2014: Impacts, Adaptation, and Vulnerability" if intending to refer to both Parts A and B of the AR5 WGII report. Right now if just refers to Part B. [Wilfran Moufouma Okia, France]	Accepted, editorial
16479	94	6	94	6	This view of the duration of some (>1M km2) summer sea ice in the Arctic seems very, very optimistic, failing to account for how observations of retreat and thinning are far ahead of model projections--I simply do not understand how there can be such high confidence in this conclusion. I know modelers don't want to admit that there parametric representation is wrong and observers won't admit their analysis is wrong, so the way, in my view, to explain this without saying either group is wrong is that the forcing being used, in particular the cleaning up of sulfate pollution and so cloud brightening in the area and the inflow of soot, is just not correct. What needs to be said here is reality--and suggesting there will still be substantial September sea ice in 2100 when the global average temperature increase is 1.5 C just seems absurd to me, especially in that many of the supposed 1.5 C pathways have significant overshoot. In any case, it is not clear why this is viewed as a significant threshold as the sea ice in the Arctic now through much of the summer is unable to serve as an adequate base for wildlife and Indigenous fishing, etc. In addition, with such low sunlight, the decrease in September sea ice cover from its present state (much reduced area and very low albedo), the increase in uptake of solar energy is going to be a very small percentage of the change that has already occurred, so what is the point of making so much of this (other than to try to put down some members of activist groups whose strange analyses seem to make this into more than just a symbolic event). The big changes in albedo and solar uptake have already occurred--and the real change that matters in terms of uptake of solar energy is the date that the surface albedo drops from fresh to melted snow (i.e., from above 70% to less, even well less, than 30%) and puddling starts. In my view, keeping this statement as is will lead to all sorts of doubting about IPCC's objectivity, and with no real point being made about a threshold, why give this issue so much attention? [Michael MacCracken, United States of America]	Accepted
16480	94	9	94	9	What is the basis for saying these changes will have, presumably only, "short-term impacts"? The environmental changes are going to be essentially permanent and ongoing as the Arctic adjusts to whatever new global average temperature results--there is no way back, and if the world is at 1.5 C, the value in the Arctic will be much larger. When I was on the author team for the first Arctic Assessment, the Indigeneous view was that climate change was going to 'destroy their culture,' which we eventually figured out meant that it would destroy the conditions that have enabled them to harvest from the land and sea and sustain a sharing cultural system that provides for all from the world around them. With warming, they will very likely have to change over to a market based supply system for their food and all the empirical wisdom/traditional knowledge built up over millennia will become useless--and this is what they meant by destroy their culture--and we understood and agreed. So, how can this assessment somehow assert the changes will be "short-term"? This seems way off what has been recognized. [Michael MacCracken, United States of America]	Accepted. "short term" is deleted.
16481	94	11	94	11	This sentence really fails to indicate how their traditional knowledge base is being undermined by climate change, how the whole system of harvesting across the frozen Arctic sea in spring is being undermined by sea ice retreat and thinning, how permafrost thawing is corrupting their traditional food preservation system, how melting of river ice is disrupting their travel paths and the migration paths of moose and more. Yes, the Indigeneous People of the region have survived for millennia with their traditional knowledge approach, but the Arctic is changing so much and so rapidly that all this past knowledge is being challenged and needs updating, and there is no assurance at all that their traditional living off the land and the sea ice can be sustained in a warmer world. I just do not think the text of this paragraph gives and real sense of how much disruption is being caused, the relocations that will be necessary, the increased reliance that will need to be placed on the market economy that would need to replace their past success in having a social safety net for all their members. And getting back to 1.5 C will not prevent this--not nearly. [Michael MacCracken, United States of America]	Rejected - this assertion is not supported by the literature. Some wording has been altered in response to the comment, but the key thrust to the text is supported by the literature cited
16482	94	16	94	18	Yes, the people are showing that they can adapt--they have to adapt to live given the amount and pace of environmental change. But from the discussions held with them during the first Arctic Assessment, this is not at all what they would like to be doing as it is requiring quite significant and disruptive changes to their traditional culture, which has been developed over thousands of years of survival in a much colder Arctic than now or in the future. Somehow, this needs to be reocgnized as not some benefit to them, as sometimes deniers of climate change are asserting--that is, warming is good for them. I do not think that is what they would say. [Michael MacCracken, United States of America]	Accepted - wording changed, noting the literature has expanded rapidly since ACIA which was over 12 yrs ago
18665	94	47	94	47	Arctic Council 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted - editorial
14112	95	1			This section contains too many generalised statements that are about SIDS, and not specific to the Caribbean (islands). In general, this section should also highlight the diversity of Caribbean island geographies and cultures and accordingly the various challenges for adaptation. [Elvira Poloczanska, Germany]	Accepted, specific case studies are discussed

Comment No	From Page	From Line	To Page	To Line	Comment	Response
11178	95	3			The key risks and vulnerabilities section does explicitly not mention the link between hurricanes and climate change. Also the compounding risks of sea level rise and increased storm intensity (and thus storm surges) should be included, along with associated impacts on e.g. port / coastal infrastrucutre and water resources. This section could also dicuss barriers to adaptation (and residual impacts that cannot be adapted to) - making clear the difference in costs of adaptation vs. damages (and the different timescales / funding channels of the associated funds) is important for making the case for adapatation. [Michiel Schaeffer, Netherlands]	Accepted, included in text
16483	95	6	95	8	Recent events seem to be raising a question whether this talking in averages makes sense--the phrase on large variations helps, but I think more attention to this point is needed. Particular hurricanes (and cyclones in the Pacific) hit particular nations and can, as recently illustrated, virtually totally wipe out the economies of particular island nations in ways that will likely take generations to really recover from. In different years, it will be different hurricanes that wipe out different islands. To be talking about such experiences in terms of averages just does not seem to do justice to what will be happening in the region (and other regions) as the likelihood of hurricanes becoming very strong is headed up. I think some modification is needed in the text that makes clearer that particular nations may well get wiped out and that use of averages really obscures the tragedies likely to keep occurring--and become more frequent (also for many Central American nations and for the US, etc.). [Michael MacCracken, United States of America]	Accepted, specific case studies are discussed
14113	95	19	95	19	The term 'adaptation readiness' should be explained/defined [Elvira Poloczanska, Germany]	Accepted
18666	95	19	95	19	Deklu Deklu [Wilfran Moufouma Okia, France]	Accepted, editorial
16484	95	19	95	23	Well, we now have some testing of the adaptation readiness analyses. I note that Puerto Rico and the Virgin Islands are not mentioned--is there some reason for this? Were they thought to not be endangered? [Michael MacCracken, United States of America]	Noted, specific case studies were chosen based on the existing literature
9143	95	25	96	25	This section discusses some aspects related to adaptation measures, but needs examine the challenges in more detail, especially as these relate to the limited ability of small islands to retreat inland due to size and topography (limits to adaptation), and affected ability to adapt due to the constant pressure to repair and recover as a result of extreme climatic events, including hurricanes (resulting high debt ratios; limited capacity; and implications for sustainable development). [Susanna De Beauville-Scott, Saint Lucia]	Accepted, specific case studies are discussed. Explaining risks, impacts, adaptation measures, challenges, and link to poverty alleviation and sustainable development
18667	95	29	95	29	Pitmann et al. 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
14114	95	37	95	37	Betzold 2015 is a summary paper on SIDS and not adequate to describe the particular case of the Caribbean. There is a wide range of case specific literature on the Caribbean, however. [Elvira Poloczanska, Germany]	Accepted, literature cited is now specific to the Caribbean
12302	95	39	95	40	Uninhabitable islands are a textbook example of "non-monetary losses and damages", as abundantly discussed at UNFCCC (COPs, side-events, etc). Accordingly, the text should be integrated as "... islands becoming uninhabitable - a typical example of non-monetary losses and damages - poses important consequences for global justice, human rights, cultural heritage (..." [Valentino Piana, Italy]	Noted, there is a specific box on this topic
14115	96	4	96	4	Even if stakeholder perception is high and adaptation plans existing, there are major problems for implementation on Caribbean islands, such as other political priorities and corruption, which, for example, prioritise large-scale tourism investments in coastal areas, rather than sustainable adaptation and coastal protection, as shown by Petzold et al. (2017, DOI: 10.1111/area.12355). [Elvira Poloczanska, Germany]	Taken into account in the diverse case studies
14116	96	11	96	12	Also the lack of resources for enforcement of adaptation measures, building codes, protection from sand mining, etc. is a problem. [Elvira Poloczanska, Germany]	Accepted
14117	96	19	96	19	Again, here Betzold mainly summarises from examples in the Pacific and Indian Ocean. This reference is not adequate to describe how seawalls are built and mainteined specifically in the Caribbean. [Elvira Poloczanska, Germany]	Accepted, other references are used
18668	97	24	97	24	Le Dang ett al. 2013; Smajgl et al. 2015 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18669	97	25	97	25	Smajgl et al. 2015; Wu et al. 2013 need a Mendely link [Wilfran Moufouma Okia, France]	Accepted, editorial
18670	97	26	97	26	Hoang et al. 2015; Wu et al. 2013 need a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18671	97	30	97	30	Schipper et al. 2010 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18672	97	31	97	31	Zanzanaini et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18673	97	36	97	36	ICEM 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18674	97	39	97	39	Sebesvari et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
16485	97	41	97	41	Using "dyke" (as is apparently the British convention) would be a mistake given that in English in many areas outside the UK, "dyke" means lesbian (and is generally considered rude). I'd advise spelling it "dike" or using some other word. And comment also applies to several other spellings of the word further in the paragraph. Also see page 98, line 33. [Michael MacCracken, United States of America]	Accepted, editorial
18675	97	42	97	42	Smith et al. 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18678	97	42	97	42	Smith et al. 2013 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18676	97	43	97	43	Renaud et al. 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18679	97	43	97	43	Renaud et al. 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18677	97	46	97	46	Sebesvari et al. 2017 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18680	97	46	97	46	Chapman et al. 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18681	97	48	97	48	Chapman and Darby 2016 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18682	97	52	97	52	Smarjgl et al. 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18380	98				Gass et al. (2011) not linked to Mendeley [Wilfran Moufouma Okia, France]	Accepted, editorial
18683	98	4	98	4	Schipper et al. 2010 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18684	98	8	98	8	Schipper et al. 2010 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18381	98	10			TSU needs a copy of the Guerra 2017 reference - hard to find [Wilfran Moufouma Okia, France]	Accepted, already sent and uploaded to Mendeley
18685	98	11	98	11	Gass et al. 2011 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18686	98	15	98	15	Gass et al. 2011 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18687	98	16	98	16	Gass et al. 2011 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18688	98	29	98	29	Renaud et al. 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18689	98	32	98	32	Renaud et al. 2014 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
18690	98	33	98	33	Smajgl et al. 2015 needs a Mendely link [Wilfran Moufouma Okia, France]	Accepted, editorial
18691	98	35	98	35	Ling et al. 2015 needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
9357	98	38	98	38	The section on "Urban Adaptation" may include the number of signatories in Covenant of Mayors with climate adaptation targets versus the number of signatories with climate mitigation targets. Previous shares have been provided in "Kona, A., Melica, G., Koffi, B., Iancu, A., Zancanella, P., Calvete, S., Bertoldi, P., Janssens- Maenhout, G., Monforti-Ferrario, F., Covenant of Mayors: Greenhouse Gas Emissions Achievements and Projections, JRC Science for Policy Report 2016, EUR 28155 EN, 2016." [Siir KILKIS, Turkey]	Taken into account, there is a specific cities box in the SR

Comment No	From Page	From Line	To Page	To Line	Comment	Response
9294	98	38	98	54	Add information from Grafakos et al., 2018 (In Press). Other chapters in Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network also provide detailed information on adaptaiton measures, implementation gaps and challenges, and adaptaion mechanisms. [Cynthia Rosenzweig, United States of America]	Accepted
1091	99	2	99	10	This paragpraph seems to counterdict previous staments in pages 34-35. No details are provided. How large is the Amazon forests uptake? Why worry now about this uptake now that we are talking of impacts of 4 degrees in this capacity? This is to underline th bias of the cahpter towards CCS. [naikoa aguilar-amuchastegui, United States of America]	Taken into account, case study has been redefined
18038	99	12	99	16	Please, consider adding to the paragraph the words in red: Finally, cities report difficulties incorporating climate change, a relatively new issue, into existing departmental functions and procedures (Aylett 2014, Lehoczky, 2017). In addition, building a common language and understanding across various disciplinal approaches and perspectives was found challenging by both academics and practitioners working on urban climate adaptation in Portugal (Lehoczky, 2017). Ref. Lehoczky, A. (2017) 'Changing horizon of Climate Science: from scientific knowledge towards demand based, integrated Climate Services'. Doctoral dissertation. University Rovira i Virgili, Tarragona, Spain. p258. (planned date of PhD project defence: 27 October 2017) [Annamaria Lehoczky, Spain]	Taken into account, case study has been redefined
1379	99	25			In climate change economics "CBA" normally refers to cost-benefit analysis, which is a usual decision-making support measure in the adaptation and mitigation arenas, I find using this acronym for "community based adaptation" could create confusion among the readers of the overall IPCC literature, because CBA is extensively used already for cost-benefit analysis in "IPCC, 2014: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlo?mer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.". [Roger Cremades, Germany]	Noted, in adaptation literature CbA is referred to community-based adaptation and is also noted in its first mention
18388	99	31	99	31	Does Tran (2014) refer to this: https://researchbank.rmit.edu.au/eserv/rmit:160809/TRAN.pdf? [Wilfran Moufouma Okia, France]	Accepted, yes
9358	99	50	99	50	The statement, "Transnational networks of cities such as C40, Resilient Cities" should include the Covenant of Mayors and the Global Covenant of Mayors for Climate and Energy [Siir KILKIS, Turkey]	Taken into account, there is a specific cities box in the SR
18692	100	5	100	5	Nobre et al. (2016) needs a Mendeley link [Wilfran Moufouma Okia, France]	Accepted, editorial
4361	100	20	100	25	Please update the last sentence: 'leading to loss of biodiversity, reducing evapotranspiration and increasing CO2 emissions'. In this sense, include the study conducted by De Oliveira et al. (2017) (IJRS) - Evaluation of MODIS-based estimates of water-use efficiency in Amazonia [Gabriel de Oliveira, Brazil]	Accepted
21195	100	37	100	37	this statement ignores major efforts in brazil toreduce deforestation [David Cooper, Canada]	Taken into account
14296	100	50	100	50	"it is s not", extra 's'? Missing word? [Jason Donev, Canada]	Accepted, editorial
18376	106	6	106	6	Should the report be Better Growth, Better Cities: Rethinking and Redirecting Urbanization from New Climate Economy? [Wilfran Moufouma Okia, France]	Accepted, change made in Mendeley entry.
19714	112	25	12	28	One way to ensure that SD pathways address quity, fairness and justice is to integrate human rights and gender equality into all SD and climate actions (as per Paris Agreement) [Tara Shine, Ireland]	Noted.
787	119	10	119	10	There is a ? Graphic in citation [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial, change made in Mendeley entry.
784	125	41	125	44	look like a duplicate [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, change made in Mendeley entry.
785	129	34	129	37	look like a duplicate [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Accepted, change made in Mendeley entry.
786	129	50	129	50	Stern should come before Stevenson [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Editorial - copyedit to be completed prior to publication
6190	132	18	132	19	As mentioned above, the correct citation is the following: Visioni, D., G. Pitari, and V. Aquila, 2017: Sulfate geoengineering: a review of the factors controlling the needed injection of sulfur dioxide. Atmos. Chem. Phys., 17, 3879-3889, doi: https://doi.org/10.5194/acp-17-3879-2017. [Giovanni Pitari, Italy]	Accepted, changed year from 2016 to 2017.
1642	132	18	132	19	Not a peer-reviewed paper and needs to be deleted. [Alan Robock, United States of America]	Accepted. The citation "Visioni et al., 2016" was replaced by "Visioni et al., 2017" (Visioni, D., G. Pitari, and V. Aquila, 2017: Sulfate geoengineering: a review of the factors controlling the needed injection of sulfur dioxide. Atmos. Chem. Phys., 17, 3879-3889, doi: https://doi.org/10.5194/acp-17-3879-2017
6191	132	20	132	20	As mentioned above, an additional reference should be included: Visioni, D., G. Pitari, V. Aquila, S. Tilmes, I. Cionni, G. Di Genova, and E. Mancini, 2017: Sulfate geoengineering impact on methane transport and lifetime: results from the Geoengineering Model Intercomparison Project (GeoMIP). Atmos. Chem. Phys., 17, 11209-11226, doi: https://doi.org/10.5194/acp-17-11209-2017. [Giovanni Pitari, Italy]	Accepted, reference added.
3701	133	29	133	30	This paper has been published in the formal literature, and please cite all three authors: Winkler, H, Letete, T & Marquard, A 2013. Equitable access to sustainable development: operationalizing key criteria. Climate Policy 13 (4): 411-431. DOI: 10.1080/14693062.2013.777610 [Harald Winkler, South Africa]	Accepted, reference changed.
7282	134	11	134	16	The Higher Education Institutions critical role could be mentioned (e.g., Implementing climate change research at universities: Barriers, potential and actions Journal of Cleaner Production 170 (2018) 269e277 https://doi.org/10.1016/j.jclepro.2017.09.105 http://www.sciencedirect.com/science/article/pii/S0959652617320954?via%3Dihub [Ulisses Azeiteiro, Portugal]	Taken into account; Reference passed on to section lead of 4.4.1
15668	14702	4	14702	5	Add: ...including under the UNFCCC or the UNCBD (Honegger et al., 2013) Honegger, M., Sugathapala, K., & Michaelowa, A. (2013). Tackling Climate Change: Where Can the Generic Framework Be Located. CCLR, 125. [Matthias Honegger, Germany]	accepted, added
15669	14702	6	14702	6	Insert sentence: Some have found that governance under the Paris Agreement addresses some crucial aspects of governance regarding future SRM deployment decisions and that any credible governance of SRM would need to imply the Paris Agreement and by extension the UNFCCC (Horton, et al., 2016). Horton, J. B., Keith, D. W., & Honegger, M. (2016). Implications of the Paris agreement for carbon dioxide removal and solar geoengineering. Policy brief. Harvard Project on Climate Agreements, Belfer Center. [Matthias Honegger, Germany]	Noted, but we cannot include this reference because we are not assessing personal commentaries, policy briefs, viewpoints and opinions even if they appear in scientific journals.
15670	14702	50	14702	50	Suggest to actually use terms used in the literature and replace "sparingly" by "to partially compensate for warming due to elevated GHG concentrations" [Matthias Honegger, Germany]	Accepted, text changed

Comment No	From Page	From Line	To Page	To Line	Comment	Response
15671	15067	7	15067	7	Add: ...yet empirical evidence indicates that the opposite effect might also be true (Merk et al., 2016) Merk, C., Pönitzsch, G., & Rehdanz, K. (2016). Knowledge about aerosol injection does not reduce individual mitigation efforts. Environmental Research Letters, 11(5), 054009. [Matthias Honegger, Germany]	accepted, reference added, text revised
15642	43255	5	43255	5	Not sure "sustainable development initiatives" is a well-known concept or term. To my knowledge there is however a well-established academic debate on streamlining sustainable development into policy planning (which can be applied similarly to mitigation policy planning). Thus I suggest to reformulate to that end. [Matthias Honegger, Germany]	Taken into account. Although it's not a common term, we felt that the mention of mitigation and adaptation "actions" would align better with "initiatives" than with the much more general "sustainable development".
15643	43255	22	43255	22	Insert: "scale and pace" [Matthias Honegger, Germany]	Reject. The point here is that the rate (i.e., pace) ahs been observed historically. The scale has not.
15644	43255	45	43255	45	Insert: "but there are only few examples of effective policies deliberately affecting reductions in meat consumption and more trial and error approaches may be necessary to advance effective policies to limit consumption of meat and other highly carbon intensive food products". [Matthias Honegger, Germany]	Noted, but rejected. We discuss the effectiveness of policies elsewhere in this section, including behavioural actions.
15645	43285	11	43285	11	The formulation that costs of DACS "seem high so far" by contrast to the previous discussion of BECCS implies that the cost of BECCS is not high, which is debatable presuming a cost-range of BECCS from 50-200USD/tCO2 stored and since BECCS has not been utilised as a mitigation option at scale to date. [Matthias Honegger, Germany]	Accept. Text revised to remove the phrase "seem high so far".
15646	43285	13	43285	13	Add: ..."and more research and development is needed to improve their potential cost-effectiveness, determine their respective mitigation potentials and likely implications on sustainable development, where they deployed at Gt-scales annually" [Matthias Honegger, Germany]	Reject. The statement was already prescriptive, and was removed for this reason. This addition would make it even more prescriptive as it is asking for more R&D.
15647	43285	16	43285	18	This statement directly contradicts the most fundamental understanding of physics and every physical evidence and research that I know of as well as line 38 on page 3-127 of this draft report: Global average temperature is pretty much the only variable on which one can predict with certainty the effect of SRM (i.e. that in theory SRM could compensate any level of warming due to elevated GHG concentrations). Whether this could be done in a way that would be beneficial or politically adequate i.e. not cause adverse results in terms of precipitation changes or other changes to other climate variables is a different question alltogether. I therefore propose the following formulation: Full compensation of temperature increases corresponding to elevated GHG concentrations via SRM would result in an imperfect reversal of change in most climate variables. Modelling evidence suggests that deployment of SRM to partially mask warming or to slow its pace, might result in a more adequate result with regard to changes in precipitation patterns and other climate variables." Refer to: Keith, D. W., & MacMartin, D. G. (2015). A temporary, moderate and responsive scenario for solar geoengineering. Nature Climate Change, 5(3), 201-206. [Matthias Honegger, Germany]	Accept (partially). Text is revised to remove the statement that is criticised here.
15648	43285	18	43285	20	This statement on moral hazard is one-sided and does not reflect for the rich academic discussion and empirical evidence to the contrary effect: In a lot of the published research addressing moral hazard "negative moral hazard" has been found, indicating strengthened support for mitigation action upon being presented with the possibility of SRM". If the executive summary is to mention this issue, it should account for this (overwhelming!) evidence! At this point the issue of "moral hazard" remains an unanswered one that requries continued attention in research. [Matthias Honegger, Germany]	Accept. The chapter reflects the more mixed literature discussion on this topic. The statement in the ES is removed.
15649	43285	22	43285	22	The statement "making it socially infeasible" is not understandable. What does "it" refer to, and what does the sentence try to accomplish? Is it a statement about the governance issue of potential unilateral deployment? If so, it does not make any sense and certainly does not reflect the research on the subject: By simple logic, the potential for harm of other countries has never prevented self-interested behaviour of sovereign states in the history of humankind. Thus I presume I have not grasped the intended meaning of this sentence and it needs revision. [Matthias Honegger, Germany]	Accept, text revised to take this comment into account. The statement on unilateral action is removed.
15650	43285	53	43285	53	Incomplete statement! "carbon neutral and carbon negative...". If we do not start to incorporate policy planning for negative emissions at all levels, we need to urgently revise the pathways against which we measure feasibility of 1.5 to 2°C (meaning decarbonization would need to happen in the 2020's if we can't assume negative emissions)! This is a very serious issue! [Matthias Honegger, Germany]	Accepted. Due to an oversight it wasn't altered in-in the SOD, maybe to 1.5C-compatible technologies that could have also included adaptation
15651	43316	3	43316	3	Add sentence: "market mechanisms for mitigation can help limit mitigation cost including for novel approaches to remove CO2 from the atmosphere, this has the potential to enable countries to engage in committments for higer mitigation ambition including net-negative mitigation targets and as a result in an increased likelihood to reach the 1.5°C target of the Paris Agreement (4.4.7)" [Matthias Honegger, Germany]	Reject. There is no evidence for this particular point in the chapter. The literature on this is also limited and divided.
15652	43316	16	43316	16	Add sentence: "This includes in particular a need for substantial research and development programs for novel technologies, which may only exist at pilot scale or as concepts, to advance their cost-effectiveness and test their potential for large scale application such as in case of technologies that ought to result in negative emissions such as BECCS or DACS." [Matthias Honegger, Germany]	Reject. This would introduce policy prescriptiveness.