

IPCC WGI SR15 Second Order Draft Review Comments And Responses - Entire Report

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235					As above. Suggest to discuss more different examples and some different angles of natural adaptation of organisms/populations/communities (terrestrial and marine alike) to temperature increase and the consequences on the impacts of climate change on the biota. [Baruch RINKEVICH, Israel]	Noted, the assessment was based on the available and relevant literature.
236					The interactions between global change drivers may induce biological, biogeochemical and biogeophysical effects in a different way that is predicted when considering just a single driver (such as 1.5C increase).For example, what are the mutual interactions between tem. increase and deforestation? can we predict enhanced impacts when considering either one of these two elements alone? I would suggest to add in either one of the chapters this issue of indirect impacts that combine major causes, and discuss it. I'll cite here just one example, a new paper dealing with the climate impact of deforestation (Scott, C. E., Monks, S. A., Spracklen, D. V., Arnold, S. R., Forster, P. M., Rap, A., et al., 2018. Impact on short-lived climate forcers increases projected warming due to deforestation. Nature Communications, 9[1], 157). From the paper's abstract: " The climate impact of deforestation depends on the relative strength of several biogeochemical and biogeophysical effects. In addition to affecting the exchange of carbon dioxide (CO2) and moisture with the atmosphere and surface albedo, vegetation emits biogenic volatile organic compounds (BVOCs) that alter the formation of short-lived climate forcers (SLCFs), which include aerosol, ozone and methane. Here we show that a scenario of complete global deforestation results in a net positive radiative forcing (RF; 0.12?W?m?2) from SLCFs, with the negative RF from decreases in ozone and methane concentrations partially offsetting the positive aerosol RF. Combining RFs due to CO2, surface albedo and SLCFs suggests that global deforestation could cause 0.8 K warming after 100 years, with SLCFs contributing 8% of the effect. However, deforestation as projected by the RCP8.5 scenario leads to zero net RF from SLCF, primarily due to nonlinearities in the aerosol indirect effect". [Baruch RINKEVICH, Israel]	Too detailed to be addressed in SPM. Some aspects related to land use effects on climate and how they may amplify or counteract greenhouse gas forcing on regional climate are addressed in section 3.6.2 and in the cross-chapter box 7.
237					Another related point is the hierarchy of the interactions between global change drivers. Is 1.5C increase more effective on organisms than, as an example, a decrease in ocean pH? There are several recent publications that discuss this issue, and I would suggest to point this complexity in the report.I'll outline here one recent example (Grotoli AG, Dalcin Martins P, Wilkins MJ, Johnston MD, Warner ME, Cai W-J, et al. 2018. Coral physiology and microbiome dynamics under combined warming and ocean acidification. PLoS ONE 13(1): e0191156. https://doi.org/10.1371/journal.pone.0191156). In this study Grotoli et al. tested water temperature and water acidification stressors on corals and found that the microbiome changed and microbial diversity in reef corals decreased in the physiologically sensitive coral with the thermally sensitive endosymbiotic algae but not in the physiologically tolerant coral with the thermally tolerant endosymbiont. The results brought them to the conclusion that temperature-stress tolerant corals have a more stable microbiome, and revealed, for the first time that this is also the case under the dual stresses of ocean warming and acidification.They further proposed that coral with a stable microbiome are also more physiologically resilient and thus more likely to persist in the future, and shape the coral species diversity of future reef ecosystems. [Baruch RINKEVICH, Israel]	The reviewer presents some interesting information on potential role that microbial organisms may have in coral health. The observations are not definitive or backed up by much other literature at this point. This reason, we have not included this study in chapter 3. we agree, however, that watching this area in future assessments may use some interesting observations on the origin of the tolerance in rebuilding corals and their microbiological partners.
359					These comments address energy efficiency as a mitigation option. They explain why I believe that Chapter 4 needs a tweak to properly address energy efficiency mitigation options. I suggest three edits. [Stephen Wiel, United States of America]	Noted.
406					Transformation needs to be treated consistently across the report, as a concept. This is a general point, most readily explained in relation to the glossary. Adaptation transformation is defined in the glossary, but not mitigation. Instead, the entry for "transformation pathways" is focused on mitigation. So if transformation pathways are the whole, where does that leave space for adaptation? I did not find reference to transformation of financial systems, which would be required to meet the aim in Paris Agreement 2.1 (c). How do transformation pathways relate to sustainable development pathways? (I would argue the latter address both mitigation and adaptation). Finally, good to see a definition of "transformation", though it does not ask the question who determines transformational change. [Harald Winkler, South Africa]	Noted.
1024					Marine phytoplankton sustains the aquatic food web, drives the marine ecosystem, and constrains the global fisheries catch. In addition, the phytoplankton absorbs the solar radiation and modulates the upper ocean heat flux, thereby influencing climate processes and biogeochemical cycles, particularly the carbon cycle. However, there is little discussion on the impact of climate change on marine phytoplankton concentrations in the global oceans. There should be a sub-section on this in the SR 15. [Roxy Mathew KOLL, India]	Noted, the assessment was based on the available and relevant literature.
1676					The linkage between different chapters should be emphasized and 1.5DS should be the focus for each chapter. Feasibility and uncertainty on 1.5DS should be more clearly discussed. Relationship between mitigation, adaptation, avoid risk, increased cost and SDG for 1.5DS should be more clearly interpreted. [Wenyng Chen, China]	Accept. The chapter structure does not allow for this comparison across chapters, but the SPM will be revised to do a better job on this, and tell the desired story across the chapters.
2382					CAs predominantly from the global North [Debra Roberts, South Africa]	Noted.
2416					There is substantial repetition within and across most chapters. Attempts to be comprehensive are putting the report at risk of being a mini-AR6 rather than an SR focused on 1.5 [Debra Roberts, South Africa]	Taken into account. Overlaps between chapters have been addressed extensively in LAM4. Cutting text will also focus chapters more on 1.5C.
2418					Report is too long which will reduce its useability. Authors teams need to adhere to allocated page limits more effectively. [Debra Roberts, South Africa]	Noted.
2462					A big improvement over the previous draft. My substantive comments have been addressed reasonably. The current draft is very long – exhaustive but also exhausting. Unfortunately I have no suggestions as to what to cut to reduce the length of the report. The key now is to make the SPM shorter and to focus it on the information policymakers need. [Erik Haites, Canada]	Noted. Chapters and SPM will indeed be shortened.
4410					In the past IPCC reports, several important messages had been cherry-picked by policymakers. One example is cost of mitigation. In AR 5, cost to attain 2 degree target was estimated around 4.8% (median) of GDP (or consumption) in 2100 or reducing annual economic growth by 0.6% . IPCC AR5, however, made it clear this was under the assumption that immediate uniform carbon tax applied globally, availability of all technologies and all players' immediate participation. Policymakers just picked up the point that cost is low (denting annual GDP growth rate mere 0.6%) and they never mentioned this is based on the above presumptions, especially uniform carbon tax that they think quite unrealistic at least for several decades.Authors of 1.5 SR should take into consideration of these policymakers tendency and describe very carefully so that a part of the report's important message not to be cherry-picked. [Mitsutsune Yamaguchi, Japan]	Noted. This is useful advice that we will take into account.
4412					We should be very careful not to give policymakers an impression that though 1.5 degree will be so hard to achieve, it would be rather easy to attain 2 degree target. We need this kind of warning at the beginning of this report. [Mitsutsune Yamaguchi, Japan]	Accept. In chapter 1, this will be clearly framed, and in the SPM as well.

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4520					<p>There are confusions about the cost figures and Descriptions.</p> <p>1) In chapter 5 (p. 36, line 4), there is a description of the cost of mitigation of 1.5 degree pathways as 2-6% of total GDP (2050). This is the only description of mitigation cost (GDP loss). This figure seems to be rather low when compared to GDP loss to achieve "likely" 2 degree goal in the Figure 6.2.1 of AR5/WG3 (p. 450). Any explanation for this point in Chapter 5 should be appreciated.</p> <p>2) In Chapter 4, text says MAC for 1.5 degree figures "are not yet available (p.70, lines 23-24)" but in SPM and Chapter 2, MAC for 1.5 degree is explained as about 3 to 7 times higher than those of 2 degree world (p.21 lines 22-23 and p. 99, lines 11-12 respectively). There are inconsistencies among chapters and need to be revisited and use the same expression throughout SR1.5 degree report.</p> <p>3) There are several inconsistencies about cost figures between SR 1.5 and AR5. In figure 6.2.1 of AR5/WG3, median carbon price in 2050 for 2 degree (likely, i.e. >66%) is more than \$100 in 2050 whereas, in SR 1.5, it is \$70 for 2 degree with greater than 66% probability (Ch. 2 p.99, line 5). Also GDP loss in 2050 is estimated as 2-6% to attain 1.5 world (Ch. 5, p. 36, line 4) but in Figure 6.2.1 of AR5/WG3 (p. 450), GDP loss in 2050 for "likely" 2 degree target seems to be around 2.2-4% (median seems to be 3.5%). In comparison to the AR5 report, 2-6% of GDP for 1.5 degree pathway (no probability is mentioned here) seems to be rather low. First of all we need to hear whether those cost figures appeared in 1.5SR was calculated in the same way as under AR5, and if yes, need explanation why this time constns are rather low, and if not yes, need explanation why. [Mitsutsune Yamaguchi, Japan]</p>	<p>Accept, these inconsistencies need to be addressed. 1) This should be taken up between chapters 2 and 5. 2) This confusion is due to the difference in the carbon price emerging from the modelling work in chapter 2, and the "real-world" carbon price as a consequence of implementation of policy instruments, e.g. a carbon tax or emissions trading. This needs to be made consistent. 3) for chapter 2 to address.</p>
4522					<p>For this 1.5 SR to be policy relevant, I really wish authors refer to Figure 3 in Ottmar Edenhofer and Martin Kowarsch, "Cartography of pathways: A new model for environmental policy assessments", Environmental Science & Policy 51, 2015 56-64. When we compare 1.5 SR (SOD), it is clear that cost information is quite poor in comparison to other factors, such as new information about the compatibility with other SDG goals (especially Figure 5.4) [Mitsutsune Yamaguchi, Japan]</p>	<p>Seems to be a framing issue.</p>
4524					<p>It is very hard for policymakers to compare 2 degree and 1.5 degree target cases. Main reason is that they do not know additional mitigation cost of 1.5 degree nor additional benefit (in any numerical figures) of 1.5 degree in comparison to 2 degree case. Information of mitigation cost and numerical difference of impact between 2 cases are very poor. Those information should definitely be in SPM and, if not available, describe so in SPM. [Mitsutsune Yamaguchi, Japan]</p>	<p>Taken into account. We have chosen to not present mitigation cost numbers but in the FD we will be presenting investment and finance numbers.</p>
5060					<p>Guidance needs to be given to the authors to scrub their chapters of the words "may" and "could" (and "might") as words such as these provide no useful indication of likelihood. Words from the IPCC likelihood lexicon should be used instead, adding a qualifying phrase if necessary to explain or justify the choice. Also, care needs to be used regarding the word "impact"--does this just mean a consequence up or down or does "impact" always imply the situation gets worse. For clarity, I'd suggest saying "adversely impact" or "beneficially affect" or something similar, always seeking to make the clear if the expected outcome will be positive or negative. [Michael MacCracken, United States of America]</p>	<p>Accept. The FD will be dissected for these words and other manifestations of policy prescriptiveness. Thank you for the suggested wordings.</p>
5738					<p>The chapters are too long. Smaller reports have more potential to reach out to a larger audience. Suggest to limit the size of the report to ~ 200 pages when printed. [Govindasamy Bala, India]</p>	<p>Accept. We are working on keeping the chapters within the length allocated by the IPCC Plenary decision.</p>
5864					<p>I noticed a degree of inconsistency between how Chapters 1 and 2 discussed PI. It shall be really important that the final draft has this consistent between the final chapter versions. Some more thought as to how to achieve this would appear warranted as you do not want readers playing split the difference in how different chapters of the final report characterise PI and change since that period. See my specific comments on Chapter 1 wrt PI definition and quantification and Chapter 2 and the FAQs of both as well as the SPM where I note a possible room for reader interpretation of a distinction between chapters. [Peter Thorne, Ireland]</p>	<p>Noted.</p>
5930					<p>Just to note, because IPCC comments system ends up by nature being somewhat highlighting of the negative (although I've tried to be constructive throughout, apologies if I slipped up anywhere), that I think the effort of all authors to turn around such a substantive set of draft chapters in such short order is pretty damned phenomenal. When you read mine (and hopefully others) comments please bear such an overarching context in mind. Going from nothing to the substantive draft so quickly is a huge effort for which the authors should take huge credit. [Peter Thorne, Ireland]</p>	<p>Thank you.</p>
6848					<p>The main messages are as follows: 1) It is still possible to meet the 1.5 degrees goal. 2) A key technology to meet either temperature goal under the Paris Agreement is carbon dioxide removal; the lower the related costs and the greater the public/social acceptability of the approach/technology the more likely it will be that the 1.5 degrees goal will actually be met. 3) The amount of CDR required strongly depends on the speed of decarbonation: the faster we can phase out fossil fuels the smaller will be the amount of carbon to be removed later on from the atmosphere. Thus it would be more cost efficient to mitigate GHG emissions now given the significant costs of most technologies for CDR and given the limited scale of cheap mitigation options. [Klaus Radunsky, Austria]</p>	<p>Noted.</p>

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5736					The report is timely as the global community has to take drastic actions to slow down and stop further warming in order to prevent severe impacts of climate change on natural and socioeconomic systems. The report assesses the limiting of warming to 1.5oC by the end of the century under various scenarios. Some of the scenarios involve overshoot and hence rely on removal of carbon dioxide from the atmosphere using technological means such as BECCS and DAC in the latter half of the century. These are proposals and the technology is not yet tested on a scale that is required to solve the climate change problem. The costs are also likely to be high. The credibility of such schemes is doubtful and should be assessed as relying on such negative emission technologies to compensate later for failures to adequately mitigate emissions has serious implications for vulnerable developing countries (Negative emission technologies: what role in meeting Paris Agreement targets? European Academics Science Advisory Council Policy Report 35, Feb 2018, ISBN: 978-3-8047-3841-6). Further, the scales of such technology are likely the same as the current fossil fuel based global energy system. The effects and damages on natural and human system and on the environment of these large scale carbon removal schemes would be of the same order of magnitude, if not larger, than the effects of climate change itself. Therefore, the natural systems could be subjected to damages from two sources of similar magnitude – one from fossil fuel emissions and the other from negative emission technologies. While solar radiation management (SRM) might be cheaper and its cooling effect is rapid, the scale (planetary scale) of the intervention again implies that the damages could be on planetary scale. Therefore, while limiting global warming to 1.5 or 2 deg is noble and ambitious, the focus should be on achieving that target using emissions reductions which is harmless to natural and human systems. The discussions on SRM and carbon removal technologies are a distraction and such distractions pose series risk to addressing climate change without damaging the only planet that we call home. I am not suggesting that the sections on SRM and CDR should be dropped. However, it would be worth conveying this message (The effects and damages on natural and human system and on the environment of the SRM and CDR schemes would be of the same order of magnitude, if not larger, than the effects of our current energy system and the consequent climate change. Therefore, the natural systems could be subjected to damages from two sources of similar magnitude at the same time) in this report. [Govindasamy Bala, India]	Taken into account. These valid points are precisely the topics addressed in sections 4.3.8, 4.3.9, the x-chapter box on SRM. We would like to add that mitigation options other than CDR may also involve risks, e.g. bio-energy. These are also addressed in chapters 3, 4 and 5.
5798					I only had time to read Chapter 1 and 2 in any depth but skimmed Chapter 3 very briefly. In all three Chapters there is a difficulty in being able to clearly trace the key findings presented at the front of the chapter in its Executive Summary specifically to the underlying assessment. The chapter texts themselves generally are not using confidence and likelihood statements in the main text and most of the time the text in the chapter summary is an abstraction of the referred to chapter text rather than a direct copy of a segment of the text. The reader is thus made to work unnecessarily hard, in my view, to fully understand the reasoning underlying the key findings. A stronger tracability would greatly help. My suggestion would be to ensure that all key findings text is present in and lifted from the underlying text across the report, allowing a direct lineage between the ES (and SPM) and the underlying assessment with no room for ambiguity on the part of the reader. In WG1 of AR5 at least some chapters had as a conclusion to any section the exact text that was to be lifted and used in the chapter summary (and hence lifted to the SPM). This has the benefit of ensuring a direct lineage which would greatly aid the reader in tracing back the thinking and forces the text to inform, directly, the associated assessment finding that is being articulated. Such an approach would also force a more consistent consideration of confidence and likelihood directly associated with the text and thus likely increase the rigor applied to all aspects of the assessment. [Peter Thorne, Ireland]	Taken into account. The FD will be clearer on the key messages and the narrative of the report. A TS will be included with headers indicating this. The TS and the ES, however, will, by regulation, not include figures.
6962					There is a lot of repetition and redundancy. Authors should be mindful to avoid inconsistencies as this would severely undermine the credibility of the report as well as of the IPCC. [Klaus Radunsky, Austria]	Taken into account. See comment response to 2416.
6964					It is noted that the Glossary does not include references for the definitions included. It is strongly recommended to provide such references in the next version of the Special Report. In addition it seems also necessary to allow for comments on definitions in the next round of comments. [Klaus Radunsky, Austria]	Accept. Glossary will be strengthened.
6974					It is noted that the report fails to address properly long-term impacts after 2100 of global warming such as sea-level rise. It is expected that such topics will be addressed in AR6. [Klaus Radunsky, Austria]	Noted.
7070					in many cases, within words "-" should be replaced with "-": for example, pre-industrial, not pre-industrial; world-wide, not world-wide; trade-offs, not trade-offs [Dmitry L. Musolin, Russian Federation]	Copy edited
7074					Titles of boxes should be bold-faced, I think [Dmitry L. Musolin, Russian Federation]	Copy edited
7150					There are rather significant differences re the use of confidence statements: many paragraphs in the chapter ES don't have any confidence statements, some show sporadic use, some after the bold first sentence, some in the non-bold text underneath. In the AR5, WGII, the consensus was to use an overarching CS after the bold sentence and then back it up with underlying CS in the non-bold text underneath. In most parts of the SOD, there is no obvious traceable account between CS in the ES and underlying chapter text. [Petra Tschakert, Australia]	Taken into account. Will be revised in the FD.
7152					The SR needs to make clear what the global average temperature is at current times. We only talk about 1C or 1.5C or 2C above pre-industrial times, but what IS the global temperature average? 14C or a bit higher? This needs to be stated somewhere, best in Ch1. [Petra Tschakert, Australia]	Noted
7154					There is an underlying assumption throughout the chapters (esp. 2 and 3) that people/societies just need to adapt or change/transform their livelihoods and lifestyles (e.g 'transformation will be required'), without much consideration for very real challenges and obstacles. Yes, but how? Many people on this planet are already enormously constrained (e.g. those experiencing multidimensional poverty!). It's a technocratic vision of feasibility that seems to brush aside too easily the social/cultural/institutional/political elements of feasibility. A more nuanced language would help. [Petra Tschakert, Australia]	Noted.
8098					All scenarios reaching 1,5°C overshoot: that is said clearly. But the report should insist more on the fact that negative emissions will face many feasibility constraints (who will pay for it, with what international scheme? Will we have enough land and water?). Hence, negative emissions are an intergenerational bet, and we should avoid as much as possible to rely too much on them. [Quentin Perrier, France]	Taken into account. Chapters 4 and 5 clearly address this. The last sentence of the comment is prescriptive and cannot be taken on board. .

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8270					<p>The Chinese government appreciates and thanks the Bureau members, lead authors and Technical Support Unit of the Special Report on Global Warming of 1.5? of the Intergovernmental Panel on Climate Change(IPCC) for their hard work in the preparation of this report. In order to enhance an IPCC assessment output in terms of science, integrity and balance while giving full consideration to its findings/conclusions in terms of equity, rationality and operability when quoted or cited, the Chinese government wish to put forward the following opinions and comments on this report in the hope that they can be adopted in the revision process.</p> <p>1. Misrepresentations of the Chinese sovereignty. There are common-sense mistakes in the report concerning the Taiwan Province of China (Chapter4 P20), all of which must be corrected, including but not limited to the specific suggested revisions to each respective chapter. At the same time, it is hoped that no such problem will be repeated in a future output.</p> <p>2. Assessments of the Global Warming of 1.5?. The Chinese government believes that the Special Report on Global Warming of 1.5? should focus on assessing the feasibility and the additional costs of keeping the global temperature rise at 1.5? under the premise of ensuring the achievement of the UN Sustainable Development Goals (SDGs), including the differences in impacts, risks and countermeasures between 1.5? and 2?, the additional socio-economic costs needed to meet 1.5?, and their impact and shock on employment, poverty reduction, food security, environmental security, etc.</p> <p>3. The practical feasibility of the countermeasures. The Chinese government believes that the measures proposed in the assessment report should consider not only theoretical and technical possibilities, but also the actual conditions of different countries in different stages of development, the availability and scalability of core technologies, the socio-economic costs of rapid transformation and the social affordability, especially the impact on the achievement of the Sustainable Development Goals (SDGs). We note that BOX 2.1 in Chapter 2 of the report analyzes the 1.5? pathways taken by four countries including China, of which the one on China features an extremely assumed and impractical scenario that highlights the technical perspective without any consideration of economic and social costs, conflicting substantially with the conclusion made by top Chinese researchers. Therefore, this box is suggested to be deleted.</p> <p>4. Criteria on country classification. The Chinese government notes that the report currently adopts a number of different criteria to categorize countries. The IPCC assessment is an intergovernmental one that is organized by United Nations agencies. So it is suggested that countries be grouped in accordance with Annex I and non-Annex I to the United Nations Framework Convention on Climate Change, Annex B and non-Annex B to the Kyoto Protocol or United Nations regional grouping criteria as far as possible when the report addresses country classification.</p> <p>5. Confidence and uncertainty formulated for the findings in the report. In view of the significant impact of an IPCC output, the findings/conclusions in a report, especially a summary for policymakers (SPM), should be supported with a high level of confidence. In case that there are much uncertainty with and limited or inconsistent literature in support of a conclusion in a SPM or an executive summary (ES), there is a need to give an objective clarification in this connection.</p> <p>6. The length, figures and tables of the report. The report goes far beyond the scope determined by the IPCC session in terms of its full text and the length of the SPM. Therefore, they are suggested to be shortened. In addition, the figures and tables in the SPM are too complicated for policymakers to understand, which is suggested to be redesigned in a more concise manner. For the ease of non-professional readers, the SPM should be prepared in a more approachable and accessible fashion. [China]</p>	1) Note and addressed. 2) Unfortunately for this there is no clear literature available. We will, in the FD, include information on how investment costs change for 1.5c compared to other scenarios. 3) Chapter 2 to address. 4) Taken into account. Following the Paris Agreement, we will work with "developed countries", "Economies in Transition" and "Developing countries". 5) for the SPM; 6) Accept. Chapters will be shortened and figures etc improved for understandability.
9016					We would like to thank the authors for providing us with this draft of the "Special Report on Global Warming of 1.5 °C (SR15)". In general we appreciate the draft and would like to congratulate the co-chairs for their efforts to fully integrate the three working groups into this report and provide us with a report that forms a good basis to work on. [Luxembourg]	Thank you.
9138					There are statements throughout the report, especially in the SPM, that are so vague and general as to be useless. Please get a good editor to either eliminate these statements, or force the authors to be much more precise and specific. This problem applies to hundreds of sentences..... [Richard Rosen, Germany]	Noted. The suggestion will be followed.
9652					1-Focusing the special report to be relevant to the Paris Agreement would require addressing how 1.5c warming compares to well below 2c warming. This is not done systematically across all chapters which makes comparing the analysis in the different chapters regarding the impacts and implications of 1.5c not comparable. 2- The relevant impacts of 1.5c in the context of Paris Agreement seem to include climatic impacts associated with 1.5c, impacts avoided by limiting temperature to 1.5c, and impacts associated with responses needed to get to 1.5c. It seems that the report is focusing mostly on the first type of impacts and working out what needed to adapt. [Mustafa BABIKER, Sudan]	Noted and addressed
10466					The overall report is too long. All the chapters in the second order draft have further expanded the length of text. But some text contains no clear message or information. There are many overlaps between chapters, particularly in Chapter 4 and Chapter 5. It is very tiring to read through when the same or similar contents are repeated within a chapter and in different chapters. Shortening the chapters by reducing repeated contents and streamline the text will greatly increase the readability of the report. [Hong Yang, Switzerland]	Noted. Many parts of the report are indeed over their prescribed length (though chapter 4 is within 10% exceeding it). Chapter 4 and 5 discussed overlaps in LAM4 and will address this.
11166					We thank the authors for their efforts in putting together the draft of this important report, and recognise the considerable work involved over a short timeframe and during a period when relevant research is still being published. The UK government has provided below detailed comments on the report which we intend to be helpful to the authors in preparing a clear, concise and policy-relevant document that addresses the request posed by the UNFCCC in 2015. We provide some overarching comments on the entire report below. These are supported by more specific comments on individual chapters and the SPM. [United Kingdom (of Great Britain and Northern Ireland)]	Thank you.

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9120					This report has gotten totally out of control. It is poorly written in many places, there is a lot of overlap both within chapters and between chapters, and it is far too long. Many of the authors seem more concerned to describe their own research and that of their colleagues, rather than to write a clear and coherent report. Furthermore, there are major topics such as financing mitigation investment and what mitigation policies and technologies should be utilized which are not discussed enough. The results from the fairly useless integrated assessment models are described far too much, such as all the overshoot scenarios and reliance on negative emissions technologies which result from use of the high 5% discount rate, especially in light of the other major flaws in those models. Scenarios created in other ways are not described enough, especially non-overshoot 1.5 degree C scenarios. Finally, major policy issues such as the appropriate discount rate are not even discussed in the draft SPM, but must be. Probably all the pathways created using a discount rate of about 5% real should be ignored, as not relevant to long-term social planning that sufficiently incorporates considerations of inter-generational equity. This choice of an appropriate discount rate for analyzing mitigation strategies is probably the most important decision that any policy maker will ever have to make, and the SPM should make this clear to policy makers. The appropriate social discount rate for this purpose should be in the 1-2% range, just as was used in Lord Stern's 2006 study on mitigating climate change. He used 1.4%. But even if a reasonable social discount rate is used for long-term economic analysis in this report, the uncertainties associated with each economic input variable are so substantial that it is probably not useful to perform any kind of "cost effectiveness" or cost/benefit analysis. These kinds of economic analysis are also not useful to do with the integrated assessment models relied on, by mistake, in this report, because many of the major costs as well as benefits of mitigating climate change are not included in the models. Why the authors do not either acknowledge or admit to their fatal flaws in the models is beyond me. All the research groups that run those IAMs could have saved themselves a lot of time and money by pooling their resources to make one or two better IAMs that are complete, and more transparent, and which include all major costs and benefits. Some examples of major mitigation costs omitted, as far as I know, are the capital costs of more energy efficient technologies and appliances, and the capital costs of substantially adding to the mass transit systems of the world's cities. [Richard Rosen, Germany]	This should be answered by chapter 2, but the Final Draft of chapter 4 will contain an assessment of investments and finance needs for mitigation that combines and compares those resulting from IAMs and from bottom-up studies.
9418					As it is seen in the Glossary, 'In this report, the term risk is often used to refer to the potential, when the outcome is uncertain, for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure (Glossary, SOD).' This definition (risk = probability of adverse outcome) widely used in SR15 SOD is the ultimate cause of many misinterpretations in the report, because severity and scale of consequences are not taken into account. If something negative occurs somewhere, this does not mean automatically that we should pay attention to it in a decision-making process. May be the damage actually is absent or negligible. Therefore, the full enumeration using risk = probability x damage approach is needed to compare +1.5C with +2C worlds. Unfortunately, this is not the case in the report. [Russian Federation]	Noted, thank you for the constructive suggestion. This has been considered as part of the definition of risk in the Glossary and SPM.
9542					It seems to me that the report tries to bend over backwards to pretend that 1.5 is still possible. Somewhat facetiously I might suggest that the entire report could be replaced by the words "that ship has sailed". Yet despite the fact that zeroing CO2 and tropospheric aerosols instantly would be enough to take us to 1.5C (figure 1.6), the report to my mind obfuscates the conclusion. What's wrong with a blunt lead-in sentence saying "There are no realistic pathways to achieving 1.5C without significant periods of substantial temperature overshoot, and even those scenarios rely on unproven negative emissions technology". Using words like "rapid phase-out" and "deep reductions" aren't as clear as they could be. [Douglas MacMartin, United States of America]	Taken into account. The report, including the summary for policymakers, acknowledges that limiting warming to 1.5°C is very challenging. IPCC, however, cannot be policy prescriptive and hence needs to steer away from political value judgments. In this context the SPM highlights: "There is no simple answer to the question of whether it is feasible to limit warming to 1.5°C and to adapt to the consequences because feasibility has multiple dimensions that need to be considered simultaneously and systematically. (1.4, Cross-Chapter Box 3 in Chapter 1, 4.3, 4.4)"
11178					The impacts chapter and its communication in the SPM lacks a strong narrative and clear, easy to communicate messages. The differential impacts between 2C and 1.5C are often qualitative and vague. The costs and challenges of the 1.5C target are generally clearly communicated, but the benefits of achieving 1.5C do not come across clearly. If it is not yet possible (or ever possible) to make clearer statements about the differential impacts then such challenges must be clearly stated. [United Kingdom (of Great Britain and Northern Ireland)]	Efforts have been made to improve the narrative of Chapter 3 and how this is reported in the SPM.
11188					In Chapter 3 and Chapter 5 the focus is primarily on impacts and sustainability implications for developing countries. This is of course appropriate given that the greatest burden in these respects will fall on such countries. However there will also be impacts and sustainability issues for developed countries and it is important that these are brought out more in the text. [United Kingdom (of Great Britain and Northern Ireland)]	Noted and efforts have been made to provide information that is regionally balanced, for example in the selection of case-studies in Chapter 4.
14118					Please review the use, or the omission, of the likelihood language in all chapters in order to improve coherence and confidence. Especially when statements are suggesting causalities, synergies and trade-offs. In many cases for this draft it was difficult to analyze the relevance and coherence of the statements due to the lacking of likelihood language [Meimain Moreno, Venezuela]	Accept. This will receive greater attention in the FD.
14126					If there is no, please make a summary to suggest better ways and methods for people to achieve 1.5C. [Zhen-Yi Wang, China]	Reject. This would be prescriptive and this is not in our mandate.
9604					Very encouraged to see that IPCC has dedicated this special report to a focus on 1.5 and that time and resources are going into pursuing efforts to limit warming by this degree. It will be especially useful to have a summary report for decision makers that pulls out key messages. Thought should go into how to make this information accessible to communities and the local level as well as grassroots organizations. Overall, chapters 4 and 5 do a good job of highlighting Indigenous peoples and importance of Indigenous knowledge - this is lacking in Chapter 3. Although it is important that this is highlighted, ideally Indigenous knowledge holders should participate in the development of these reports so that they stand as an example of HOW to be engaging with Indigenous knowledge. In particular, the high vulnerability of the Arctic Indigenous population is mentioned several times. There are many communities and individuals from this population whose voices, knowledge, and experience would have strengthened the writing of this report had they been brought in from the beginning. [Joanna Petrasek MacDonald, Canada]	Noted and we also thank contributions made by experts reviewing the report drafts.

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11168					We request that all authors refer back to the scope and page limits agreed by the Panel and ensure that every paragraph of the report fits within these limits. The length of the report is excessive. Many of the chapters are padded out with material that does not appear to be specific to the analytical challenge of 1.5C and the accepted scope, and as a result, the report lacks clarity and specificity in many places in a bid to cover a breadth of related areas. Key messages for policymakers are unfortunately lost. By way of example, the discussion of the anthropocene in Chapter 1 is lengthy and appears to offer little further contribution to the rest of the report. We identify below a number of areas that are beyond the scope and can be removed. [United Kingdom (of Great Britain and Northern Ireland)]	Noted. Reducing the length, removing redundancies and bringing out key messages is high on our agenda.
11170					Away from the scenario analysis and some of the impacts work, it appears as though relatively little of the analysis is specific to 1.5C. Too often the text talks in generalities, without making it plain how it (or the underlying references) relate specifically to 1.5C. A typical example would be summary table 5.1 and the underlying research. This lack of specificity makes the document less valuable than it could be as it is harder to design appropriate policy for 1.5C on the basis of research that may not be directly targeted at this particular challenge. At the very least, where the research is more generic, it needs to be made clearer how it remains relevant or where it does not. If a research gap exists, it should be mentioned. Also, it is difficult to ascertain what additional measures/actions/mitigation is required for 1.5C compared with that required for 2C, and to identify where there is new understanding of 1.5/2C. [United Kingdom (of Great Britain and Northern Ireland)]	Accept. We were tasked with looking at the 1.5C-relevant literature, but the report should be as 1.5C-specific as possible. Tables and figures, as well as all paragraphs, will be related specifically to 1.5C, or it will be made clear how the information relates to 1.5C.
11172					There are regularly inconsistencies between chapters, in particular between Chapter 2 and 4. These appear to have been written in parallel, rather than one informing and providing the basis for the other (for example, the scenarios of chapter 2 do not appear to have been used in any great detail in the feasibility discussion in chapter 4). We also provide a number of examples of numerical inconsistencies. We recognise and appreciate the limited amount of time available to produce the report, but for the next draft it is important that these inconsistencies are removed and that the chapters are truly integrated and complement and inform each other. [United Kingdom (of Great Britain and Northern Ireland)]	Accept. The chapters indeed have been written largely in parallel due to the stringent time schedule of this report. In LAM4, we have identified on a detailed level the links between the chapters. Thank you for helping us identify inconsistencies.
11174					A clearer narrative and use of global carbon budgets is required. As currently written, the budget concept is confusing and it is not sufficiently clear what new policy focused messages have emerged. A focused narrative that describes what a carbon budget is, why the concept is useful, how the specific numbers have been derived, where uncertainties emerge from, the significance of the broad range and what the key findings are from the latest values is needed. As it stands, the discussion in Chapter 2 is confused, inconsistent and does not present a strong message to policy makers. It is particularly important the carbon budget concepts are clearly articulated that it forms the basis of the rationale for net zero emissions and immediate action, and given the focus on this area of the debate after the publication of Millar et al. [United Kingdom (of Great Britain and Northern Ireland)]	Noted and implemented in the preparation of Chapter 2, in coordination with other chapters and reported on in the SPM
15406					There are a number of incorrect statements made in the report about the Paris Agreement, including the specific obligations it creates for Parties and the operation of its provisions. The Paris Agreement is also widely referenced throughout the report in support of a wide range of claims, some of which are quite overblown or simply incorrect. Given the importance of this report to informing implementation of the Paris Agreement, it is important that all references to it are correct. References to the Agreement throughout the report should be checked for accuracy. [Australia]	Accept. All references to the Paris Agreement must be made correct, but we are also assessing literature that discusses interpretations of the Paris Agreement, which may need to paraphrase.
15408					Be clear to what extent statements can be quantified, this is particularly relevant for indication of quantities (and confidence levels) for changes of (i) the Present day versus a 1.5degC world, (ii) the 1.5degC world, and then (iii) the 2degC world. Also please be clear on what we don't know/gaps in the science/data and modelling limitations. [Australia]	The IPCC uncertainty language has been applied by chapter consensus and the definition of 1.5°C and 2°C warming relative to pre-industrial levels is defined in section 1.2.1., knowledge gaps have been described at the end of each chapter.
17804					SR15 should be written in accordance with its length constraints strictly. [Republic of Korea]	Thank you.
17900					there seems to be two different definitions of the 1.5°C target. In the SPM it says that it is a 30yr average while in chapter 2 it is defined related to a probability to limit warming to 1.5°C in 2100. This inconsistency is problematic [Brigitte Knopf, Germany]	The working definition of the report of 1.5°C relative to pre-industrial levels is in section 1.2.1.
19350					Pages in SOD has headers of "First Order Draft" e.g. in Chapter 2 between pages 25 and 92 [Jennifer Morgan, Netherlands]	Copy edited
11176					The role of bioenergy and land based CDR is not clear. This is a crucial issue that will receive a lot of attention, yet the main messages are not clearly communicated and there is no sense of an overall perspective on feasibility. There are no scenarios without major implications for land use, yet it is not clear in the SPM or executive summary for Chapter 2 that even if we do not go down a BECCS route, that bioenergy will be operating on a vast scale (the largest form of renewables in many scenarios). The feasibility of this large scale adoption of bioenergy and/or BECCS is skirted around - challenges are mentioned, but fundamentally no clear picture emerges. It would be very helpful to have a clear and objective look that lays out all of the benefits and risks of these technologies. Additionally, there is no clear description of an alternative if the sustainability concerns around BECCS and bioenergy means they are not feasible (at the scale assumed in the scenarios). Beyond reduced demand, what are the alternatives? Policy makers need to know whether 1.5C (2C) is out of reach should these technologies not be available at scale. None of these issues are sufficiently clearly articulated. The feasibility of BECCS is likely to be an issue on which the SR is scrutinised carefully and a lack of clarity on these issues risks undermining the credibility of the report. [United Kingdom (of Great Britain and Northern Ireland)]	Accept. The result of chapter 2 is that BECCS plays a big role, the result of chapters 4 and 5 is that its role is constrained by different impacts. This needs to be brought out more clearly.
11180					It would be helpful to have greater clarity on the difference in mitigation efforts between 1.5C and 2C. There are points made in this respect (e.g. greater balance on rapid emission reduction than on additional CDR) and they are clear and well made in isolation and Chapter 2 has useful material on the specific elements on 1.5C pathways (but not this is not necessarily explicitly compared against 2C). However it could be improved if there were a single focused summary that draws together all of the different themes. This would be a very helpful narrative for policymakers. The SPM may be an appropriate place, or perhaps a dedicated box in Chapter 2. [United Kingdom (of Great Britain and Northern Ireland)]	Differences in mitigation efforts have been described, including in tabular form in Chapter 2 and the SPM.
11182					It would be helpful to provide greater clarity on the strengths and limitations of Integrated Assessment Models. The role of SSPs in driving and influencing the scenarios needs to be expanded and made more transparent, along with a fuller description of exactly why the reliance on BECCS/CDR emerges in models. Beyond this the main messages from the helpful discussion in 2.6.1 should be more clearly communicated to policy makers - for example to highlight what is missing from IAMs and how this may make the mitigation challenge easier or harder. The main overarching messages of the report are very heavily based on IAMs and a it would be helpful to be more open about the strengths and limitations (i.e. a general sense of the full uncertainty space). What would be helpful would be a clearer sense of how the quantitative results of IAMs emerge to form the high level statements/numbers of the report. [United Kingdom (of Great Britain and Northern Ireland)]	Thank you for the constructive reflections. The limitations of Integrated Assessment Models are discussed in section 2.6.2.

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11184					The feasibility assessment of scenarios is not always robust. Specific reference was made to the question of bioenergy/BECCS feasibility, but there is a wider concern that feasibility in general is not being robustly assessed. Chapter 4 often makes use of generic statements, without specific reference to the details of the sectoral decarbonisation requirements outlined in Chapter 2. It appears as if limited effort has been paid to using Chapter 2 data to in Chapter 4, to rigorously assess what is and isn't possible. In a number of instances there is also a positive, high level assessment without any balanced critical judgement. Examples of these points are provided below. [United Kingdom (of Great Britain and Northern Ireland)]	Accept. Chapter 4 is working hard on addressing the traceability and robustness of the feasibility assessment, and linking with chapter 2. See also response to comment 11172.
11186					Much of the interaction of the relevant climate science presented in the report with sustainable development goals is high level and lacking specificity to 1.5C. While we recognise the crucial interactions with SDGs, it may be more valuable to focus on those areas where the science is particularly strong and robust and enables clear conclusions about the sustainability implications of 1.5C. This would help focus on actionable messages for policy makers and cut down the text. Furthermore, as stated in the general comment on Chapter 5 below, the chapter as currently written presents mixed messages to policy makers regarding the compatibility of mitigation/adaptation and SDGs. [United Kingdom (of Great Britain and Northern Ireland)]	Thank you for the constructive reflection, the points are well noted. The SDGs have been used as metrics for the interactions between different response options with sustainable development, with the assessment based on the available relevant literature.
20518					The report focuses on the difference between 1.5 degrees celsius and 2 degrees celsius in the context of sustainable development, poverty eradication and equity, considering adaptation and mitigation options. We understand this was the special report's mandate, that said, framing the report solely on the marginal difference of half a degree celsius rather than adding the extra frame which presents the difference between 1.5 degrees celsius and business as usual softens the urgency of the actions to stay below 1.5 degrees Celsius. [Jennifer Morgan, Netherlands]	Noted.
24432					The Special Report is well-organized and clearly puts accurately the state of the art to limit warming to 1.5 degree centigrade. Both in content and in synergy between chapters provides a better understanding to the limiting global warming goal set for in its title. The explanatory boxes are useful and well-written and I think are the best answer to those who name themselves "scepticists" on the anthropocene. In general the report provides a clear update to that of AR5. In spite of the general positive impression that I got reading the Report, I should stress the fact that there is a general tendency to use updated papers (after AR5) mostly from the Lead and Contributing Authors. I think the references should be broadened. [Christos Zerefos, Greece]	Noted.
29362					There are a lot of abbreviations across different chapters. If they are not necessary, it would be better to reduce abbreviations as too many abbreviations make them difficult to remember. [Yuanyuan Huang, France]	Noted and implemented in the Annex II
29520					We very much appreciate the expertise and work of the authors to produce this topical, policy-relevant Special Report. [Finland]	Thank you.
29870					The Government of France thinks that the draft SPM is already quite useful in its current version and that many important messages are clearly expressed. France agrees with most of the messages stated in the SPM and Chapters. The SPM and its high level statements properly reflect the general balance between the different chapters. France considers that the general organisation of the report is in line with the instructions given at the scoping meeting and should therefore be maintained. [France]	Thank you.
11190					Many of the figures used in the report need considerable work to simplify them or improve their clarity. This is particularly the case in the SPM where, at present, most figures require a lot of effort to determine the key messages being communicated and too much is being squeezed into each one. We suggest that the authors identify 1 or 2 key points and design their figures around these. Additionally, many of the figures are low resolution - we assume this will be improved prior to publication, but it's important that they are of professional quality. In June 2017 the IPCC Secretariat informed us of 'a project being undertaken by the University of East Anglia (UEA) Tyndall Centre for Climate Change Research and the UEA Schools of Psychology and Environmental Sciences. They are developing guidance to support the communications of climate change data in visuals. We hope that this guidance will be relevant to the authors preparing the IPCC Special Report on Global Warming of 1.5°C (SR15), and other IPCC products' - the guidance is here: https://climateoutreach.org/resources/ipcc-communications-handbook/ . Being dated 30 January, we recognise it may not have been available to authors of the SOD, but we hope it will be used going forward. [United Kingdom (of Great Britain and Northern Ireland)]	Noted.
15402					The report is too long. The IPCC Plenary asked for a 225 page report, this draft presents us with over 1000 pages. Suggest authors review the document to reduce length in a manner that provides an evidenced-based, consistent and balanced report. Possible options to reduce report length: (i) retaining AR5 information specific to the issues being addressed in the Report, in a concise manner (ii) removing information that is not based on evidence (eg storylines), (iii) consider how the Report will be accessed on the web, eg use hyperlinks to provide technical or further information. The Summary for Policy Makers should be no more than 10 pages, the Executive Summary of each chapter should be no more than 2 pages maximum. Beyond this length it is no longer a summary and will not be read by policymakers. [Australia]	Taken into account. First of all IPCC-approved pages are longer than normal word pages. Second, this has the warm attention of the chapters involved, chapters will be streamlined, and page numbers will be reduced to the required amounts.
15404					The report needs a consistent way of talking about "warming" versus particular manifestations of that warming, such as surface air temperature change. If "warming" or "global warming" refers to the climate system as a whole, including ocean heat content, ice sheet net loss, and other manifestations, then "global mean surface temperature change" (as in Box SPM 1) should be used whenever this particular variable is referred to. This particular variable is a key indicator and the policy target, so the text needs to be as specific as possible (for example there is no ocean heat content "guardrail" declared by the UNFCCC). [Australia]	The definition of global warming used in report is the estimated increase in global mean surface temperature (GMST) averaged over a 30-year period, or the 30-year period centred on a particular year or decade, expressed relative to pre-industrial levels unless otherwise specified. For 30-year periods that span past and future years, the current multi-decadal warming trend is assumed to continue.
18758					Terminological suggestions: - Terms should be defined, preferably when they first appear and in the Glossary. Key terms in the report remain vague (like "carbon neutrality") and/or used inconsistently. - Use FCCC terminology and scientifically defined terms, wherever possible. E.g., "removals" are preferable to "negative emissions", and "carbon neutrality" should be avoided and replaced by more exact terms (like net zero emissions, although that also needs to be more clearly defined). - "net zero" and "net negative" should be defined before or when first used. It should be clear whether it refers to all fluxes to/from the atmosphere, or just anthropogenic ones. If the latter, it should be clear how those are separated from natural fluxes, in particular for land use. [Andrea TILCHE, Belgium]	Noted and implemented in the Glossary

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19124					I commend the authors for a significantly improved manuscript. Consistency across the chapters and with the SPM has increased but there remains a few areas of concern. My overall comments are a lack of consideration of the role of cooling short-lived species in a highly-mitigated world typical of a 1.5 or 2°C trajectory, carbon budgets that may not be fully traceable to the complex models and/or the scientific literature, and statements in the exec summary / SPM that are left to interpretation or do not reflect the more complex views expressed in the chapters (eg on solar radiation management). [Olivier Boucher, France]	Noted. We are working further on improvement of consistency between chapters. [add further reflections by chapters]. Chapter 4 is improving its reflection of SRM in the Executive Summary.
29872					Some sentences of the SPM are still complicated or ambiguous. The SPM should be shortened as possible by 10-20%. It would be highly appreciated if figures and tables, especially in the SPM, could be clarified and made more intelligible, as most of them are difficult to read due to complexity and/or low resolution. What is more, Chapters are still difficult to read for non-specialists. [France]	Noted. We are working on simplifying the language in the chapters and shortening the SPM.
29874					Every time NDC are mentioned, especially to underscore that current pledges are not compatible with 1,5°C, it should be specified that the implementation of NDCs, and not only the pledges themselves, is paramount to achieve the goals set. [France]	Accept.
29876					In the SPM, several statements call for a « rapid » emission reduction or development of a technique. Yet, « rapid » is not quantified, and could thus be understood very differently. More quantitative statements should be used when possible. [France]	Rapid' is defined according to the rate of percentage change relative to coming decades.
29878					The mention of climate uncertainties is essential, but it would deserve more explanations. It should be clarified which uncertainties are taken into account in the concerned statements in particular by distinguishing between uncertainties and sensitivity arising from climate models and those arising from energy-economic models (e.g. growth, technical progress, etc...) [France]	Accepted: this is a valid point, and as far as possible consistent with clarity we have tried to distinguish climate response uncertainty from scenario dependence.
29880					Many statements are qualitative and useful, but some quantitative statements could be added to strengthen them when possible. [France]	Qualitative statements have been made where the information is available in the underlying relevant literature.
29884					Please harmonize the use of "evidence" and "agreement" propositions, as there are not in the same order (evidence, agreement) or (agreement, evidence) each time. [France]	Noted.
29886					Some definitions are abusively considered equivalent in the glossary and should be distinguished, for example, ecosystem services and environmental services, or blue carbon and enhanced seagrass meadows. [France]	Accepted. 'Environmental services' and 'enhanced seagrass meadows' removed. Others also altered.
18760					<p>Comment on the GLOSSARY:</p> <p>In general, UNFCCC and other formal definitions should be followed. New terms should only be used when necessary, to avoid confusion and proliferation of terms. E.g., "negative emissions" should generally be "removals".</p> <p>Specifically:</p> <p>"Afforestation" (and reforestation/deforestation and other LUC): It should be clarified how it is interpreted in this report. Under the FCCC and related IPCC guidance, land cover transitions are considered LUC only for 20 years (by default), after which the related land enters the "LL" categories. In this report, high ambitions (and estimates) assigned to afforestation suggest that their (cumulative) impact is considered for a longer (perhaps indefinite) period. That may be reasonable, but then it creates a discrepancy with IPCC terminology used elsewhere, and raises serious conceptual issues on how to separate afforested land from other forest.</p> <p>"Anthropogenic [emissions]": Anthropogenic removals should be defined, including how they are separated (conceptually, scientifically or in modelling) from natural removals. NB, bioenergy in general, and BECCS in particular rely (at least implicitly) on anthropogenic removals. Also, "land use" should be included in the definition(s) (currently only land-use change is mentioned, but that is the lesser part of the land C fluxes).</p> <p>"Biochar": this is not a neutral definition, but a biased presentation of (unsubstantiated) benefits. Surely, the soil emissions should be taken into account, but also the CH4 from the production of the biochar, the opportunity cost of the land where it is produced and/or the biomass from which it is produced, the albedo effect (on the land where it is applied and in the cryosphere where its black carbon is likely to be taken) and the potential risk of soil contamination. It should recognise the fact that the char needs not be disposed into the soil, but could be sequestered elsewhere (i.e., the application of soil should not be assumed automatically, only where the benefits outweigh the considerable risks) and that it could also be used differently (e.g., for substitution of solid fossil fuels).</p> <p>"Bioenergy and Carbon Dioxide Capture and Storage (BECCS)": It may be reasonable to mention indirect land-use changes (for the micro-level assessments), but not before direct land use impacts are recognised and addressed. That is much more important, including the opportunity cost of the land (and/or biomass) supporting BECCS. ILUC may be a minor (perhaps negligible) component. In any event, in global modelling there should be no "ILUC", as a global model should internalise land use entirely.</p> <p>"Carbon Dioxide Removal (CDR)": the description fails to distinguish between natural and anthropogenic removals. That is particularly the case for removals resulting from land use not involving LUC (e.g., the enormous potential of sequestering C in soils through better management of existing land uses, the restoration of degraded forests and other ecosystems, etc.). As written, it may include some or all natural sinks as part of CDR, therefore all would be considered "mitigation". That would be wrong.</p> <p>"Energy balance" this refers solely to the energy balance of the planet. It would be important to discuss in the report (and mention in the glossary) the energy balance of socioeconomic systems, in particular the "energy return on energy invested" (EROEI), which can be a major factor in the foreseen energy transition, but never mentioned (neither by this name nor otherwise).</p> <p>"Negative emissions": This definition is unclear and possibly wrong. It fails to differentiate between the natural and anthropogenic components of removals. Under this interpretation, it is not reasonable to include "as a result of human activities", as the definition would apply regardless of the reason. Notably, the cessation of human activities could lead to the same result. [Andrea TILCHE, Belgium]</p>	<p>Afforestation - usage in the report addressed in chapter 2. Anthropogenic removals now defined, with definition including land use. Biochar - IBI definition adopted. BECCS - no longer applicable, definition re-written. CDR - definition makes clear it is a 'special type of mitigation'. Energy balance - definition removed. Negative emissions - definition modified to more clearly distinguish between anthro. and natural.</p>

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19352					Industry - financed or otherwise industry controlled sources and references should not be used. One prominent example is the IEA, the International Energy Agency. IEA is openly lobbying for specific technical solutions and systematically underestimating how renewable solutions grow and become cost-competitive. Also pro-nuclear and pro-fossil fuel organisations directly contribute to writing and reviewing the IEA reports referred to this draft eg. the referenced Energy Technology Perspectives and World Energy Investments reports. As an example the ETP reports have among their authors, reviewers and funders experts from OECD Nuclear Energy Agency, Natural Resources Canada, Japan Gas Association, BP, EON, Total, China Energy Group, Volkswagen, Osaka Gas, Areva etc http://www.iea.org/publications/freepublications/publication/EnergyTechnologyPerspectives2014.pdf [Jennifer Morgan, Netherlands]	The IPCC assesses the knowledge in the available scientific and technical literature in a comprehensive, balanced and transparent manner.
29888					Technical terms, frequently used in the SPM, such as overshoot, climate-smart agriculture, anthropogenic removals, should be defined in the Glossary. [France]	Terms that are key to chapters and those that appear in multiple chapters are defined in the Glossary. Definitions of key concepts are provided in the SPM.
29898					Regarding non-CO2 drivers, the CO2eq unit should be added every time it is relevant. [France]	Taken into account.
29900					This report could insist more on the fact that although all 1.5°C scenarios rely on negative emissions, the political and economic feasibility is far from granted. [France]	The report assesses scenarios available in the literature.
29902					To be able to use CCS technology, included BECCS, the development of CO2 transport and storage infrastructures is needed, which will increase the cost of this technology. How is this bottleneck considered in this report ? [France]	Taken into account. In Chapter 4, this is addressed in the feasibility assessment of options in 4.3 and 4.5, which considers as part of its economic and institutional feasibility the transport and storage infrastructure.
29904					It is important to define the concept of « climate-smart agriculture » which is used several times across the report. [France]	Taken into account, the FAO definition of climate smart agriculture has been adopted for this report.
29906					Agro-ecology is not evoked in the changes in agricultural practices, despite the benefits it can have regarding mitigation, adaptation, biodiversity etc [France]	Noted. Chapter 4 is strengthening its agricultural mitigation options.
29908					Soils carbon sequestration through changes in practices, although mentioned in the glossary, could appear more explicitly in the SPM. What is more, it would be useful to homogenize the terms used (sometimes « carbon removal », « carbon sequestration », « carbon storage »). Soil carbon sequestration should always be kept apart from greenhouse gas mitigation ni agriculture. [France]	Accept. SCS is kept separate from agricultural mitigation options in Chapter 4. SCS is also clearly separated from the more generic "carbon sequestration" and "carbon dioxide removal", to which it is a subcategory.
22784					The substance of the report and its systematic flow is of high standard. It rightly includes different kinds of methods used in deriving data for the quantification of significant differences between the 1.5°C and 2°C future climate scenarios. However, I am of the thought that more information can be added which outlines the advantages and disadvantages of each method of deriving the 1.5°C and 2°C global warming scenarios. Therefore, I am briefly suggesting some statements below pertaining to methods used to derive he two warming scenarios: - Using the Coupled Model Inter-comparison Project (CMIP) style simulations, the lower temperature goal of 1.5°C exhibits less warming than what would likely be achieved in the CMIP5's most aggressive mitigation of the Representative Concentration Pathway 2.6 by the end of the 21st century (Sanderson et al., 2017, Van Vuuren et al., 2011). Additionally, as uncertainty increases with time in these simulations, such experiments are inadequate to inform assessments on the impacts at specific levels of warming such as 1.5°C or 2°C, let alone the difference between two such warming levels (James et al., 2017). - Although the HAPPI (Half a degree Additional warming, Prognosis and Impacts, Mitchell et al., 2017) model inter-comparison project is the primary tool or one of the primary tools that was employed by the community to address the difference between 1.5°C and 2°C of warming and to inform this IPCC Special Report, the HAPPI experiment has an intrinsic limitation of prescribing sea surface temperatures (SSTs) to stand-alone atmospheric general circulation models. This technique does not include coupled ocean-atmosphere internal variability, which is critical for simulating climate extremes, such as drought variability and persistence (Seager et al., 2005, Coats et al., 2016, Routson et al., 2016). Another limitation of using the HAPPI data is that all its simulations have the same SST pattern evolution (with a constant pattern offset to represent warming), and the estimation of significance of the difference in climate states may exclude internal variability (Lehner et al., 2017). - Another method used in some of the studies was the 'time-slice' technique. This method involved taking periods in the existing CMIP5 projections from high greenhouse gas emission scenarios, where global mean temperatures equal the warming level of interest (Schleussner et al, 2016). This approach can be complicated when using a period of transient change that still exhibits a strong trend because the pattern of warming may differ from the equilibrium state (Lehner et al., 2017, Schleussner et al, 2016, Herger et al., 2015). However, the NCAR CESM low-warming experiment (Sanderson et al., 2017) used in some places in the report has an advantage that it is based on a fully coupled model with equilibrium climates at the 1.5°C and 2°C warming levels. There is also an article submitted in October 2017 currently going through peer review about record-breaking climate extremes in Africa under stabilized 1.5 and 2C global warming scenarios. It uses the NCAR CESM low-warming experiments. Probably 1 or 2 statements or ideas from it could be used to complement this report under the Africa sub-section. [SHINGIRAI SHEPARD NANGOMBE, Zimbabwe]	Accepted: these are all very valid points, and the relative merits of different methods of assessing the impacts of a warming of 1.5°C compared to a warming of 2°C are assessed in Chapter 3, within the limitations of the literature, noting that some of these issues remain topics of active research.
29404					This is a very instructive and detailed chapter: however frankly I did not have enough time to read it entirely in detail chapter 3 that I selected. I imagine this is/will be also the case for many experts, politicians etc.. To help the readers of chapter 3, but also of other chapters, an electronic sorting tool on the on-line document could be useful. For instance, if deciders, scientists, teachers... are interested a geographical region, say the Mediterranean, by asking "Mediterranea" the on-line tool should edit a document gathering paragraphs and sub-paragraphs in which this region is significantly discussed. That would be not simply a tool looking for paragraphs where the selected word(s) appears, the selection should be smart enough to select and gather paragraphs really relevant to the request. It could work for geographical areas but also for other topics (for instance marine resources...). I don't know whether this kind of tool is already under development for next IPCC reports, but I am convinced that it would help a wide set of potential readers, like deciders. I would be happy if it already exists... (and if my comments is not so useful...) [Alain Mazaud, France]	Noted.

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29890					The impacts of climate change of 1.5°C are often described in comparison to impacts of 2°C. Most policy-makers will not have in mind what are exactly the impacts of a 2°C warming (in terms of precipitation, droughts, floods, cyclones etc.) so the comparison might not be helpful enough. If possible, we would suggest adding in section 2 of the SPM a Figure or a Table describing the impacts at 2°C, then at 1.5°C and comparing them. A Figure using a design such as the one produced by Carbon Brief (https://www.carbonbrief.org/scientists-compare-climate-change-impacts-at-1-5c-and-2c) would be both informative and easier to read. [France]	To explore avoided impacts and reduced risks at 1.5°C compared with at 2°C of global warming, the chapter adopts the AR5 'Reasons for Concern' aggregated projected risk framework (Section 3.5) also comparing to observed warming.
29910					Organic agriculture is not mentioned and low emissions products are preferred. Organic products also have low emissions and benefits for biodiversity, water quality, etc. [France]	Noted, thank you. The assessment was based on available relevant literature published by the 15th May 2018.
29912					The importance of inequalities seem not to be developed enough : what are the inequalities at stake (economic, access, information), and what are their links to poverty and vulnerability. These three concepts seem to overlap in the report. [France]	The revised chapter 2 discusses explicitly inequalities in the context of different SSPs, with notably an explicit list of inequality dimensions considered in SSP4 focused on this question (Table 2.3) The revised Chapter 5 discusses in a systematic manner issues related to different forms of inequalities, notably in the context of synergies and trade-offs with SDG10, and seeks to be explicit about the type of inequality considered in each instance
29914					The impact on employment is not always clear. Does "job losses" mean net losses and increase in unemployment, or job shifts (e.g. from thermal power plants to variable renewable). Socio-political implications can be very different. Is it possible to assess the job potential of the 1.5°C target? [France]	The interplay between mitigation options and employment is discussed explicitly in section 5.4, when considering synergies and tradeoffs with SDG8. Notably a specific discussion is made in section 5.4.1.2 regarding the situation in economies dependent upon fossil fuel-based energy generation and/or export revenue. But the literature does not provide robust estimates for quantification of the net effects. This is explicitly acknowledged in section 5.4.1.1
29916					The importance of offshore wind and storage seems underestimated, especially in chapter 4. The report may be lagging compared to most recent publications. [France]	Taken into account. As this report cannot be comprehensive, we tried to discuss only those mitigation and adaptation options for which significant new literature or developments happened since AR5. Wind energy and energy storage are addressed briefly in 4.3.2.
29918					Although many diverse scenarios are presented, there is no critical evaluation of these scenarios. Depending on the scenario, the potential of a given CO2 reduction measure varies by a factor of 10. In such case, one can wonder what the average means. Ideally, IPCC could make a critical evaluation of the scenarios - but this is certainly a difficult task which is not specific to SR1.5. [France]	Taken into account, the assessment has been based on the scenarios available in the literature whose characteristics are described.
31118					The SR1.5°C report should highlight the need of total national emissions targets to be incorporated into NDCs in order to calculate the gap between accumulation of NDCs target and 2°C and 1.5°C pathways. Some countries have not set total national emissions targets, instead they adopt carbon intensity (the amount of CO2 emitted per unit of economic output) target. So the change in GDP growth rate causes a great deal of deviation in prospects of global emissions based on the accumulation of NDCs of all countries. Therefore, when discussing the gap between 2°C and 1.5°C pathways and NDCs, it is crucial not only to discuss the difference in emission pathways that result from the achieving probabilities for the temperature target (climate sensitivity uncertainty) alone, but also to discuss it together with the huge uncertainty in NDCs of large emitting countries who set their NDC based on carbon intensity (the amount of CO2 emitted per unit of economic output) target. (see and do mention the following papers in this report). However, the draft has barely mentioned the subject. It should be specified in the Entire Report and SPM. Rogelj J, Fricko O, Meinshausen M, et al., Nature Communications 8 (2017) https://www.nature.com/articles/ncomms15748 [Japan]	Accept. There is indeed literature on the uncertainties in NDC results as a consequence of intensity targets of different natures. This is addressed in the x-chapter box on NDCs as "variations in overall socioeconomic conditions, such as Gross Domestic Product and population growth", and it will be made more explicit.
31120					Since there are many general descriptions that can apply even for targets of more than 2°C and are not limited to the case of a 1.5°C warming world, IPCC has to indicate clearly what is particularly unique events, risks, and influences of 1.5°C compared to 2°C warming world. And those description has to be a quantity because the number is the most indispensable information for policymakers. In addition, there are many common and general descriptions such as "the risk increases in the 1.5°C warming world compared to the 2°C warming world" because we all know risks are higher in the case of 1.5°C and interested in how different. Such descriptions are highlighted especially in the SPM. It is misleading and should be revised so that policy makers can understand how different the impacts or risks between 1.5°C and 2.0°C are. We also have the concerns that SR1.5 might be used for justification of the 1.5°C goal because of those general descriptions, hence it should be more neutral. IPCC is expected to and has to quantitatively describe to what extent it actually changes. [Japan]	To explore avoided impacts and reduced risks at 1.5°C compared with at 2°C of global warming, the chapter adopts the AR5 'Reasons for Concern' aggregated projected risk framework (Section 3.5) also comparing to observed warming.
31122					Given IPCC rule, the IPCC works by assessing published literature and it does not conduct its own scientific research. Therefore, each element of the figures and tables needs to be supported by published literature and all the descriptions and statements in the assessment report should specify the basis of the literature. It needs to be clearly indicated which articles are referred, and what is a level of agreement as well as evidence. In case of low agreement and limited numbers of supporting articles and/or evidence, please specify so with appropriate scale of confidence. [Japan]	Accept. All figures and tables will be checked for this.
31124					The amount of supplemental material and animation is significant and it might put a great strain on policy makers to read the entire report. We would suggest that IPCC should comply with the number of pages we agreed in the plenary where we agreed the outline of SR1.5 as well. [Japan]	The point is well taken, supplementary material
31128					Please specify the basis of the literature regarding Fig. 3.19, Fig. 3.23, Fig4.5, Fig 4.6, Fig. 4.7, Box 4.11, Fig. 4.8, Table 4.8, Table 4.9, Table 4.10, 4.11, Fig. SPM.2, Fig. SPM.3. It needs to be clearly indicated which articles are referred, and what is the level of agreement as well as evidence. In case of low agreement and limited numbers of supporting articles and/or evidence, please specify so with appropriate scale of confidence since IPCC rule reads the IPCC works by assessing published literature. [Japan]	Accept. See response to comment number 31122
31130					Policy Maker wants to know how much the impacts of climate change decrease, additional mitigation cost increases, and benefits increase in numeric figures when climate change goal changes from 2°C to 1.5°C. However, such information cannot be found in the report. The information as such should be added to especially in the SPM and also in relevant chapters. [Japan]	Noted. Literature and data availability as well as methodological constraints are preventing this report from making firm statements on this understandable question.

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31132					As there is too little information on costs to achieve 1.5°C, more information should be added. Since the only information is "mitigation cost of 1.5°C pathways as 2-6% of total GDP (2050)" shown in Chap 5 (p. 36, line 4), this information should be mentioned in SPM. Costs & risks, climate impacts & vulnerability, and Co-effects on additional policy objectives should be evaluated for each temperature target. In this perspective, the following should be referred: Figure 3 in Ottmar Edenhofer and Martin Kowarsch, "Cartography of pathways: A new model for environmental policy assessments", Environmental Science & Policy 51, 2015 56-64. [Japan]	Accept. See response to comment 4520
31136					It would be misleading to put too much emphasis on the difficulty of achieving 1.5°C target since it could relatively imply that the 2°C target would be an easy target. It is necessary to emphasize that great effort is required to achieve 2°C target as well. [Japan]	Accept. This was discussed and will be reflected in the SPM and elsewhere
31138					Although it is easy to lead an ideal solution from the model, it is quite difficult in the real world. For example, the loss of GDP at the achievement of 2°C target was estimated around 4.8% (median) in AR 5, but this is premised on uniform carbon tax that is difficult in reality. Since Policy makers tend to pick up conclusions only without fully understanding the premises, careful descriptions are needed, including premises. [Japan]	Accept
31126					According to the IPCC AR5 WG1, the equilibrium climate sensitivity (ECS) is likely to be in the range of 1.5 and 4.5°C, and the most likely value was not provided. On the other hand, MAGICC model probably employs that the ECS is likely to be in the range of 2.0 and 4.5°C and the most likely value is about 3.0 °C according to the AOGCM results only. This means that the probability distribution function (PDF) of ECS is also uncertain. However, the achieving probabilities for the temperature targets are estimated by using MAGICC and provided without descriptions for the uncertainties in the PDF. Please describe the assumed PDF of ECS for the estimations of the achieving probabilities for the temperature targets. [Japan]	The MAGICC pdfs are used, but these are complemented by the FaIR model results which adopts the AR5 range of ECS from 1.5C to 4.5C. The FaIR mode gives slightly cooler temperatures. This is part why pathway temperature threshold boundaries are fuzzy. Low overshoot pathways, for example, overshoot in MAGICC but not in FAIR, so are classified as 1.5C pathways. The differences between MAGICC and FaIR are discussed in the technical annex of Chapter 2. The probabilities are not meant to be exact - so it would be inappropriate to give the exact PDF.
31134					Since there are descriptions that seem to be inconsistent with Chapters and SPM, they should be corrected. 1. There is a description that "MAC for 1.5°C are not yet available (p. 70, lines 23 - 24)" in Chapter 4. On the other hand, "MAC for 1.5°C is about 3 to 7 times higher than those of 2°C world" is mentioned in SPM and Chapter 2. (p.21 lines 22-23 and p. 99, lines 11-12 respectively). Clarification for descriptions that are not consistent with AR 5 is necessary, for example: 1.? The figure of 2-6% mentioned in "mitigation cost of 1.5°C pathways as 2-6% of total GDP (2050)" in Chap 5 (p. 36, line 4) is lower than the GDP loss (around 2.2-4% (median seems to be 3.5%)) when 2°C achieves "likely" in the Figure 6.21 in AR5WGIII. Is it calculated in the same way as AR 5? The calculation should be described. 2. Median carbon price in 2050 (likely, > 66%) at 2°C (figure 6.21 in AR 5 WG III) was more than \$100. However, it is \$70 (greater than 66% probability) in Ch. 2 p.99, line 5. [Japan]	Accept. See response to comment 4520
31652					A major weakness of the entire report is its bias towards natural science/technical solutions/engineering aspects, also implying favoring numbers/quantitative analysis to qualitative analyses, and also a very visible top-down and planner/engineering framing. Then a few social/societal/political feasibility/ethical perspectives are added afterwards. This mostly reduces the 1.5 C challenge to a technical/engineering exercise. But where is the 'social engineering' perspective, to be integrated with the 'natural/technical engineering' stuff? This conception of 1,5 C transformation significantly under-estimates the challenges involved, and also to a large extent places a veil on our understanding of the challenges involved and thus produces a handicap on our ability to identify the most efficient and feasible roadmaps to 1,5 C. [Asbjørn Torvanger, Norway]	Noted. Attempts were made throughout the process to integrate the modelling outcomes better with social science and humanities outcomes. Figure 2.31 is an example of that, and both chapters 4 and 5 have strengthened their inclusion of social science. Because of different approaches, vocabularies and communities, we realise that we have not fully succeeded. In the SPM, further integration is foreseen.
32738					Congratulations to the authors for an excellent draft bringing together so many different disciplines and considerations. In closing, I am worried that the length of the document and the style that is at times very technical may reduce the level to which it is accessed, understood, and used by the public. I would recommend making the text shorter and simpler whenever possible, and strive to include plain language summaries of sections, chapters, or of the entire report if feasible. [Christopher Campbell-Durufé, Canada]	Noted.
32852					Some chapters are extremely long which may make the report bulky [Kenya]	Accept.
35448					There are many grammatical, typographical etc. errors in the report at various places. A thorough editorial review would be useful before finalizing it. [Ashok Sreenivas, India]	Copy edited
35450					In general, the report talks about different kinds of global mitigation actions to meet the 1.5 target. But it seems there is insufficient literature (or it has not been cited) about differential actions by different regions/countries - e.g. some countries/regions take on more aggressive actions and others less aggressively over different periods of time. Research of this kind is likely to lead to greater consensus and actionable ways forward. This would also be more genuinely reflective of CBDRRRC - the treatment of the world as a uniform entity is likely to be counterproductive. If such literature is not available, it should be cited as a gap in understanding. [Ashok Sreenivas, India]	Noted. This report, because of space and literature constraints, cannot go into regional specificities. Also, passing judgment on how countries or regions are taking responsibility for climate change action is beyond IPCC's mandate.
35742					Harmonizing of the scenarios should be considered throughout the report...For a reader the definition of 1.5 and 2 degree C scenarios need to be defined and followed uniformly across the chapters of the report for consistency in understanding. [India]	Taken into account. The use of pathways is as streamlined throughout the report. Pathway types are being introduced in Chapter 1 and are then applied in Chapter 2 and 3. Chapter 4 and Chapter 5 then look more at the level of measures and the level of more localized interactions. What precisely consists a 1.5°C or 2°C scenario is ambiguous, however, because of risk preferences differ between persons.
35744					Developing a summary chart on impacts on urban and rural areas in 1.5 and 2 oC scenarios may be considered. [India]	Too detailed to be addressed in SPM.
35746					A region-wise impact, and adaptation/ mitigation options needs to be added in the report. More information from South Asia needs to be made part of the report. [India]	Noted. This report, because of space and literature constraints, cannot go into regional specificities. The mitigation assessment in Chapter 2 is hence necessarily limited to a global discussion.
36966					I have read through the entire report and could not find anything to question or to change! [Mats Winroth, Sweden]	Thank you.

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37058					There are Figures and Tables? Fig. 3.19, Fig. 3.23, Fig4.5, Fig 4.6, Fig. 4.7, Box 4.11, Fig. 4.8, Table 4.8, Table 4.9, Table 4.10, 4.11, Fig. SPM.2, Fig. SPM 3) of which literature basis is not clear and seem to be based on subjective expert judgement. Since IPCC report is supposed to be written with assessment of published literature, Figures and Tables without such robust basis should be either eliminated or, at least, be presented with a unequivocal caveat that they are based on expert judgement with limited evidence, low agreement and low confidence. [Jun Arima, Japan]	The assessment was based on knowledge in the available and relevant literature.
35736					Throughout the report, there is an emphasis on use of carbon capture and storage / BECCS /other carbon capture/storage technologies for a climate secure future. The 1.5 degree scenario, especially, relies too heavily on carbon dioxide removal technologies. However, it should be noted that as on date, large scale CDR technologies are not proven or available. Carbon Capture and Storage (CCS) has many associated technical, safety, logistic and legal concerns/ issues eg. high capital costs, high auxiliary power consumption, low net efficiency, very limited experience of commercial scale application especially in Power Sector, non-availability of maps for potential sites for CO2 storage, and uncertainty in preventing leakage of the stored CO2 - to name a few. These constraints are also reflected at a few instances in the report. As such, it may not be prudent to continue to rely on adoption of a technology whose political, socio-cultural and technical acceptance is highly questionable. The report, however, at times acknowledges the constraints associated with CCS. [India]	Taken into account. Many pathways rely on CDR and on CCS, but the literature also includes pathways that rely less on such technologies and practices. This will be highlighted in the SPM and in the chapter texts. As stated, chapter 4 provides a discussion of the constraints which may be planned to be elevated to the SPM, if space allows.
35738					At several places in the report, phasing out fossil fuel /coal is considered to be essential for a climate secure future. However, coal being a mature technology, continues to be attractive in many countries. It needs to be highlighted that the potential for a fossil fuel phase-out pathway varies amongst countries and for several developing countries in particular, coal/ fossil fuel would continue to be the mainstay, atleast in the foreseeable future. It also needs to be highlighted that for developing countries, the transition to non-fossil fuel based energy sources is dependent upon provision of technical, financial, and capacity building support from developed countries. Without such support, phasing out fossil fuels globally may compromise the developmental interests of the developing countries, and particularly the most vulnerable ones, by exacerbating poverty. [India]	Noted and addressed in the report also in terms of achieving sustainable development, including examples from case studies
35740					There are numerous instances of reference to decarbonisation of production & consumption, and specifically so for the electricity system. It should be noted that even today, while huge strides are being made for adoption of renewable energy technologies, fossil fuels continue to dominate electricity systems across the globe – including in developed countries. This coupled with the fact that proven large scale CO2 removal/ sequestration technologies are not available, limits the potential of decarbonisation of the electricity system, at least in the foreseeable future. Needless to say, for developing countries, the potential is even further diminished due to financial, technology, capacity and energy security constraints. In this view, decarbonisation must not exacerbate economic and social inequalities. Even as several developing countries have also committed to low-carbon growth, the pursuit of complete decarbonisation, must not misplace the principles associated with 'equitable access to sustainable development' in view of historic emissions and fair sharing of carbon space. [India]	Noted and thank you for the constructive reflections.
35748					The Report mentions "decarbonisation" at various points. The Paris Agreement invited the IPCC to provide a Special Report on the impacts of global warming of 1.50 C above pre-industrial levels and related global greenhouse gas emission pathways. This Report is in the context of strengthening global response to the threat of climate change. The term "decarbonisation" has not featured in the Paris Agreement. What Paris Agreement aims at, according to Article 2 (b), is increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production. Any indicator to measure 'decarbonisation' may have considerable implications against the Sustainable Development objectives of the developing nations. This difference needs to be maintained throughout the report. [India]	Taken into account. In line with the Special Report's mandate, Chapter 2 assesses mitigation pathways compatible with 1.5°C in the context of sustainable development. The body of literature assessed allows to identify key characteristics of such pathways. In line with the findings of the IPCC AR5, this Special Report shows that reducing carbon-dioxide emissions to zero is critical and that also other non-CO2 greenhouse gases are to be kept at as low as possible levels. A balanced discussion of both components is provided in Chapter 2, as well as their interactions with other societal objectives and sustainable development in Chapters 3 and 5.
37260					My comments on the FOD have been sufficiently addressed in the SOD; THX. Overall the SOD is an enormous improvement of the FOD. [Ton Wildenberg, Netherlands]	Thank you.
38706					The role and function of boxes vs the text in teh section seems inconsistent throughout the report. Are the boxes mean at "supporting and focused" information? Or are they also meant for assessment? [Jan Fuglestedt, Norway]	Boxes are giving further relevant supporting information, including concepts, or highlighting further details for example with case studies
38708					SLCF is one of the cross cutting themes that need coordination across chapters. [Jan Fuglestedt, Norway]	Noted.
38710					The Executive Summaries have very different styles across the chapters. This needs coordnation and editing. [Jan Fuglestedt, Norway]	Taken into account. The format of the executive summaries have been streamlined with support from the TSU.
38712					I think it should be made very clear in the beginning of the report why most focus has been given to 2100. [Jan Fuglestedt, Norway]	Noted.
38714					A consistent presentation of the three main categories of scenarios should be secured across the chapters (overshoot, transient, staying below). [Jan Fuglestedt, Norway]	Taken into account. Chapter 1 introduces three types of scenarios. Two of those types, overshoot and staying below, are subsequently taken up by Chapter 2.
39044					The role of boxes vs sections in the chapters seem to need some more considerations and clarifications. Are the boxes meant to support the assessment in the sections (with facts, background etc) or are they meant also for assessment? [Jan Fuglestedt, Norway]	Boxes are giving further relevant supporting information, including concepts, or highlighting further details for example with case studies
39048					The format and style of Executive Summaries need a stronger coordination across the chapters. [Jan Fuglestedt, Norway]	Taken into account. The format of the executive summaries have been streamlined with support from the TSU.
40410					Indigenous knowledge is mostly treated as an isolated issue among others, but it is a cross-cutting issue whose role and relevance need to be addressed in many, if not all, sections of the report. As an example, in section 4.3.3.2 on ecosystems and forests, there is a subsection on Indigenous Knowledge; but it is not considered in the subsections on Forest Management, Wetland Management or Forest Restoration. (See Ford et al (2016) "Including indigenous knowledge and experience in IPCC assessment reports", Nature Climate Change volume 6, pages 349–353; and references therein.) [Pedro Alfredo Borges Landaez, Venezuela]	The assessment was based on knowledge in the available and relevant literature.

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35750					The report assesses the limiting of warming to 1.5 degree C by the end of the century under various scenarios. Some of the scenarios involve overshoot and hence rely on removal of carbon dioxide from the atmosphere using technological means such as BECCS and DAC in the latter half of the century. These are proposals and the technologies are not yet tested on a scale that is required to solve the climate change problem. The credibility of such schemes is doubtful and should be assessed as relying on such negative emission technologies to compensate later for failures to adequately mitigate emissions has serious implications for vulnerable developing countries. This needs to be covered in the report. [India]	Accepted. The report discusses both scenarios that limit warming to 1.5°C and those that temporarily overshoot it (Chapter 2). Furthermore, in Chapter 4, the state-of-the-art of carbon dioxide removal is assessed to contextualize the deployment rates found in some of the integrated scenarios from Chapter 2.
35752					There is virtually no discussion anywhere in the report on the key role of technology transfer (and associated finance) to LDCs and emerging economies for mitigation and adaptation. This needs to be added, given the transformation that is needed in the context of sustainable development. Chapter 4 has a brief section on the topic should also add the challenges and opportunities for transfer and also the financing and institutional mechanisms for large scale joint innovation. Chapter 5 has only two instances, one in a box on oil-producing countries, and another box listing the SDGs. It should include the narrative on technology transfer. Technology transfer and capacity development from advanced economies outward is necessary, for securing a common future. These range from highly arcane elements involving advanced storage and renewable technologies to facilitating the sharing of South-South community scale practices. Some of the latter could also involve South-North transfers. It is equally important to examine the political ecology of ongoing investments and technology transfers. Refer, for example, Szogs, Astrid, Andrew Cummings, and Cristina Chaminade. "Building systems of innovation in less developed countries: the role of intermediate organizations supporting interactions in Tanzania and El Salvador." Innovation and Development 1, no. 2 (2011): 283-302; Mallett, Alexandra. "Technology cooperation for sustainable energy: a review of pathways." Wiley Interdisciplinary Reviews: Energy and Environment 2, no. 2 (2013): 234-250. [India]	Noted and has also been addressed in the SPM.
37048					It is fair to assume that the readers of the SR1.5 must have read AR5. Therefore, it is crucial that the SR1.5 clearly presents how 2.0 degrees stabilization world is different from 1.5 degrees stabilization world in terms of such factors as climate related risks, mitigation and so forth. In general, there is little information as to the comparison between the above two temperature scenarios, which erodes the utility of this report for policy makers. Given that many readers will compare the SR1.5 with AR5, it is advisable to use as comparable tables and figures as possible so that readers could grasp additional benefits/costs for seeking 1.5 degrees stabilization. For example, the figures with the same format of Figure 6.21 of AR5/WG6 Chapter 6 should be presented in SR1.5 with a view to facilitating such comparison. [Jun Arima, Japan]	Taken into account. While this Special Report has tried to avoid replication of AR5 findings, special attention has been given to provide comparisons of characteristics of 1.5°C and 2°C scenarios. These comparisons are in slightly different formats from the figures provided in AR5, because scenarios are grouped based on temperature outcomes rather than concentrations, as in AR5.
37050					What matters for policy makers is not only the difference between 2 degrees scenario and 1.5 degrees scenario. They also need to know the magnitude of challenge for achieving 1.5 degrees scenario compared with the current course of action. Mere comparison between 2 degrees and 1.5 degrees scenarios could give a fallacious impression that 2 degrees scenario is foregone. In fact, as clearly presented in the AR5, it is already highly challenging to aim at 2 degrees scenario. This is another reason why figures with the same format of Figure 6.21 of AR5 should be presented for facilitating comparison not only between 1.5 and 2 degrees scenario but also 1.5 and current pathway. [Jun Arima, Japan]	Noted. Given the constraints in space and scope, this Special Report had to focus its assessment. Comparisons with the current trajectory are given for emissions, through a comparison with the NDCs, as well as for investments, through a comparison with estimates of current investments.
40880					Consider harmonizing the scenarios through the report....For a reader the definition of 1.5 and 2 oC scenarios need to defined and follwed uniformly across the chapters of the report for consilancy in understanding. [NARESH KUMAR SOORA, India]	Noted and implemented, in particular clarifying and coordinating the terminology used in the SPM
40882					Consider developing a smummary chart on impacts on urban and rural areas in 1.5 and 2 oC scenarios [NARESH KUMAR SOORA, India]	Too detailed to be addressed in SPM.
40884					Try to give one summary chart showing how this report builds over AR5 and what are the specific additionalities. [NARESH KUMAR SOORA, India]	Figure 1.6 attempts to present the storyline of this report, emphasising it is a synthesis of information relevant specifically to 1.5°C
40886					Give region-wise impact, and adaptation/ mitigation options. This report has less information from South Asia. [NARESH KUMAR SOORA, India]	Noted, the assessment was based on the available and relevant literature.
40888					low carbon technology exchange/ sharing across nations/ stakeholders will facilitate meeting mitigation targets. A mention on this may be made...if not already mentioned [NARESH KUMAR SOORA, India]	Noted, the assessment was based on the available and relevant literature.
43624					My comments here are mainly general errors of omission and so my review of the whole report is the most useful for the IPCC. I regret not having reviewed the FOD, but please consider my comments for the 1.5°C report and the AR6. [Peter Carter, Canada]	Noted.
43626					The title and purpose of the report is to present "the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty." Food security should be included here. [Peter Carter, Canada]	Noted, food security is addressed in the report.
43628					All three goals require radical transformations, as the report says "the concept of transformation implies fundamental changes ... in values, institutions, technologies ... contrasted with more incremental responses to climate change" (Ch.5, p.12). However, the report throughout gives mitigation options for substantial delays, as for example "a delay of global mitigation policy, following NDCs until 2030" (Ch.2, 3.2.3). [Peter Carter, Canada]	Noted.
37052					Since it is more than obvious that 1.5 degrees stabilization is better than 2.0 degrees stabilization from the viewpoint of climate change, what matters for policy makers is how much additional cost must be borne for seeking 1.5 degrees. In this regard, it is regrettable that there is very scarce information about cost implication of 1.5 degrees stabilization except for "1.5 degree pathway would cost 2-6% of total GDP in 2050" (chapter 5 p36) and "carbon prices between below 1,5 degrees 50% and belwo 2 degrees 50% or 66% scenarios differ by about a factor of three to seven". This would damage the utility of this report. More information about cost implication compared with 2 degrees pathways should be presented. [Jun Arima, Japan]	Taken into account. The literature on cost and investments for 1.5°C scenarios is sparse, and consequently the amount of information that be given on this topic is low. In the revisions of the second order draft, special attention has been given to further clarify the investment compatible with achieving a 1.5°C pathway. Where the literature is limited this has also been highlighted.
37054					Given that most readers will juxtapose SR1.5 and AR5, there should be clear explanation if there is inconsistency between them. In fact, there are some discrepancies. For example, while AR5/WG3 estimates that median carbon price in 2050 for achieving 430-480 ppm or 2 degrees (>65%) will be more than \$100 (see Figure 6.21). SR1.5 states that scenario "below 2 degrees" with a greater than 50-66% probability show carbon prices in the range of \$30-70 (see Chapter 2 page 99 and Figure 2.29). It is extremely bizarre that more ambitious scenario requires lower carbon prices and readers who have read AR5 will be puzzled. Another example is GDP loss. While AR5/WG3 estimates 2-4% of GDP loss in 2050 for seeking 2 degree (>66%) (see Figure 6.21). SR1.5 estimates 2-6% of GDP loss for aiming at 1.5 degree pathway (see Chapter 5 page 36). Again, it is rather odd that GDP loss for seeking 1.5 degree pathway is not largely different from that for seeking 2 degree. There should be clarified how the figures in AR5 and SR1.5 have been calculated and why there are apparent inconsistencies between them. [Jun Arima, Japan]	Noted. As highlighted by AR5, carbon price, cost, and GDP loss estimates are very uncertain and highly model dependent, as well as dependent on the portfolio of mitigation options considered. There seems to be only limited inconsistency between a range of 30-70 USD for scenarios limiting warming below 2°C with 50-66% and the higher estimates for scenarios that do so with greater than 66% probability from AR5.

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37056					In addition, there seems to be inconsistencies among Chapters. On one hand, Chapter 4 states that worldwide marginal abatement cost for 2 degree target in AR5 was 130-260\$/t-CO2 and the one for 1.5 degree is not yet available (page 70 line 23-24). On the other hand, Chapter 2 states that carbon price for "below 2 degree", "return to 1.5 degree" and "below 1.5 degree" is in the range of 30-70\$, 90-105\$ and 240\$ respectively. Chapter 2 also states that "below carbon price between "below 1.5 degrees 50%" and "below 2 degrees 50% or 66%" scenarios differ by about a factor of three to seven by 2050. There are many discrepancies. First, marginal abatement cost or carbon price for seeking below 2 degree (30-70\$ in 2050) is much lower than the figure for seeking 2 degree in AR5 (130-260\$). Why carbon prices for seeking more ambitious temperature "below 2 degree (30-70\$ in 2050)" and "return to 1.5 degree (90-150\$ in 2050)" are lower than AR5 figure aiming at 2 degree (130-260\$)? Why carbon prices for 1.5 degree are presented in Chapter 2 while Chapter 4 states such figures are not yet available? Readers will be very much confounded by such discrepancies. Since cost information is particularly crucial for policy makers, full consistency across the entire report should be secured. [Jun Arima, Japan]	Accept. Thanks for this sharp comment. This will be made consistent. Chapter 4 was not yet aware of the results of Chapter 2 on this because of the tight time schedule of this report.
40412					Feasibility: This concept, as define in the glossary ("The degree to which climate goals, response options, transformations, or societal futures are considered possible, plausible and/or desirable"), is extremely confusing and of very little use. Possibility, plausibility and desirability are three different dimensions with very different potential scientific, ethic, social, cultural and political implications. They cannot be meaningfully combined in a single concept. Additionally, there is not a clear or unambiguous conceptual framework for its interpretation or a reliable and consistent methodology for its estimation. I suggest not to use this concept, and to analyse, when relevant, the three dimensions separately. [Pedro Alfredo Borges Landaez, Venezuela]	Noted, the assessment was based on the available and relevant literature on the multiple dimensions of feasibility
43630					In general, the report is very comprehensive and very good on the impacts but tragically lacking on mitigation to prevent (with very high certainty) many frequent disastrous and catastrophic impacts to practically all regions above 1.5°C equilibrium. [Peter Carter, Canada]	Noted.
43632					Strengthening means totally converting all atmospheric greenhouse gas pollution sources to the readily available and far better in all ways nonpolluting alternative sources, and doing it fast starting immediately, but conversion does not come across in the report. Only conversion can lead to "near zero emissions of carbon dioxide and other long-lived greenhouse gases," which is the bottom line of all mitigation (IPCC 2014 AR5 SYR Headlines) but not stated in the report. [Peter Carter, Canada]	Noted.
43634					Only "net zero" is referred to, with the one important exception of Figure 1.5, which has CO2 emissions. Without the zero fossil fuel definition, net zero is not reliably "near zero." [Peter Carter, Canada]	Chapters 1 and 2 make it clear that net zero also refers to land-use emissions as well as fossil fuel. We agree that land-use emissions are inexact but they form part on the GHG inventories and are included in the Paris agreement so also included within the net zero definition of the report
43636					Scant reference in chapter 2 is given for the rapid phasing out of fossil fuel energy, and this is not mentioned in the other chapters, including chapter 5. To reliably limit to 1.5°C (high certainty), replacing all fossil fuel combustion with 100% clean renewable non-combustion energy is a climate science imperative and needs to be stressed and frequently. [Peter Carter, Canada]	1.5°C mitigation pathways are discussed in Chapter 2, which clearly states the need for rapid reductions in fossil fuel energy consumption at multiple occasions (SOD Figure 2.7, 2.11, 2.13, Section 2.3.3.1, Table 2.9, Section 2.4.1, 2.4.2, 2.5.2.2) and reaching carbon neutrality by mid century (SOD Section 2.3.1, 2.3.3.4).
43640					"Strengthening" as stated in the Report Goals means global CO2 emissions must be reversed right away – and can be. Ch.1, Figure 1.5 correctly shows global CO2 emissions declining from 2015. [Peter Carter, Canada]	Noted.
43638					In the report, "1.5°C scenarios include ... rapid decreases in the carbon intensity of electricity and of the residual fuel mix." Mitigation is said to depend on "reductions in the carbon intensity of electricity ... and reductions in the carbon intensity of the residual fuel mix" (Ch.2, p.7). Decreasing carbon intensity reduction does not reliably lead to near zero emissions. In fact, it can encourage faster and longer fossil fuel extraction on the delusion of better-carbon-intensity fossil fuel energy being a mitigation of climate change. All fossil fuel energy has to be replaced 100% with clean renewable non-combustion energy. [Peter Carter, Canada]	The cited statements from the executive summary of Chapter 2 SOD are correct. They are placed next to other statements about full decarbonization of electricity and rapid phase out of coal usage.
43642					All relevant, current (Oct 2017), observed greenhouse gas data should feature in the report as it proves the extreme urgency for immediate rapid global emissions decline. This would include data and text from the WMO Statement on the State of the Global Climate in 2016; the WMO Greenhouse Gas Bulletin State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2016; and BAMS 2017: State of the Climate in 2016 Bull. Amer. Meteor. Soc. Abstract and Plate 1.1 Average time series for essential climate variables through 2016. This data proves the planetary extreme urgency of aggressive mitigation to ensure our future long-term survival and that the only scenario to consider is the immediate time frame rapid decline of global emissions, as in the Report's Figure 1.5; IPCC RCP 2.6 median and higher probability; and the UN Climate Secretariat May 2016 INDC Update explicitly, among other sources. [Peter Carter, Canada]	Accepted: Up-to-date data for recent emissions are provided in the supplementary information for Chapter 1.
43644					To comply with the Report Purposes, there are not many other options (pathways), as the Report says, to achieve the goals, to minimize disastrous and catastrophic impacts, and to prevent planetary catastrophe with high level of certainty (e.g., reference Yongyang Cai, Timothy M. Lenton, and Thomas S. Lontzek, 2016, Risk of multiple interacting tipping points should encourage rapid CO2 emission reduction, Nature Climate Change). [Peter Carter, Canada]	Noted.
43646					The coverage of the impacts at 1.5°C and the differences to 2°C is comprehensive and proves with overwhelming evidence that global temperature must be stabilized below 1.5° C equilibrium with very high certainty, to prevent permanent collapse of civilization and as a matter of our common future survival. [Peter Carter, Canada]	Noted.
43648					To limit warming to 1.5°C (or 2°C) with high certainty, the science and the ethics require that global emissions must decline on an immediate time frame basis, which the report should but not does not emphasize. [Peter Carter, Canada]	Taken into account.
43650					The long-lived emissions of CO2, methane (defined by the IPCC as a long-lived greenhouse gas) and nitrous oxide are required to drop to "near zero" (IPCC 2014 AR5 SYR Headline Statement), which the Report does not state. The IPCC 2014 AR5 SYR Headline Statement says: "... pathways would require ... near zero emissions of carbon dioxide and other long-lived greenhouse gases" This means actual emissions of CO2, not limited to net CO2. Many of the scenario pathways in the Report, by design, include overshoot of 1.5°C warming. While this may be now unavoidable it should not be included as an optional mitigation pathway. The assumption of an option of "shaving" overshoot by BECCS is invalid and unethical. To mitigate for below 1.5°C with a high level of certainty, there must be no combustion energy, which means no burning of biomass for energy and no biomass energy carbon capture and sequestration (BECCS), which for a great many years has been promoted as a CO2 removal method without progress. [Peter Carter, Canada]	Noted.

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43652					Involving the big powerful banking institutions at the table (the banks are mentioned just once in Ch. 5) is essential because they are the root perverse economic cause driving the continued GHG pollution ("greatest market failure ever," according to Stern, 2006). Green municipal and state banks should be mentioned, and also fossil fuel divestment and reinvestment in clean energy are obvious for individuals and financial funds. There are many clean renewable energy technologies to invest in with a healthy return on investment. [Peter Carter, Canada]	Accept, we have devoted more attention to the financial sector, especially in chapter 4. A dedicated section (4.4.6) is on the financial sector. Municipal and state banks are not mentioned because of lack of literature.
43654					On sustainable development, all governments recommitted to the 1992 UN Agenda 21 specific transformative principles at the 2012 Rio+20 conference. These principles are not in the Report but should be because they are fundamental to transformation. They include pollution prevention, polluter pays, precautionary principle policy, full costing, avoidance of externalizing of costs, and zero future discounting of costs (per D. Partha). The report mentions sustainable development throughout but does not include the sustainable development principles. [Peter Carter, Canada]	The report assesses the available relevant literature based on the approved outline.
43658					Developed country populations will also be affected by dislocations, with loss of life and homes, which has already been observed. "Impacts of such climate-related extremes include alteration of ecosystems, disruption of food production and water supply, damage to infrastructure and settlements, morbidity and mortality, and consequences for mental health and human well-being ... for countries at all levels of development" (IPCC 2014 AR5 WG2 p.6). [Peter Carter, Canada]	Noted.
43660					Massive dislocations and forced migrations will make poverty-causing impacts much worse in countries at all levels of development, because public services will be overwhelmed, as has already been observed. At and above 1.5°C, these impacts can be expected. Mitigation and adaptation measures are required on an emergency basis, which involves the world preparing now for the worst ever ongoing environmental population health calamity involving tens and hundreds of millions of people (Report 1.4.1 mass migration). [Peter Carter, Canada]	Noted, the report assessment was based on available relevant literature.
43662					With respect to massive dislocation and forced migration, and the successful adaptation assumed in the Report, there is a principle that for adaptation to be effective in any lasting way, it must accompany mitigation, which does not come through in the Report. Annex 1 nations are required under the 1992 UN Framework Convention on Climate Change to provide all manner of specified assistance to the most vulnerable and least developed countries which is a clear ethical imperative, but which is not pointed out in the Report. [Peter Carter, Canada]	Noted, the report assessment was based on available relevant literature.
43666					One of the frames putting the human population at grave risk should be that governments are uncooperative (lack ambition) in putting global emissions into rapid decline to prevent planetary catastrophe, as they surely have to. Only two nations have emissions targets (INDCs) compliant with a 2°C warming (only by 2100), and the INDCs of those two small-economy nations are for emissions increase (Climate Action Tracker). [Peter Carter, Canada]	Noted.
43656					On the Report's ethical goal of eradication of poverty, realistically without these sustainable development transformations and without an immediate massive emergency response on mitigation and adaption, poverty will be increased and multiplied. "By the mid to late 21st century, climate change is projected to be a poverty multiplier that makes poor people poorer and increases poverty head count, and the association of temperature and economic productivity is not linear (high confidence)" (Report, Ch. 3, p.12), which, as the Report says, will be greatly increased by climate change driven conflict. Massive forced migrations will make poverty-causing impacts much worse. At and above 1.5°C, these impacts can be expected. Mitigation and adaptation measures are required on an emergency basis, which involves the world preparing now for the worst ever ongoing environmental population health calamity involving tens and hundreds of millions of people (Report 1.4.1 mass migration), who will be totally destitute because they are not recognized as refugees. They must be given refugee status. [Peter Carter, Canada]	Noted, the report assessment was based on available relevant literature.
43664					The Report correctly says that 1.5°C is not safe and gives overwhelming evidence that it is disastrous and catastrophic to human populations, including in developed countries, though far better than 2°C. The Report properly records the devastating risks and impacts to the most vulnerable regions and populations of the Global South, but it practically ignores those that will affect the temperate Global North (as have already been observed), and so the enormous threat to the human population as a whole. [Peter Carter, Canada]	Noted, the assessment was based on the available and relevant literature finding that populations at disproportionately higher risk of adverse consequences with global warming of 1.5°C and beyond include disadvantaged and vulnerable populations, some indigenous peoples, and local communities dependent on agricultural or coastal livelihoods.
43668					The Report provides invalid excuses for uncooperative governments to continue with their unethical lack of ambition, like scenarios that include large delays in peak emissions and the assumptions throughout the Report that fossil fuel CCS and BECCs will be effective and at scale. On evidence, the assumption should be that they are not. [Peter Carter, Canada]	The assessment is based on available relevant literature.
43670					Uncooperative governments may use the Report as an (invalid) excuse to continue with their unethical lack of ambition that presently amounts to business-as-usual, such as scenarios that include large delays in peak emissions and the assumptions throughout the Report that fossil fuel CCS and BECCs will be effective and at scale. On evidence, the assumption should be that they are not. [Peter Carter, Canada]	Noted.
43672					While the termination of fossil fuels for energy is essential and feasible without any biomass combustion (M. Jacobson et al., 2017, 100% Clean Renewable Wind, Water, and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World, https://www.sciencedirect.com/science/article/pii/S2542435117300120?via%3Dihub), Chapter 4 does not explicitly have zero fossil fuel energy, only phase out of coal without CCS. The Report says that "deployment of carbon capture and storage CCS is deployed in all mitigation pathways consistent with 1.5°C" (2.4.2.2) but that is not the case nor is it the safest option because "one scenario specifically excludes the use of CCS and BECCS (Grubler et al., 2017)" so the Report is wrong in making CCS and BECCS necessary for 1.5°C. [Peter Carter, Canada]	Noted. The Jacobson et al 2017 paper is cited in chapter 4, as are the various criticisms in the peer-reviewed literature of this particular paper and approach. The statement on the need for CCS or BECCS is indeed corrected. However, the need for CDR is there in all scenarios, including Grubler's scenario. Also, the exclusion of (BE)CCS is predicated on the fast reduction of energy demand on the short term.
43674					Global climate change lasts for many hundreds to a thousand years at least, as acknowledged in the Report, and its real-world impacts must be assumed to be irreversible because of climate system and socio-economic lags. CO2 removal, now unfeasible at any scale, cannot be assumed to make impacts reversible. The claim that Arctic sea ice loss is reversible (from manipulating model studies that "... find that sea ice returns within a few years of its loss" Ch.3, p.57) is impossible in the real world. [Peter Carter, Canada]	The assessment is based on available relevant literature.

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43676					At this time, we must at the very least act to ensure the survival of civilization and the future of the human race – now at a great and rapidly increasing risk, but not indicated by the report – by the immediate rapid decline of global emissions. The reasons not acknowledged in the Report are: (1) Greenhouse gas emissions (CO2 and methane) are increasing close to the worst-case scenario (M. Saunio, 2016). The growing role of methane in anthropogenic climate change, which is not acknowledged in the report. (2) All the data (accessed by NASA and NOAA interactives; see StateofOurClimate.com) of atmospheric greenhouse gas pollution indicators and direct observations are getting rapidly worse with the most important indicators accelerating. This includes atmospheric CO2 concentration, global surface warming, ocean heat content, ocean acidification, ocean deoxygenation (the latter is in this Report). Atmospheric CO2, at 407 ppm now, is at its highest in 3-5 million years and its rate of increase is without past precedent. Its rate of increase is “nearly 100 times larger than that at the end of the last ice age” and “as far as direct and proxy observations can tell, such abrupt changes in the atmospheric levels of CO2 have never before been seen (WMO 2017). (3) There is evidence that the terrestrial carbon sink has started to fail. This includes the tropical rainforests (A. Baccini, 2017, Tropical forests are a net carbon source based on aboveground measurements of gain and loss) and the Arctic (“Thawing permafrost releases carbon into the atmosphere ... overall tundra is presently releasing net carbon into the atmosphere” from Highlights, NOAA Arctic Report Card, 2016). (4) Carbon feedback emissions have been triggered (NOAA Arctic Report Card, 2016). Emissions of methane and CO2 are responsible for the Arctic carbon sink to source switch. The Report acknowledges these feedbacks including as a tipping point (Ch.3), but the feedbacks are not included in warming projections or mitigation in the report. (5) The aggregate of the national emissions of voluntary nonbinding targets (NDs) is a substantial increase in emissions by 2030 and still increasing, projecting a global surface warming of over 3°C by 2100 (Climate Action Tracker, 2017), which is double the over 1.5°C acknowledged in the report and will be much higher after 2100. [Peter Carter, Canada]	Noted: all of these points are acknowledged at various points in the report, except for the claim that the terrestrial carbon sink has started to fail. While carbon sinks may be saturating in individual regions, it is not clear what is happening at a global level, and some reduction in terrestrial uptake is factored in to 1.5°C emission pathways.
43678					For these above reasons, the Report should rank what are the safest and most feasible and certain (by today's evidence) mitigation approaches to the 1.5°C limit, which would be most policy relevant and not policy prescriptive, but the Report does not, except for unreasonably favouring BECCS over the other methods of CO2 removal. [Peter Carter, Canada]	Thank you for the suggestion, the preparation of the SPM has highlighted key findings of the report.
43680					In the Report, the treatment of risk (as the standard precautionary definition: likelihood times magnitude of impact) and catastrophic risk aversion for human population security is such that risks are practically ignored. The Report covers a likelihood but does not multiply it by the potential magnitude of impacts. As the most deadly global pollution ever, assessment and management should follow the established standard environmental population health methodology of environmental toxic pollutants, for example, air pollution and environmental toxins, which applies the most extreme precaution at every level of calculation. Environmental health risk assessment applies worst-case scenarios and worst ranges, not the medians as done in this report. The Report, with future of the human race hanging in the balance, does not apply extreme precaution. [Peter Carter, Canada]	SPM Figure 2 provides the assessment the risks of warming of 1.5 and 2C for select human and natural systems, and for the five reasons for concern (related to the Article 2 of the Convention on dangerous anthropogenic interference with the climate system). This assessment is based on scientific understanding of how the levels of risk could change with different degrees of warming, including the possible consequences, taking into consideration the possibility of adaptation. Also, please see Cross Chapter Box 8 on 1.5 warmer worlds.
43682					There are many sources of very large under-estimating errors and ignoring of risk, as defined by the definition likelihood times magnitude of impacts (listed below). [Peter Carter, Canada]	Noted.
43684					(1) A huge potential source of error and underestimation which rejects risk applies to all projections used in the Report is that only the single fixed metric for climate sensitivity of 3°C is used, which does not account for failure of carbon sinks and increased greenhouse gas emissions from feedback emissions that occur with rising global surface temperature. IPCC AR5 says carbon feedback this century will be positive. 'There is high confidence that the feedback between climate and the carbon cycle is positive in the 21st century; that is, climate change will partially offset increases in land and ocean carbon sinks caused by rising atmospheric CO2. As a result more of the emitted anthropogenic CO2 will remain in the atmosphere' (IPCC,AR5, WG1 SPM E.7 p.26). There is now a large number of research findings that the actual sensitivity is at the upper range of the IPCC AR5, of 4.5°C. There is not a high certainty of 3C in IPCC AR5, the estimation of which includes a large number of studies finding above 3C (IPCC AR5 WG1,TFE.6, Figure 1). Additionally IPCC AR5 noted that 'No best estimate for equilibrium climate sensitivity can now be given because of a lack of agreement on values across assessed lines of evidence and studies' (IPCC WG1 SPM p. 16). The Report acknowledges the possibility from paleoclimatic system models of climate sensitivity being double, i.e., 6°C (“This analysis shows that current models that do not include these long-term feedbacks may underestimate the equilibrium warming response of the Earth System to CO2 climate forcing by up to a factor of 2.” Report Ch.3, p.63). With impacts now occurring far sooner than projected, for our future security and survival it is therefore imperative that the climate sensitivity of at least 4.5°C be applied, as was provided in the first IPCC assessment in 1990. [Peter Carter, Canada]	Chapter 2 assesses updates to ECS which disagree with the comments that ECS is being revised upwards. The results in the report also are not based on a single value of ECS but the AR5 range of 1.5-4.5C, as chapter2 assess that this range stands is doesn't need updating. Therefore a possible ECS of 4.5C is factored into the main probability statements of the report
43686					(2) A huge potential source of error and underestimation that runs throughout the Report is the assumption of the effectiveness of carbon capture and sequestration (CCS) for fossil fuels and bioenergy carbon capture and sequestration (BECCS) for carbon dioxide removal (CDR), and even at scale. These do not exist today on any practical commercial basis at any scale after decades of trying, with large investments. The evidence is that they cannot be assumed effective in mitigation pathways and BECCS is not safe. [Peter Carter, Canada]	Noted.
43692					(5) In general, projections in the Report for impacts and management only go to 2100. Global climate change lasts for hundreds of years, so projections must go to at least several hundred years, which means that projected risks and impacts in the Report are much greater than stated. These projections are available from the AR5. [Peter Carter, Canada]	Noted. Pathways considered in this report, consistent with available literature on 1.5°C, primarily focus on the time scale up to 2100, recognising that the evolution of GMST after 2100 is also important.
43694					(6) The global warming projections, including for mitigation, explicitly do not account for extra emissions from failing carbon sinks and extra emissions from the large sources of feedback to global surface warming. These will increase with both global temperature and duration of warming and by 2100 (the IPCC AR5 says that carbon feedbacks will be positive this century). Certainly, these extra sources of GHG emissions will increase this century and very greatly increase up to equilibrium, after 2100. Though they are not accounted for, they do apply for this Report for 1.5°C and 2°C. This also applies to the so-called carbon budget. [Peter Carter, Canada]	Noted, the assessment of CMIP6 in the WGI AR6 report will address coupled climate feedbacks.
43700					(9) In particular, ocean heating, ocean acidification and ocean deoxygenation – acknowledged to be accelerating – are not accounted for in the mitigation scenarios, in net zero CO2, nor in the carbon budget. These threats to the oceans constitute an enormous threat to life on land, which rules out using net zero CO2 and the carbon budget. [Peter Carter, Canada]	Noted, the assessment of CMIP6 in the WGI AR6 report will address coupled climate feedbacks.

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43702					(10) While there is evidence in the Report that global emissions must decline on an immediate time frame, the Report does not include this urgency and it allows peak emissions to be delayed to an extent inviting planetary catastrophe from further greatly accelerated global warming, climate disruption, ocean heating, acidification and deoxygenation. [Peter Carter, Canada]	Taken into account. The evidence assessed in the report clearly now shows that emissions reductions before 2030 are required for limiting warming to 1.5°C. This is also communicated.
43706					The imperative of ensuring the survival at the very least of human population is the most essential frame but not indicated in the Report. Effective mitigation has been delayed for so long that global climate and ocean disruption has become an existential threat for what is now our common future survival (V. Ramanathan, September 2017, New climate risk classification created to account for potential "existential" threats). [Peter Carter, Canada]	Noted. IPCC reports assess scientific evidence related to a predefined scope. Value judgments about which framing is most essential lie outside the mandate of the IPCC.
43688					(3) Mitigation probabilities of only 50-66% of meeting 1.5°C or 2°C in the Report are arbitrary and unethical high-risk exposures to devastating and catastrophic irreversible impacts and our future survival. For catastrophic risk aversion, probability should be at the safest end of ranges. This would be helpful for policymakers by cutting down the number of pathways. From the Report: "Our assessment of mitigation pathways under the range of physical climate uncertainties assessed in AR5 shows that the number of available mitigation pathways limiting warming below 1.5°C drop from ten to zero when moving toward a higher level of probabilities (i.e., 66% or 90% likelihood)." This makes the planetary emergency and the need for immediate global emissions reversal clear. [Peter Carter, Canada]	Taken into account. The probability levels are indeed arbitrary and the report thus decided to highlight levels that have been used in earlier scientific literature as well as policy reports. To clarify the probability distribution further, we highlight potential lower probability, yet high impact outcomes in CrossChapter Box 8
43690					(4) A totally unjustifiable very large error source is a new application of a warming limit only to 2100. The report does not apply the long-standing, long-term equilibrium warming after 2100. The 2°C temperature limit since 1996 has always been an equilibrium warming, and obviously to prevent multiple adverse (disastrous to devastating) impacts affecting all regions and multiple frequent, ongoing catastrophic impacts that will affect the generation of today's children and all future generations, the global warming projection has to be the equilibrium after 2100. [Peter Carter, Canada]	Noted, but this is not primarily an issue for the assessment of 1.5°C pathways. As is made clear in figure 1.4, in pathways that limit warming to 1.5°C in 2100 temperatures are either stable by then or declining following an overshoot, because the timescales for reaching 1.5°C are the next few decades.
43696					(7) The 1992 UN Framework Convention on Climate Change, which to this day binds all governments, gives the metric for preventing dangerous interference of the climate system of atmospheric greenhouse gas concentrations, which is correct according to the science. The carbon emissions budget should not be used in place of the much more reliable atmospheric carbon concentrations. The carbon budget allows a number of extra warming sources to be ignored. The carbon budget in the Report invalidly allows delaying peak emissions. Early (immediate) peak emissions is not obviated by the carbon budget. "A lower warming target, or a higher likelihood of remaining below a specific warming target, will require lower cumulative CO2 emissions. Accounting for warming effects of increases in non-CO2 greenhouse gases, reductions in aerosols, or the release of greenhouse gases from permafrost will also lower the cumulative CO2 emissions for a specific warming target" (IPCC 2014 AR5 WG1 SPM). As the Report says, we do have to remove some CO2 for 1.5°C or 2°C just to 2100, there can be no carbon emissions budget left to prevent, with a high degree of certainty, future global catastrophe to the human population and to the planet. [Peter Carter, Canada]	Rejected. Carbon budget are scientifically shown to be good proxies for global warming, which in turn is a good proxy for impacts that can lead to dangerous interference. The report provides an adequate assessment of both the strengths and the weaknesses of this approach.
43698					(8) The long-established science is that stabilization of global temperature (the same applies to ocean acidification) requires zero carbon emissions (e.g., Susan Solomon, 2009, Irreversible climate change due to carbon dioxide emissions). The IPCC AR5, in all mitigation calculations, uses CO2-equivalent. The Report changes CO2 emissions and CO2-e emissions to net zero CO2 emissions, for which I cannot find a Report definition. This use of "net zero CO2 emissions" introduces a huge, extremely dangerous degree of uncertainty and intolerable risk. MIT defines net-zero CO2 as "anthropogenic emissions minus anthropogenic sinks such as carbon capture and sequestration and reforestation." The undefined net zero emissions in the Report therefore allows for substantial fossil fuel emissions to continue over a prolonged period of time, based on the invalid assumption of CCS and BECC effectiveness. Only if net zero carbon emissions is defined to include zero fossil fuel combustion could warming be limited to 1.5°C or 2°C, with an ethical level of certainty. There is no good reason to use net zero CO2 emissions, and many good reasons not to, and so actual CO2 emissions and CO2-e emissions should be used, not "net." [Peter Carter, Canada]	The pathways analysed in chapter 2 are clear on the amount of negative emissions. The reviewer is correct that net CO2 emissions accounts for land-use emissions and anthropogenic sinks, such as afforestation and BECCS, this is made clear both in Chapter 1 and Chapter 2. The report also details the pitfalls of heavy reliance on BECCs. Yet land-use sinks remain an important part of the inventory so are included within carbon budgets and the accounting of the Paris agreement, so included as standard in the report. Figure SPM3, for example shows both net emissions, and negative emissions from CCS in the pathways.
43714					Re: involving stakeholders as recommended in Chapter 5, the position of global civil society in the 2014 Climate Action Network (CAN) International position statement "Long term global goals 2050 phase out all fossil fuel emissions and phase in 100% energy" calls for "ending the fossil fuel era," "eliminating all fossil fuels use" before 2050, a 1.5° the limit on global warming, peaking of greenhouse gas emissions in 2015, zero carbon emissions, elimination of fossil fuel subsidies and pricing carbon. [Peter Carter, Canada]	Noted
44292					The reports fails to provide key guidance for the next wave of NDCs, which was at the core of the demand by UNFCCC to carry out it. In particular, it does not indicate by how much the ambition of NDC should be raised in order to enter into an emission pathway that does not exhaust the Threshold Peak Budget of 1.5°C. This is a crucial piece of information for the Facilitative Dialogue. [Valentino Piana, Italy]	This is beyond the scope of the report.
44294					The report should indicate the level of emissions in 2030 that are compatible with a 1.5°C pathway that remains within the Threshold Peak Budget for 1.5°C. [Valentino Piana, Italy]	Accepted. The report now focusses on these more relevant numbers, for example, in the Chapter 2 Executive Summary and the SPM.
44296					The report should indicate the yearly percentage fall in total emissions that would keep the world within (the planetary boundary of) the 1.5°C Threshold Peak Budget for ever. This for the Median TPB and for the likely range due to geophysical uncertainties. [Valentino Piana, Italy]	Taken into account. Instead of providing the direct translation of carbon budgets into reduction rates, the report provides the range of emissions for 2030 that is consistent with limiting warming to 1.5°C, thus also providing an indication of how budgets are translated in emissions reductions

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43704					(11) The greatest possible risk to our common future survival is further boosting of the rate of climate and ocean disruption by multiple inter-reinforcing large planetary sources of amplifying feedback emissions, which are all but ignored by the report. Runaway is mentioned, but only to dismiss it in Ch3: "In spite of some warming, the HTM and LIG show greenhouse gas concentrations similar to preindustrial (Bereiter et al., 2015; Loulergue et al., 2008; Schneider et al., 2013) suggesting a relatively low risk of runaway greenhouse gas effects for such limited global warming." Any risk of runaway demands immediate, rapid decline in global emissions with the most aggressive mitigation measures. Even the permafrost feedback, which is acknowledged by the IPCC to result in a large amount of additional carbon emissions by 2100, is incorrectly dismissed by this Report: "Transient releases of CO2 and CH4 are likely to occur when permafrost melts but may be partially compensated by a long-term increase in peatland carbon storage (Yu et al., 2010). This contradicts both the 2014 IPCC AR5 and the 2007 AR4. Within this century, magnitudes and rates of climate change associated with all scenarios apart from the best-case RCP2.6, "pose high risk of abrupt and irreversible regional-scale change in the composition, structure, and function of terrestrial and freshwater ecosystems, including wetlands. Examples that could lead to substantial impact on climate" (i.e., feedback) "are the boreal-tundra Arctic system and the Amazon forest. Carbon stored in the terrestrial biosphere (e.g., in peatlands, permafrost, and forests) is susceptible to loss to the atmosphere" (i.e., feedback emissions) "as a result of climate change, deforestation, and ecosystem degradation (high confidence). Increased tree mortality and associated forest dieback is projected to occur in many regions over the 21st century" (carbon sink failure and feedback), "due to increased temperatures and drought. Forest dieback poses risks for carbon storage" (i.e., feedback carbon sink failure). "Under sustained Arctic warming, modelling studies and expert judgments indicate with medium agreement that a potential combined release totalling up to 350 PgC as CO2 equivalent could occur by the year 2100" (IPCC AR5 FAQ 6.1). This would be a very large additional warming by 2100 and continue to become much higher long after 2100 to equilibrium warming. This risk above a 1.5°C warming is extremely high. "The upper bound for the strength of the feedback is reached under the less intensive emissions pathways so permafrost carbon release could lead to significant warming, even under less intensive emissions trajectories, like 1.5°C scenarios" (A. MacDougall, 2012, Significant contribution to climate warming from the permafrost carbon feedback). Thawing permafrost has a tipping point for self-warming irreversibility. This tipping point may occur close to a 1.5°C warming (for reference, A. Vaks et al., 2013, Speleothems Reveal 500,000-Year History of Siberian Permafrost). Thawing permafrost is already releasing methane, CO2 (much more than anticipated), and nitrous oxide. A 2°C and 1.5°C equilibrium warming over time could cross that tipping point. All these many enormous sources of extra GHG emissions are simultaneous and inter-reinforcing. "Runaway carbon dynamic" (IPCC 2001 TAR) is a recognized worst-case possible risk (IPCC 2001 TAR WG1 Risk of singularities; F. O'Connor et al., 2010, The role of wetlands permafrost and methane hydrates in the methane cycle in future climate change: A review). Note that carbon feedback emissions will also increase ocean acidification, which is already accelerating (WMO 2016), and this is not included in the Report. [Peter Carter, Canada]	Noted.
43708					The great threat to our future survival is made all the greater by the still rapidly increasing atmospheric greenhouse gas concentrations, with atmospheric CO2 accelerating at a rate without past precedent. This is an atmospheric GHG commitment to a higher degree of global surface warming and is another proof for immediate global emissions decline, which the report should specifically state as the only ethical option and the safest and most certain pathway for 1.5°C. Today's global climate change commitment is an essential frame but is under-stated and not estimated in the report. The 2012 constant composition commitment was put at "about 2°C" in the 2013 IPCC AR5 (Working Group 1 Ch. 12.). The real-world commitment due to climate system and socio-economic lags is a substantial commitment to a future higher degree of global warming and climate change, which the report practically ignores. The modeled instant zero emissions commitment, in the Report, is not policy relevant but rather policy misleading. [Peter Carter, Canada]	Committed warming is analysed differently in the literature. The report does not ignore socioeconomic "lag". This lag is incorporated into the pathways in Chapter 2. Chapter 1 discusses the different literature definitions of committed warming, including concentration commitment, zero-emission commitment and infrastructure commitment. The instant zero commitment is designed as a bound on the problem and is not used to inform policy makers of realistic pathways.
44618					The entire report has become rather long - somewhere in the region of 280 IPCC pages, it appears. It would be preferable if it were significantly shortened. This is not merely an editorial issue, but critical for a clear and succinct message. [Penny Urquhart, South Africa]	Noted.
44636					Are policy makers and implementers still considered to be a significant part of the target audience for the report? If so, and this would be wise given the global context and timing, then greater attention needs to be paid to not only the language used, which is overly abstract and 'academic' in places, but also the relative focus given to what may be termed 'strategic' findings versus the more highly technical parts of the assessment that underpin them. Bearing this in mind may help the author team to further condense the text. [Penny Urquhart, South Africa]	Thank you, this is noted and authors have worked to improve the text and policy relevance, amongst other things, building on the Government review process.
46048					Very good content and balance among chapters. However one feels that a science writer is missing, one who can write beyond scientific facts but mainly cogent writing. Readers such as journalists, engineers, mayors, community leaders, CEOs need not only understand but also feel involved and responsible for the issue. You may wish to look at the writing of reputed science writers such as Elisabeth Kolbert, Franz Kotteder of the SDZ newspaper. [Milton Nogueira da Silva, Brazil]	Noted and we have collaborated with science editors in parts of the report such as the SPM and FAQs
46488					Cross-Chapter Box lengths are estimated at 21.8 IPCC pages (1.8 over the 20 page limit agreed by the IPCC panel). This estimate does not include figures, tables. Please find areas of the chapter / sections of text than can be edited down to reduce the length and take care not to increase this between the SOD and the Final Draft. [Sarah Connors, France]	Noted.
48252					The issues of technology transfer and developing, supplying financial resources and capacity building has been mentioned briefly in the report. It is necessary to assign a special section to this issues to clearly address the technology transfer, supplying financial resources and capacity building in developing countries, as well as means of implementation to achieve global warming bellow 1.5 °C. [Iran]	The report assesses the available relevant literature based on the approved outline.

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43710					Some text and projection graphs indicate that for 1.5°C, global emissions must decline on an immediate timeframe: Figure Figure 1.5 (Dynamic illustration of the relationship between global temperatures, emissions and impacts) correctly shows immediate global emissions decline (from 2015) and there is text such as "To avoid temperatures exceeding 1.5°C, the rate of human-induced warming would need to be reduced, starting immediately" (Report 1.2.6). However, overall the report says that global emissions decline can be delayed even for a number of decades, which is incorrect by the science, by risk and by the ethics. The IPCC 2014 AR5 (RCP2.6) and all other authoritative sources including the UN Climate Secretariat show that 1.5°C and 2°C median and higher probability pathways require the immediate decline of global emissions. This goes back to the 2007 IPCC AR4 assessment in which the category 1 (best-case 2-2.4°C equilibrium warming) mitigation scenario has global emissions in decline from 2015 (IPCC AR4 2007 WG1 Table SPM5). The same is the case for the 2014 IPCC AR5 RCP2.6 (the only scenario that does not exceed 2°C by 2100) emissions at and better than the mean probability. The RCP2.6 mean probability is now immediate as global emissions decline by 2020. This is also the case in the May 2016 update of aggregate of INDCs by the UN Climate Secretariat Figure 2 footnote 4 "Immediate onset scenarios with more than 66% likelihood of staying below 2°C." [Peter Carter, Canada]	Rejected. The report does not suggest emissions reductions can be delayed for several decades. On the contrary, the 1.5°C consistent emissions range in 2030 is clearly below today's global emissions levels. The concerns of the reviewer are thus addressed.
43712					This delay in global emissions decline beyond immediately is based on the unjustified assumption that carbon capture and storage of fossil fuel energy emissions is feasible and will be effective for deep near zero decarbonization, and that bioenergy with carbon capture and storage (BECCS) is feasible and will be effective for negative carbon emissions. There is an unjustified impression throughout the Report favoring BECCS and against all other methods of decarbonization, which are feasible, safer and more certain methods. For the future economy to be sustainable long-term (terms of thousands of years), it has to be a zero-combustion economy, i.e., zero fossil fuel and biomass economy, which is feasible. The Burning Age is over. [Peter Carter, Canada]	The assessment was based on knowledge in the available and relevant literature.
43716					The other most essential frame that is not included in the Report as such is the fact that industrial civilization has brought about the sixth mass extinction of the only life in the known universe (G. Ceballos, 2017, Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines). Throughout the Report it is stated that mitigation has cost or risk, one of which is to biodiversity: "Stringent mitigation pathways reaching 2°C or 1.5°C are often associated with large-scale land-use changes due to afforestation and/or bioenergy deployment. The bioenergy deployment in these scenarios may be confronted by substantial concerns for competition over land with potentially high biodiversity impacts" (Ch5, 5.4.3.5). This mitigation risk or cost is due to the adverse effects on natural ecosystems and biodiversity from biofuels, biomass combustion and assumed BECCS. We cannot mitigate with bioenergy because it will contribute further to the extinction of species and loss of biodiversity, which will be increased by climate change. "A large fraction of both terrestrial and freshwater species faces increased extinction risk under projected climate change during and beyond the 21st century, especially as climate change interacts with other stressors, such as habitat modification, over-exploitation, pollution, and invasive species (high confidence). Extinction risk is increased under all RCP scenarios, with risk increasing with both magnitude and rate of climate change" (IPCC 2014 AR4 WG2 SPM p.4015). These risks and costs of mitigation rule out bioenergy, biomass combustion, and BECCS. The increased extinction risk under all scenarios reinforces the imperative of immediate, rapid decline of global emissions. [Peter Carter, Canada]	The assessment is based on available relevant literature.
43718					The prime climate change limit consideration that affects the very survival of civilization is world and regional food security, which should have been specifically stated in the goals of the Report. Adverse impacts on crops is another cause of the risks or costs of mitigation in the Report. Adverse impacts on crop yields is the other reason for the risks and costs of mitigation, which are due to assumed use of bioenergy. "Reducing climate costs through limiting the degree of global warming are ... projected to be offset by the impacts of increasing mitigation costs. In mitigating costs associated with climate change impacts on many nations, food production is a key factor for consideration. That is, although restraining the global temperature increase to 2°C is projected to reduce crop losses under climate change, the associated mitigation costs may imply an increased risk of hunger in low-income countries. It is plausible that the even more stringent mitigation measures required to restrict global warming to 1.5°C will further increase this risk" (Ch 3 p.13). This rules out the use of bioenergy, biofuels and biomass combustion for mitigation. [Peter Carter, Canada]	The report assesses the available relevant literature based on the approved outline.
48256					According to the report, climate response options are expected to continue to impose differential regional impacts. For example, economies dependent upon oil and gas export revenues will be disproportionately affected by future efforts to restrict the use of fossil fuels via stranded assets and unusable resources. So, these countries should be supported by international financial and technology. [Iran]	The report assesses the available relevant literature based on the approved outline. Defining how countries respond goes beyond the mandate of the assessment process.
48262					The report overstates the co-benefits of mitigation and adaptation measures, making rather limited reference to potential adverse effects of climate change policies without providing any quantitative information on macroeconomic costs, such as GDP and consumption losses. Therefore, there is a need to bring more balance into the text to ensure sufficient reference to potential adverse impacts, and providing a quantitative estimate of those effects on Single-product economy. [Iran]	Noted. The limited nature of the underlying 1.5C relevant literature makes it difficult to make quantitative estimates of costs
48264					In the report, there is no emphasis on "economic diversification " as an option to help reduce risk in the current climate and to manage future risks in the face of climate change. This issue should also be considered in the analysis. [Iran]	Noted. Good point, but literature on this is missing, especially in the context of 1.5C.
48266					The UNFCCC principles including those of common but differentiated responsibilities and respective capabilities (CBDR-RC) and historical responsibility are not effectively considered in the assessment of 1.5°C pathways. It is argued that Climate-resilient development pathways (CRDPs) incorporate conceptual advances regarding CBDR-RC, however no further elaboration on this matter is provided and the concept of burden sharing has not been articulated in any quantifiable detail. [Iran]	The assessment was based on knowledge in the available and relevant literature.

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43720					<p>On food security, the Report is confusing as it implies different danger limits to crop yields. Considerably more detail is required on this all-important survival issue. The Report should include impacts at global and regional warming specific to the world's major food-producing regions and most vulnerable regions. Essential detailed information in the Report on food security is Supplementary Table S5-3.4.6. This shows significant yield declines above 1.5°C in a wide range of countries including temperate regions as well as tropical regions. The Report is accurate in saying "Global temperature increases at 1°C or 2°C above preindustrial levels, combined with increasing food demand, would pose large risks to food security globally and regionally, and risks to food security are generally greater in low latitude areas" (Ch.3 p.119), and "For the major crops (wheat, rice, and maize), the highest negative impacts are expected at +2°C or more warming in the late-20th-century levels especially over tropical and temperate regions (my emphasis)" (Report Ch.3 p.118). The Report should explain that tropical crops are projected to decline at above 1°C, and temperate crops are projected to decline by 2°C with the sole exception of rice (IPCC 2014 AR5 WG2 Figure 7-4). The United States is particularly important for world food security. The 2013 USDA report Climate Change and Agriculture in the United States projected for "crops and livestock production systems climate change effects over the next 25 years will be mixed," while "the continued degree of change in the climate by midcentury and beyond is expected to have overall detrimental effects on most crops and livestock." By mid century global warming will have reached 1.5°C at least, as in the Report, so this projection for the United States productivity is of enormous concern. At 2°C of global warming, regional warming of all major food-producing regions are at 2-3° C with Russia at 3-4° C (S. Seneviratne, 2016, Allowable CO2 emissions based on regional and impact-related climate targets). This would result in negative yield impacts for all these major food-producing regions, with tropical regions suffering large declines in yields. Also from AR5: "With or without adaptation, negative impacts on average yields become likely from the 2030s with median yield impacts of 0 to -2% per decade projected for the rest of the century and after 2050, the risk of more severe impacts increases. These impacts will occur in the context of rising crop demand, which is projected to increase by about 14% per decade until 2050" (2014, AR5, WG2 Table 7.3 and Figure 7-5). These projections from the IPCC AR5 are without assuming successful adaptation, which is the policy-relevant, ethical and risk approach, particularly as there are so many adverse effects not well captured by the linear projecting crop models. The significant study is in the Report (Zhao et al., 2017a): "Combining four different methods for assessing the impact of each degree Celsius increase in global mean temperature on yields of wheat, rice, maize, and soybean." This paper showed a "global average reduction of 6.0 ± 2.9%, 3.2 ± 3.7%, 7.4 ± 4.5%, and 3.1%, respectively." The Report should include from this paper's abstract that "Results are highly heterogeneous across crops and geographical areas." The other significant study in the Report is Schaubberger et al. (2017): "Using an ensemble of nine crop models, revealed that when temperatures are above 30°C, US maize, soybean and wheat yields decline, and the increased CO2 can only weakly reduce these yield losses." This daily temperature limit applies to all regions. "Crop yields have a large negative sensitivity to temperatures around 30°C throughout the growing season" (IPCC 2014 AR5 WG2 TS). However the projected timing and the rate of decline of crop yields recorded here are median projections, which does not account for risk by which the worst-case projections would be used, not the median. We can expect worse from increasing extreme weather, surface ozone (which is toxic to crops and increases under global warming), weeds, pests and pathogens as surface temperature increases, which are not captured well by the models. [Peter Carter, Canada]</p>	<p>When producing the final version of SPM, the risks to crop production in tropical regions remains highlighted, we now also include central Europe and the Mediterranean amongst areas that we highlight where the literature projects risks for 1.5C global warming. We did not include the breadbasket areas such as the US in these statements because as we mention in Ch 3 full text, in addition to the points you make, there is recent literature which does not find a clear distinction between the effects of 1.5 and 2C warming in some breadbasket regions (Rosenzweig et al 2017, 2018). Since the literature is not in agreement on this point, we are not able to make statements in the SPM, which require at least medium confidence, i.e. there has to be a reasonable degree of consensus in the literature.</p>
48268					The report emphasized carbon pricing as an increasingly important and expanding instrument of climate and energy policy around the world, without elaborating adequately on the drawback of such market mechanism. [Iran]	Taken into account. Carbon pricing is one of a portfolio of policy instruments that will need to be deployed in order to limit warming to any level really. A fuller assessment of the pros and cons of policy instruments will be provided in AR6. The cited text is factually true.
48270					Given the emphasis of the International Atomic Energy Agency (IAEA) and in line with the IAEA's vision for the year 2050, the report should emphasize the important role of the use of nuclear energy in reducing greenhouse gas emissions. [Iran]	The assessment is based on available relevant literature and needs to be balanced, transparent and comprehensive, and not policy prescriptive.
48290					For investigating the uncertainties of the SR1.5 report, all relevant climate scientists and experts in developing countries must have free access to the data banks (climate satellite data, inventory systems and . . .), data processing systems, and also international and regional relationships between climate experts. [Iran]	Noted
48292					Accepting this report needs to access the accuracy and uncertainties of all results, suggestions and conclusions. [Iran]	Noted.
48294					For making the most ambitious NDCs, it is needed to access to meaningful and real transfer of technology, finance, capacity building, training smart experts for production, maintenance and repairing and also technical feasibility for mitigation and adaptation activities in energy, water and waste water sectors. Also, accessing to new environmental-energy- water technologies, climate funds such as AF, GCF and strengthening flexible and market based Mechanisms such as CDM, GEF without any political and economical restrictions is essential for all developing countries. [Iran]	Noted.
48296					MRV system is needed for technology transfer, financing and capacity building from developed countries to developing ones without any political or international restrictions [Iran]	Noted.
48298					In line with measures to reduce global warming of 1.5 oC in developing countries, it must be satisfied to access to current energy-water international and regional markets and also to access to new environmental and financial markets. Real satisfaction for no decreasing in national incomes related to changing the fossil fuels markets is needed [Iran]	Noted.

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43722					A major adverse effect in reducing crop yields is the global surface warming exceeding crop tolerances of 30°C (referenced above) under maximum daily temperatures and under extreme heat events. Models project substantial warming in temperature extremes by the end of the 21st century. It is virtually certain that increases in the frequency and magnitude of warm daily temperature extremes will occur in the 21st century at the global scale. It is very likely that the length, frequency, and/or intensity of warm spells or heat waves will increase over most land areas (IPCC SREX 2012 SPM p.11). Heat waves are not well captured by the mean linear projecting crop climate model results. To estimate this, the report provides Figure 3.5: Projected local warming of extreme temperatures, with Annual maximum daytime temperature, T _X . This shows that at 1.5°C under extreme heat events, all major food-producing regions will be at the regional warming increase of 2-3°C including the USA, Europe, the Baltics, most of Russia, China, India, and S. America. At this regional temperature increase, all major food-producing regions and crops are projected to decline with the one exception of temperate rice. At 2°C, under extreme heat events, all major food-producing regions will be at the regional warming increase of 3-4°C, with the exception of India, Indo-China and parts of China at 2-3°C. Increased regional drought under global warming of above 1.5°C will cause faster crop yield declines, which should also be reported by region. At 1.5°C, major food-producing regions are projected to have significant drought of -0.8 mm soil moisture (IPCC 2014 AR5 WG1 Figure 12.23). These projections from the IPCC AR5 are without assuming successful adaptation, which is the policy-relevant, ethical and risk approach, particularly as there are so many adverse effects not well captured by the linear projecting crop models. There is a great risk that warming above 1.5°C would be disastrous for world food security, and above 2°C would be catastrophic. To prevent declining world crop production and declining yields affecting all major food-producing regions, global emissions absolutely have to decline immediately and rapidly. Even then we are entering a new, changed world, losing our accustomed food security that we enjoy due to the amazing achievements of modern agriculture. [Peter Carter, Canada]	Too detailed to be expressed in the SPM. Heat stress upon crops is indeed an important issue that is not captured by most crop models. This is noted in section 3.4.6.21 of Ch 3 where we cite for example Deryng et al 2014 which is one of the few studies to capture this. We also cite studies projecting effects of heat stress in crops on China in Ch 3. Our SPM statements match the literature available at the time and further discussion of the role of heat stress belongs in IPCC AR6 where there will be more space available and hopefully more literature to cite expanding upon the issue.
43724					Standard economic cost / benefit analysis for risk assessment cannot be applied where millions to billions of future lives are at stake, particularly when the costs of climate change impacts are not accounted for, as in the Report. Mitigating climate change to save our future is not an economic cost but an economic benefit. It is estimated by a full cost / benefit accounting, including the enormous annual costs of fossil fuel air pollution and zero future discounting to include the cost of impacts of global climate change over the forthcoming decades. The cost of not acting on climate change is \$44 trillion (Citibank, 2015, Energy Darwinism II: Why a low carbon future doesn't have to cost the Earth; World Bank, 2014, Climate-smart development: Adding up the benefits of actions that help build prosperity, end poverty and combat climate change; M. Burke, 2015, Global non-linear effect of temperature on economic production; Risky Business reports). [Peter Carter, Canada]	Noted. We have considered cost-benefit analysis but there is a lot of scientific debate on the validity of such comparisons. Also, they are not available for 1.5C yet. The studies cited in the comment are all grey literature.
45392					A fall of 9% in total emissions (each year from 2016 on) would forever keep the cumulated emissions under the TRB for 1.5°C . A range of value for non-constant or delay-beginning pathways can be easily computed (e.g. with starting point of the reduction being 2018 or 2020). Such values should be explicated in the Report. The 9% headline figure derives for the median TRB of 580 GtCO ₂ and the current emissions (2015). It would generate in 2050 cumulative emissions for 430 GtCO ₂ , so at that moment in time it would comply also with the more stringent 490 GtCO ₂ TRB budget in the worst case for geophysical uncertainty. Even starting reducing in 2020, a 9% yearly reduction would respect the median TRB. By providing this headline number, the report would launch a very communicable and operational message. [Valentino Piana, Italy]	Rejected. While correct mathematically, the report draws upon an assessment of scenarios from the integrated energy-economy-environment literature to inform emissions reductions that are consistent with both the carbon budget and technological and other constraints.
48300					For adapting and resiliency to climate change in water and power sectors and development of renewable energies, transfer of new technologies, financing and capacity building without any international obligations and restrictions is needed. [Iran]	Noted.
48302					carbon pricing, economy diversifications, accessing to regional and international economical markets, accessing to environmental friendly technologies, international cooperation, energy securities are very important issues which are not mentioned in this report. Financial mechanism and economical analysis are not cleared in the report. [Iran]	Noted. See responses to earlier comments, such as number 48268. International cooperation, by the way, is very much discussed in various places in chapter 4 and 5.
48308					The report emphasizes on pricing as " an increasingly important expanding instrument of climate and energy policy around the world" without elaborating adequately on the drawback of such market mechanism. [Iran]	Taken into account. Carbon pricing is one of a portfolio of policy instruments that will need to be deployed in order to limit warming to any level really. A fuller assessment of the pros and cons of policy instruments will be provided in AR6. The cited text is factually true.
48376					Examples detailed in Boxes and Cross-Chapter Boxes are useful, but it should be explained every time why some regions or examples are illustrated over others. [France]	Noted, thank you.
49326					To cut on number of pages it may be helpful to decide if there can be more clear division of labour among chapters. I can see ch 2, 4,5 can have some more discussion so policy, SDG links can be re organised , some overlap removed. [Joyashree Roy, India]	Noted and efforts have been made to focus the chapters and reduce duplication.
49328					Chapter 4 and 5 need more coordination to avoid repetitions in ES. [Joyashree Roy, India]	Noted and efforts have been made to focus the chapters and reduce duplication.
49492					A key aspect relates to most global greenhouse gas emission pathways that allow to stay within the 1.5°C target. They rely on CDR technologies. However, CDR technologies are not available or mature enough to operate a large scales and at acceptable (foreseeable) environmental costs (such as eg. land competition, food security, ecosystem degradation). This starting point, and the terms and conditions under which CDR can indeed contribute within other target spaces (such as SDGs) requires explicit attention and careful arguments (the precautionary principle). [Karheinz ERB, Austria]	Noted, thank you. The assessment was based on available relevant literature published by the 15th May 2018.
49684					BECCS receives prominent consideration under land use changes - despite the controversies and high scientific uncertainty. Approaches like restoration, agroforestry (which can be overlapping even with BECCS) are not as appropriately reflected considering their high social, economic and quantitative potential: ca. 2 billion hectares degraded land are suited for mosaic/broad scale restoration (Gibbs&Salmon, 2015, Stanturf et al. 2014) reaching billions of rural people, esp. in Africa. Concentrated on abandoned land, restored lands may contribute to food or/and biofuel production without further reducing arable land. Currently, Agroforestry / trees in agricultural lands capture 0.75 Giga tonnes per year (i.e. ca. 1/13 of global emissions, cf. Zomer et al. 2016. References. Forest and Landscape Restoration should have a more prominent role esp. in chapter 5. References: Zomer, R. J., Neufeldt, H., Xu, J., Ahrends, A., Bossio, D., Trabucco, A., ... Wang, M. (2016). Global Tree Cover and Biomass Carbon on Agricultural Land: The contribution of agroforestry to global and national carbon budgets. Scientific Reports, 6, No. 29987; Gibbs, H. K., & Salmon, J. M. (2015). Mapping the world's degraded lands. Applied Geography, 57, 12-21; Stanturf, John A., Palik, Brian J., Dumroese, R. Kasten (2014): Contemporary forest restoration: A review emphasizing function. Forest Ecology and Management, 331: 292-323 [Sabine Reinecke, Germany]	Noted - however, afforestation and reforestation has its own subsection with assessment in chapter 4 in the same way as BECCS, avoided deforestation; ecosystem restoration and agroforestry are furthermore assessed as being synergistic with adaptation; and forests are also highlighted in chapter 5 as part of the assessment of mitigation in the context of the SDGs. Space restrictions and keen awareness of the SRCCL being underway prevented us to go into further detail, even though we appreciate the co-benefits of restoration.

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49686					Be clearer about the assumptions behind terminology such as A/R, BECCS, restoration, sustainable land use/management, agroforestry - as used in SR and as used in the literature that you refer to. This is not always coherent and leads to false conclusions. Several references help clarifying: Stanturf, John A., Palik, Brian J., Dumroese, R. Kasten (2014); Contemporary forest restoration: A review emphasizing function, Forest Ecology and Management, 331: 292-323; Pistorius, T.; Kiff, L. (2017). From a biodiversity perspective: risks, trade-offs, and international guidance for Forest Landscape Restoration. Freiburg, Unique; Stanturf, J. A., Kant, P., Lilleas, J-P. B., Mansourian, S., Kleine, M., Graudal, L., & Madsen, P. (2015). Forest Landscape Restoration as a Key Component of Climate Change Mitigation and Adaptation. Vienna, Austria: International Union of Forest Research Organizations (IUFRO). I U F R O World Series, Vol.. 34 [Sabine Reinecke, Germany]	Noted, thank you.
50504					Throughout the report, the 'voices' of the individual authors can still be heard rather clearly in different sections. This manifests itself through high variation in the density of references used, the employment of bold font, substantial differences in paragraph length, the amount of jargon employed, the length and complexity of sentences, the repetition of information, and the implicit judgement of policy options such as CDR and SRM. In some cases, it is also reflected in the assumptions pronounced (e.g: some say melting of sea ice is irreversible - Ch.3, p.56 & 181, while others say it is not - Ch.3, p.159 & 171). This is obviously a reflection of the variation in opinions held by climate scientists, but the authors of the report might want to consider streamlining the language that is used and discussing internal debates more explicitly. If contradictory things are said in the same report (or even in the same chapter), it does not seem like the IPCC is speaking with one voice. [Ina Möller, Sweden]	The use of IPCC uncertainty language and statements made in Executive Summaries are prepared by the chapters as groups.
51136					Heck et al. 2018 Biomass-based negative emissions difficult to reconcile with planetary boundaries, Nature Climate Change 8, 151-155 argues that in order to remain within safe planetary boundaries, in particular with regard to freshwater use, biogeochemical cycles, land-use change and biosphere integrity, less than 0.1GtC/yr CDR could be realised via BECCS. Given the SDG context of the present report, IAM scenarios that rely on excessive CDR (>200 GtCO2) should be excluded from consideration as the social, ecological, political, economic and ethical risks and adverse impacts of their technology deployment assumptions make them fundamentally incompatible with sustainable development. [Linda Schneider, Germany]	Taken into account. Sustainability concerns of BECCS are assessed in the report and highlighted in both the chapters and the SPM. This provides all evidence and information for decision makers to draw conclusions and make the decision they feel is most appropriate. IPCC assessment have to be policy relevant but cannot be policy prescriptive, even not if a certain assessed policy is clearly suboptimal. However, see SPM Section C.2 for a critical assessment of BECCS and its trade-off.
51176					To the extent that the present report considers geoengineering (CDR and SRM) technologies, it should make reference to decisions taken at the UN Convention on Biological Diversity (in particular, Decision X/33 on climate-related geoengineering and biodiversity, adopted in 2010 and reaffirmed in subsequent CBD COPs), and draw on the knowledge on impacts of geoengineering produced by CBD subsidiary and technical bodies (https://www.cbd.int/climate/geoengineering). As a scientific body facilitating the work of the UNFCCC, the IPCC must not undermine the objectives of a sister Rio Convention, or disregard the work carried out and decisions taken at this multilateral body with almost identical international representation. [Linda Schneider, Germany]	Noted, thank you.
51294					In the pdf report, at some places, CO2 has been written without "2" in subscript form. This needs to be updated as CO ₂ with "2". [Muhammad Latif, Pakistan]	Copy edited
54216					The reviewing system (this worksheet) does not permit to write any comment on any other documents not foreseen in column B, such as the Glossary or the Annexes. The sheet does not provide options allowing for that. This is a kind of problem that emerge when the reviewing system is not designed by experts on the subject to be reviewed. Therefore, from this row ahead I will use this column to locate the position of the comment, just in case that my comments can be useful. [Jordi Salat, Spain]	Noted.

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50236					<p>Overall, I find the report completely underestimates the seriousness of global warming, and will in my opinion, will be detrimental. We can keep going with our current plans and will be greeted by decision makers with a sigh of relieve. This work is only comparable to the western world underestimating the rise of Hitler in the 1930's and will be considered so, in my view, by later generations.</p> <p>There is a reliance on climate models to give precipitation forecasts, and it is well known and accepted that climate models get rainfall wrong (e.g. up to 2m precipitation a year for the Indian monsoon, (e.g. Latham et al, 2012, d.o.1. 10.1098/rsta.2012.0086 but also many others). Amazingly, the role of clouds and atmospheric convection hardly make an appearance in this document. This reliance of climate models as the truth, especially regarding precipitation is hugely detrimental to the quality of this report. Climate models are wrong with rainfall over a large fraction of the planet. This particularly affects Chapters 3, 4 and by implication Chapter 5. There is strong evidence that climate models are in accurate for anything but temperature. (e.g. precipitation, ice cover). Why has all the work of Peter Wadhams, an eminent expert on polar ice (and an author of "Farewell to Ice") been ignored and not referenced. His work, in several papers, suggests a much more serious impact on Arctic ice than is represented here. In my view this is reprehensible and demeans the report.</p> <p>In section 3.7, of the SPM "Issues related to governance and ethics, public acceptability and impacts on sustainable development could render solar radiation management economically, socially and institutionally infeasible.", is in my view not justified. It may be correct, BUT by omission of the discussion of other science which contradicts this view is reprehensible. Economically, the costs of "Marine Cloud Brightening" geoengineering, is the cost of running one large warship. This report only represents a conclusion based on a biased selection of the science discussed in the chapters by authors who do not represent or cover the whole subject area.</p> <p>My specific comments relate only to chapter 4, and if not found below.</p> <p>Specific comments</p> <p>I will refer only to the section in geoengineering, which appears in chapter 4, where the subject of geoengineering is discussed. None of the lead authors has done any noticeable work on geoengineering. None of the contributing authors has any experience of geoengineering. Only one of the contributing authors on the x-chapter boxes has any experience of geoengineering (and he is opposed to the concept). Thus I find the whole section biased and does not represent the subject area. This report is biased, just as the press barons who control the press and media in the western world would give a good and comprehensive discussion if the advantageous of running the world on socialist lines. The lack of anyone of these 50 authors who has any experience or a positive view that geoengineering should be discussed and considered in a less than negative light is reprehensible. Also this section of the report document is totally biased, and ignores work done on the subject by for example, Stephen Salter and Peter Wadhams, to mention just two names. There is no reference to their work. This is also is reprehensible and will be noted when the report is published.</p> <p>There is a reliance on climate models to give precipitation forecasts, and it is well known and accepted that climate models get rainfall wrong (e.g. up to 2m a year for the Indian monsoon, (e.g. Latham et al, 2012, d.o.1. 10.1098/rsta.2012.0086 but also many others). As a meteorologist, and user of climate models, the reliance on climate models in the report is unjustifiable in the sense that these models do not represent many of the physical processes going on in the real world and atmosphere.</p> <p>Section 4.3.9.2</p> <p>This section discusses the cost of geoengineering, with reference to the sulphur injection, and puts the cost as USD 1-10 billion per annum. This is a reasonable estimate for the sulphur scheme. However, why is there little discussion of the side effects (e.g. Tilmes et al, 2008, Science 320, 1201-4) who showed that there are significant issues with ozone depletion. There are other consequences of geoengineering which should be mentioned, if this were to be a robust study. All these issues should be discussed.</p> <p>No mention is made of the costs for Marine Cloud Brightening geoengineering. These costs for ~ the same radiation reduction (1-2 Watts) are less than 300 million USD per annum. This section assumes no work has been done on this and that is not true. Salter et al, 2008, Philosophical Transactions of the royal society, A, doi:10.1098/rsta.2008.01.0136, is also a paper that I mentioned in my first set of comments and has not been referenced. This is not defensible (at one stage this paper had the highest number of citations ever, in this journal). This paper above provides costs and so does Salter et al, 2014, Royal Society of Chemistry, doi:1039/9781782621225-00131. Other work by Salter, has provided more details on cost and governance, but I imagine these are too late for this document.</p>	Noted.
50954					First of all, congratulations on the important improvement and deepening of the second order draft (SOD) text. [Mario Valentino Romeri, Italy]	Thank you.
54218					Glossary P7, under Carbon cycle, 3rd line: it reads 1 GtC = 1015 g of carbon. It is a clear error of transcription because 15 must be an exponent to the 10. [Jordi Salat, Spain]	Accepted. Corrected.
54220					Annex 3, P3 last sentence. It refers to a Section 3.2.2.1 that does not exist in Chapter 3. Note in addition that data in the previous sentence is not referenced. [Jordi Salat, Spain]	Noted.
54222					Annex 3, P4 last sentence before the references. It is a very pertinent comment that, in my opinion, should appear in the main chapter if not in the SPM. [Jordi Salat, Spain]	Noted.
54224					There are many figures with very low resolution and poor quality. They were probably vector graphs converted to raster with low resolution. Just as an example, in Fig. 3.17 it is impossible to recognize even the colour scale at a scale of 400%. This is only an example but there are many of such low definition pictures that are useless if not improved. It should be assumed that many readers will be using the pdf files. [Jordi Salat, Spain]	High resolution figures are available for the published report.
54724					Given the starkness of this report and the significance of biomass and AFOLU as forms of passive geoengineering, policy-makers will require practical examples of how to invest in these mitigation methods; the fundamental policy challenge is then how to connect the large institutional investment pools looking for climate de-risked and climate de-risking investments with these new forms of natural infrastructure. [Henry David Venema, Canada]	Noted.
51150					The Paris Agreement Decision text Preamble explicitly refers to "...aggregate emission pathways consistent with" the objective, whereas it does not refer to pathways overshooting the objective. Given irreversible damages done to ecosystems and human communities around the world, and the risk of crossing critical tipping points in the climate system, the report provides no convincing justification for considering overshoot pathways. Given, furthermore, the non-linearity of the climate system, the asymmetrical response of various climate parameters to CDR (see Keller et al. (submitted) The Effects of Carbon Dioxide Removal on the Carbon Cycle, Current Climate Change Reports), and the fundamental uncertainties around the technical, ecological, social, economic, political and ethical - as well as geophysical - feasibility of CDR, overshoot pathways should be eliminated from the range of 1.5 aggregate emission pathways consistent with the temperature objective. Non-overshoot pathways, in contrast, significantly reduces the risks and impacts of climate change, as mandated by the Paris Agreement. [Linda Schneider, Germany]	Taken into account. Although the revised draft still includes scenarios with and without overshoot, it now explicitly highlights the differences between scenarios having overshoot and those that don't and also the impacts resulting from such overshoot, for example in Figure SPM.3, and further in Chapter 2.

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53930					CDR is not mitigation - The decision from IPCC to include CDR as mitigation is not based on the definitions in neither IPCC or UNFCCC and has clear political implications. CDR is never equivalent to emissions reductions, that is what is urgently needed. Based on sound science, IPCC has a strong responsibility of presenting decision makers with the reality: what reductions are needed, etc. Mixing the concept of MITIGATION with technologies that are overwhelmingly not even proven to be technically and economically feasible or environmentally sound, is misleading and irresponsible. We urge IPCC to respect the definition that it has earlier adopted in AR5 and assume the responsibility of presenting the reality, not masking it with unproven options. [Elenita Daño, Philippines]	Noted. Whether CDR is mitigation is a discussion that is ongoing.
53932					Inclusion of CDR as geoengineering - The agreed outline of the SR1.5 did not include the consideration of geoengineering, yet it is mentioned in virtually all chapters in the SOD. Furthermore, in Chapter 4, most of contributors or references to the issue are proponents of geoengineering, with clear vested interests in the technology, and in many cases with even commercial interests that profit from promoting geoengineering over other technologies. We ask IPCC to make a thorough consideration of critical perspectives - including from grey literature- and not turn this report in a legitimization of this highly risky and unjust set of technologies. The redefinition of geoengineering as not including CDR is not helpful at all. [Although CDR is generally regarded as under the scope of national regulations, that is not the case in several of technologies that fall under the CDR category such as ocean fertilization and enhanced weathering. For these technologies to have an effect on counteracting climate change - if they would function at all, as they have not proved to do so- they have to be deployed at large scale, thus affecting transboundary and global systems. Multilateral democratic and participatory governance would be the only way of considering the sum of the effect of the deployment of these technologies, that cannot be considered separate from each other or at national level. Therefore, separating CDR from the concept of geoengineering is not helpful to consider its impacts. We urge the IPCC to consider and take as reference the report ETC Group et al, 2017, "The Big Bad Fix; the case against climate engineering" http://www.etcgroup.org/content/big-bad-fix [Elenita Daño, Philippines]	Reject. We believe that the literature makes no substantial suggestion that would mean that the physically very different set of responses, CDR and SRM, should belong together under one umbrella term. We are not using the word geoengineering at all in the report, not for CDR nor for SRM. We have attempted to assess the peer-reviewed literature, as per IPCC procedures, while excluding as much as possible opinion and commentary pieces.
54776					Overall would be good to see this report more nuanced with an understanding of the on the ground realities in developing countries in particular, recognition of loss and damage and the spectrum of adaptation strategies and other comprehensive risk management approaches is needed. The focus on CCS is also not appropriate given the realities. I did not see any mention of lifestyle including significantly reductions in global consumption of meat. This report is a start but needs a lot of work to be a more realistic depiction of what will be required to achieve a 1.5 degree world and what type of impacts that will come. There are a lot of trade offs, particularly in the context of sustainable development, and those need to be more accurately reflected. [Erin Roberts, United Kingdom (of Great Britain and Northern Ireland)]	Accept. A full section on lifestyle and behaviour change is included in section chapter 4. Trade-offs are clearly reflected in chapter 5.
55294					Avoid including any submitted, not accepted publication. Chapter 3, in particular, includes too many submitted manuscripts. [ELISA BERDALET, Spain]	Literature has been included that was accepted for publication by May 15th 2018.
55506					Indigenous knowledge is also absent in other topics in which it is very relevant, such as biodiversity, management of fire-dependent ecosystems (dry forests and savannas) and use and conservation of coastal areas and wetlands. Focusing the contribution of indigenous knowledge systems exclusively towards the implementation of adaptation and mitigation responses, limits their impact on climate policies and decision-making. [Noemi Chacón, Venezuela]	Noted, though the report has assessed relevant literature in the context of the scoped report.
56360					My general impression is that all documents are still too long. In particular Chapter 3, is excessively meticulous, and needs summarizing all the information and providing clear messages. Maybe this is part of the process, and a shortened, focused document will be elaborated in the future. I understand that this is a long process that involves a huge effort, and I thank all the involved people. [ELISA BERDALET, Spain]	Noted and efforts have been made to focus the chapters, coordinate cross-cutting topics and reduce duplication.
57680					As several chapters are overly long, a strategy could to move lengthy disciplinary excursions into the OSM, thereby it will be easier to develop interdisciplinary messages and bring key messages to the front. [Hans Poertner, Germany]	Noted.
57804					Overall chapters seem slightly disjointed. There is often a lack of coherence between subsections within chapters, which often make contradictory statements. This could be improved through more rigorous chapter editing, and either resolving contradictory statements, or acknowledging where alternative views and evidence exists. [Kate Dooley, Australia]	Noted and efforts have been made to focus the chapters, coordinate cross-cutting topics and reduce duplication.
55504					Indigenous knowledge systems have been considered in the report in two ways: 1) as one of the sources of knowledge used for the development of the report and 2) for the implementation of adaptation and mitigation response, specifically in the box 4.3 of chapter 4. Due to the fact that indigenous knowledge systems was mention as one of the sources of knowledge for the preparation of the report, it would be expected that this issue was addressed as a cross-cutting issue across the entire report. However, in chapters 2 and 3, these knowledge systems were not taken into account for the development of the different topics addressed. In chapter 3, for example, indigenous knowledge, which is critical in relation to climate, was not considered. There is a great deal of literature that shows the potential contributions of indigenous knowledge to weather forecast and assessment of climate variations, particularly in remote areas. (e.g. Berkes, F. -2012-. Sacred ecology (3rd ed.). New York: Routledge; and reference therein) [Noemi Chacón, Venezuela]	Noted, thank you. The assessment was based on available relevant literature published by the 15th May 2018. Indigenous knowledge continues to be assessed in the reports throughout the AR6, including with a cross-chapter box in the Land and Climate Change special report.
55924					Note that I am writing as a former negotiator, engaged for the past 11 years primarily in bringing cryosphere scientists together with current negotiators, stakeholders and other policy makers. As such, to enhance the understanding of, and therefore impact on these important end-use readers, strongly suggest that terms of uncertainty (eg, "extremely likely") and confidence levels (eg, "medium confidence") NOT be used in the Executive Summaries. As many negotiators previously have noted, such terms inevitably are interpreted by lay readers as conveying uncertainty (translating into the bottom line message that understanding remains insufficient to translate into hard decisions and economic transformations at this time). Current use is inconsistent, but the clarity of message is striking between those authors using this convention within the ES (see for example 3-10 to 3-11 through line 13, versus 3-11 lines 15-onwards which avoids this convention and reads far more clearly). Use of the conventional uncertainty/confidence language in the ES sections would undermine the urgency for mitigation prior to mid-century, or indeed 2030 to achieve 1.5 degrees as a policy goal. [Pamela Pearson, United States of America]	Noted but the suggestions do not comply with the requirements of the IPCC assessment procedures.
58516					My comments pertain solely to issues related to the treatment of AFOLU, for which I have the following observations/suggestions. These comments below apply to SPM and multiple areas of the report [Daniel Zarin, United States of America]	Noted.

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58518					Nowhere did I see adequate contextualization of the role that the land and especially forests already play in compensating for anthropogenic GHG emissions - i.e.50% of fossil fuel emissions end up not in the atmosphere but in oceans or on land (more than half of that 50%) [Daniel Zarin, United States of America]	Noted. Land and ocean sinks play indeed an important role at present to take up part of the CO2 emitted into the atmosphere. This has been clearly assessed in the IPCC AR5. This Special Report's mandate is to look at the specificities of 1.5°C pathways and impacts in the context of sustainable development. This results in not all aspects being covered to the same extent, in particular when they are not fundamentally different for 1.5°C pathways.
58520					Most references to consumption throughout the report focus on energy-related consumption even when the topic is treated generically. Diet is for many the largest way, other than air travel reduction, in which individual behaviors can reduce GHG footprints. The extent to which this issue matters is under represented in the report, and in particular the relative lack of attention to reducing the consumption of ruminants (esp. beef) [Daniel Zarin, United States of America]	Taken into account - Both chapters 2 and 4 now assess dietary shifts as a mitigation strategy in the context of land use and chapter 4 also elevates it to the executive summary to highlight its importance.
58522					With all of the attention given to CDR and more balanced approach to BECCS, I found no reference to the medium/long-term opportunity of combining afforestation/reforestation with increased use of wood-based construction, substituting for high-emission construction materials like cement and steel. This is an emerging field and should be mentioned. [Daniel Zarin, United States of America]	Taken into account - the definition of CDR now (for the first time in IPCC history) includes products as a possible place of storage for CO2. Wood construction, in particular, is mentioned in 4.3.3.1 "Urban energy systems."
58524					The significant role of indigenous peoples and local communities in preventing expansion of deforestation fronts, which is well-documented for example in the Brazilian Amazon, is not adequately addressed, given the very large carbon stores those populations are currently safeguarding [Daniel Zarin, United States of America]	The assessment was based on knowledge in the available and relevant literature.
58666					KEY ISSUE (5 of 14): A focus on information directly relevant to 1.5°C would more adequately highlight the significant global economic costs of pursuing a decarbonization trajectory consistent with this benchmark. The document does not adequately communicate the extraordinary changes in the global economy required in order to reduce emissions to levels consistent with limiting average global surface temperature to 1.5°C. [United States of America]	The report has assessed the available, relevant literature in a balanced way.
58676					KEY ISSUE (10 of 14): In general, the second order draft fails to provide a clear and comprehensive assessment – in quantitative terms where possible – of the state of progress in research, development, demonstration, and deployment of these and other important low or zero carbon technologies relative to the degree of deployment required in the stabilization scenarios discussed in this report. This should be remedied in the final report. [United States of America]	The report has assessed the available, relevant literature.
58682					KEY ISSUE (13 of 14): We further emphasize that the report should not expand the consideration of equity and ethics to include discussion of human rights, which is a discipline that is distinct from those topics and that was not included in the adopted outline for this report. [United States of America]	Noted: chapter 1 situates the discussion of equity and ethics in the context of human rights, which is consistent with the literature on these topics.
58684					KEY ISSUE (14 of 14): We have made a number of comments to correct inaccuracies in the characterization of the U.N. Framework Convention on Climate Change and the Paris Agreement. In light of numerous references throughout the report to the Paris Agreement, we take this opportunity to reiterate that the United States intends to withdraw from the Paris Agreement at the earliest opportunity absent the identification of terms that are more favorable to the American people, and that comments on this report should be understood as expert comments that do not reflect any change in the U.S. position in this regard. [United States of America]	Noted, thank you.

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57788					<p>The second order draft of the IPCC 1.5 omits and thus fails to assess critically important publications that identify opportunities for a rapid and prosperous transition to a carbon-free society. [see bibliography of missing literature below].</p> <p>Moreover the SOD SPM does not treat or assess some sources appropriately. The overwhelming weight given to the results of Kriegler et al, 2017 regarding the feasibility of limiting warming to 1.5 is not warranted given the established shortcoming of the IAMS employed by Kriegler et al. See for example Creutzig et al. 2017 listed in the bibliography for Chapter 4 which establishes that the IAMS significantly underestimate the potential of solar power to mitigate climate change. More recently see Ritchie and Dowlatabadi, 2018. Defining climate change scenario characteristics with a phase space of cumulative primary energy and carbon intensity. Environmental Research Letters, Volume 13, Number 2 which analyzes results of integrated assessment models against observed decarbonization trends and suggests that climate change targets outlined in the Paris Accord are more readily achievable than projected to date.</p> <p>The failure of the SOD to identify and assess recent energy industry reports is a critical failing as the energy sector is undergoing rapid and transformative change not reflected in the out-of-date academic sources and models employed by the IPCC authors. In this light industry reports [see bibliography below] can fill a critically important gap in the current draft assessment.</p> <p>Key statements in the SPM do not reflect the material in the underlying chapters. In particular the high-level statement on the feasibility of limiting climate change to 1.5 degree is not consistent with the potential of technological innovation and recent developments discussed in Chapter 4, section 4.2.2 [Transitions and rates of change], see lines 38-45 in particular, and section 4.4.4.1 [The nature of technological innovations and some recent developments], (see lines 1-17 in particular)</p> <p>Some key statements in the SPM imply policy choices and thus are policy prescriptive statements. Any statement that is based on patterns of investment is policy prescriptive as such patterns are largely dictated by policy choices.</p> <p>Missing publications</p> <ul style="list-style-type: none"> - 2016 Renewable Energy Data Book, December 2017. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. - Abramczyk et al. 2017: Positive Disruption: Limiting Global Temperature Rise to Well Below 2 °C. Rocky Mountain Institute, 2107. - Gahleitner, Gerda 2013: Hydrogen from renewable electricity: An international review of power-to-gas pilot plants for stationary applications. International Journal of Hydrogen Energy https://doi.org/10.1016/j.ijhydene.2012.12.010 - Ram et al. 2017: Global Energy System based on 100% Renewable Energy – Power Sector. Lappeenranta University of Technology and Energy Watch Group, 2017. - Breyer, et al.: Solar photovoltaics demand for the global energy transition in the power sector. Progress in Photovoltaics Research and Applications, 2017. DOI 10.1002/pip.2950 	<p>Taken into account. Thank you for providing these additional studies for consideration in the assessment. In particular, the peer-reviewed publications were considered and included wherever assessed appropriate. The report now includes references to Creutzig et al 2017 and studies by Jacobson et al 2017, as key examples of how transitions could occur faster than is currently implied by the assumptions in models. However, the reviewer seems to misunderstand the scenario analysis in Chapter 2 of this report. This does not draw on Kriegler et al 2017, but on an ensemble of most recent scenarios, submitted by a wide range of modelling groups for the assessment in this report (see Annex to Chapter 2). Industry reports indeed provide important additional information but require specific treatment as they are considered grey literature. Wherever possible, these reports have also been taken into account.</p>
58658					<p>KEY ISSUE (1 of 14): The United States appreciates the opportunity to review and provide comments on the second-order draft of the "Special Report on Global Warming of 1.5°C." Consistent with its past practice, the U.S. Government solicited a transparent call for comments by expert reviewers from government agencies and the American public. This process informed the development of U.S. Government views on the document. Comments received through this solicitation have been provided to the Intergovernmental Panel on Climate Change (IPCC) authors for their consideration as they prepare the final draft of the special report. While minor copyediting was performed on these comments, in the interest of full transparency, no effort was made to reconcile different perspectives within the comments. Consistent with our procedures for soliciting comments, the content in this submission reflects the views of experts providing comments on this report and as such should not be interpreted as an official statement of U.S. climate policy. [United States of America]</p>	<p>Noted. The efforts of the United States to provide detailed expert comments on the second order draft are much appreciated.</p>
58660					<p>KEY ISSUE (2 of 14): The Second Order Draft of the report and its Summary for Policy Makers (SPM) are excessively long and often repetitive with itself and with previous IPCC reports. We note that the genesis of this report is from a specific request to the IPCC from the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) "to provide a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways." We strongly urge revising the entire report to more closely reflect this request and what was agreed to in the outline by member governments to allow for a more coherent and explicit presentation of the key technical messages that remain within the scope of this report. In the current draft, many key messages are buried underneath more general high-level statements that could be made about any level of warming. As the authors prepare the final draft report, they should remove excessive background material (including repeating results from the AR5 cycle reports) and redundancies within chapters and across chapters, and instead narrow the focus on communicating the key technical findings since AR5 that are specifically relevant to the request from the UNFCCC. [United States of America]</p>	<p>Noted and efforts have been made to focus the chapters and reduce duplication, the assessment has assessed the literature relevant in the context of the scoped outline of the report.</p>
58662					<p>KEY ISSUE (3 of 14): We recognize that responding to the UNFCCC request is challenging due to the lack of specific information on 1.5°C warming scenarios in the literature. In this regard, we emphasize the importance of the IPCC maintaining rigorous standards in presenting the strongest, most robust scientific information, primarily drawn from peer reviewed literature. Emphasis should be given to findings which have an empirical basis. Authors should clearly indicate where authors have used expert judgment to develop key findings and provide traceable information on the scientific basis used to develop these findings. On topics in the scientific literature on climate change where no or insufficient relevant information yet exists regarding warming of 1.5°C, the authors should make note of the gap in information and propose that the topic be further considered in future IPCC reports as additional information becomes available. [United States of America]</p>	<p>Noted, thank you.</p>

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58664					KEY ISSUE (4 of 14): In an attempt to capture the breadth of possible impacts, the Second Order Draft provides general statements for a variety of impacts where there is no specific information regarding 1.5°C. These statements can often be boiled down to the simple statement "less warming is better than more warming." This is at the cost of assessing the specific, quantitative results that are reported in the literature and that are needed to inform policymakers about potential natural system thresholds. The authors should focus and refine their messages about what can be stated in specific and quantitative terms regarding 1.5°C, with the acknowledgment that some impacts may be left out because they are currently unknown. [United States of America]	Some specifics have been provided, e.g. separate assessments for temperature extremes, heavy precipitation, droughts or floods.
58668					KEY ISSUE (6 of 14): Of critical concern, the second order draft provides insufficient and in some cases misleading information about the economic impacts of such pathways. A thorough and balanced look at the costs and cost-effectiveness of various mitigation pathways is essential to assessing policy targets, but the current draft does not provide this. In several instances, the draft glosses over the high costs of achieving the 1.5°C benchmark and the potential tradeoffs that would be involved. For example, Chapter 2 displays median global carbon prices in 2050 for 1.5°C scenarios as being close to \$100 when the actual model results find 2050 carbon prices around \$400, reflecting a non-standard use of discount rates that is not made clear to the reader. The report additionally states that stranded assets could be avoided if immediate action is taken, an assessment that is at odds with modeling of the high rates of decarbonization that would be needed to limit warming to 1.5°C. [United States of America]	Accept. A closer look at the cost numbers will be taken, and made consistent in the final draft.
58688					The primary challenge in limiting warming to 1.5°C is political. Technological and economic mechanisms for attaining the 1.5°C goal are either known, or known within bounds. The central message of this report should be the uncertainty in whether, collectively, the international community will undertake actions that are assessed (technically) to have significant likelihood of attaining warming limits at various levels. This central message should be more apparent among the details of how such a choice, if made, could be implemented. [United States of America]	The findings of the report are such based on the comprehensive, balanced and transparent assessment of the available, relevant literature.
58690					In an almost 900-page document, fewer than six pages are dedicated to agriculture and food. This is a missed opportunity. [United States of America]	The assessment was based on available relevant literature.
58692					The draft report is notable for a lack of optimism. It seems to have a starting point that emphasizes the massive burden achieving the 1.5°C target will have on developing countries. By starting there, it seems we are capitulating to the impossibility of achieving the target. The report should emphasize the pathways that could help us (collectively) achieve the 1.5°C target, channeling for example, all the green economy and green growth work that is taking place in many countries, in some cases with support from multi-lateral and bilateral donors. [United States of America]	The assessment is based on available relevant literature and needs to be balanced, transparent and comprehensive, and not policy prescriptive.
58670					KEY ISSUE (7 of 14): In addition, there are important aspects of the pursuit of the most rapid decarbonization pathways that will have serious implications for the promotion of energy access, the reallocation of land use to support bioenergy, and employment within communities reliant on fossil fuel extraction that should be more adequately addressed. The report simply states: "Tradeoffs across many [sustainable development] dimensions can be eradicated through complementary/redistributional measures" without elaborating what those measures entail. [United States of America]	The report discusses in detail in section 5.4.2 the scale of trade-offs along specific dimensions of sustainable dimension such as air pollution and health, food security and hunger, energy access/ energy poverty and water security. Based on the literature, it provides estimates for the amount of investment needs for complementary measures able to avoid trade-offs for the above dimensions (Figure 5.5). the report also explicitly acknowledges that the nature of these complementary measures need to be adapted to the specificities of the local circumstances to follow climate-resilient development pathways (section 5.5.3)
58672					KEY ISSUE (8 of 14): It is also essential that the report provide balanced and comprehensive coverage of potential mitigation measures, in line with the Second Order Draft's own findings that strongly suggest the importance of a broad suite of technologies for the effort. Several potential mitigation measures are not sufficiently addressed in the draft report, including electricity storage, demand-side reductions in energy consumption, food waste, soil carbon sequestration, shift to shorter-lived HFCs, reducing emissions from deforestation and forest degradation (REDD+), nuclear power, and especially, carbon capture and storage, which plays a critical role in 1.5°C pathways. The report should note which of these measures is consistently included in modeled pathways and which are essential in all pathways. [United States of America]	Accepted. Insights in the mitigation measures considered in mitigation pathways is critical for understanding the applicability and limitations of the pathways available in the literature. Chapter 2 has updated its overview table of mitigation measures and in response to this comment explicitly reports the level of inclusion of specific measures in the assessed mitigation pathways. This information allows then in return underpins the confidence assessment of statements in the SPM.
58674					KEY ISSUE (9 of 14): Notably, all of the 1.5°C consistent emissions pathways examined in this report include carbon dioxide removal (CDR) technologies, and bioenergy with carbon capture and sequestration (BECCS) is the preferred CDR technology in many of these runs. This key point is not sufficiently discussed and assessed in the second order draft. The report should make clear that BECCS is the combination of two distinct technologies (bioenergy and CCS), which must be separately assessed. [United States of America]	Accepted. The contributions of various CDR options are discussed explicitly in Chapter 2, and its contributions and variations are assessed and highlighted in both the chapter and the SPM. The distinction between the two components of BECCS is highlighted in a dedicated box on BECCS in Chapter 2.
58678					KEY ISSUE (11 of 14): As a technical matter, given its potential to have greater relevance in 1.5°C scenarios, the report should provide a clearer and more consistent discussion of solar radiation management (SRM) that would more directly address the distinct advantages and disadvantages, technical feasibility, scalability, geographic scope, and sustainable development implications of various options. Such an analysis should more clearly frame the applicability and tradeoffs in a balanced, policy-neutral way so that 1.5°C scenarios that include deployment of SRM to varying degrees could be viewed in comparison to other scenarios. [United States of America]	Noted - SRM is assessed in chapter 4, but there have been no 1.5°C pathways with SRM published before the literature cutoff, which could have been assessed in chapter 2.
58680					KEY ISSUE (12 of 14): The SOD is imbalanced in its treatment of the concepts of equity, fairness, justice, and ethics as these concepts apply to the consideration of global warming of 1.5°C. There is a diversity of views on how these concepts may be applied to climate policy, and there is no consensus on their meaning or application in the text of the UNFCCC or Paris Agreement. No consensus exists among Parties and within the scientific community. Yet, the report emphasizes particular views of these topics. For reasons of length and focus, we recommend the authors consider sharply reducing these discussions, which could be deferred to the working group assessment reports. Should these topics be retained in the report, the authors should present a balanced and comprehensive review of differing perspectives and avoid applying a single specific view of these topics. For example, within the concept of fairness, the report should consider issues of economic competition within and between sectors and countries and the implications of 1.5°C pathways for different populations, including those who would be economically or otherwise harmed by mitigation or adaptation measures. This aspect of fairness is central to the task of international cooperation pertinent to this issue. This is particularly important in regards to the pathways outlined in this report, as they clearly demonstrate significant emission reductions from all sectors and countries are required to limit warming to 1.5°C. [United States of America]	Thank you for the constructive reflection. Particular views are not emphasised in the report, the IPCC reports and assesses the knowledge in the available, relevant literature in a balanced, comprehensive and transparent way.

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58698					There are important differences between the findings of this report and AR5 that would be appropriate to highlight. These include the reliance on CDR as a necessary component of scenarios that achieve the 1.5°C goal, as well as a much stronger emphasis on behavior change. Although these are identified as issues in several places, they are not highlighted as significant differences. [United States of America]	Noted. Findings have been reported in a balanced way based on the available, relevant literature.
58700					GLOSSARY: Definition of UNFCCC references CBDR. Reference to CBDR and the obligations of only one set of parties. Everything after "...climate system." should be deleted. [United States of America]	Accepted - reference to CBDR removed.
58702					GLOSSARY: There is no agreed upon definition of the political term 'loss and damage'. The IPCC should not attempt to create one. This term and the accompanying definition should be deleted from the glossary. [United States of America]	Rejected - definition reflects usage in the research literature and now distinguishes 'Loss and Damage' from 'losses and damages'.
58706					Considerations of human rights is not included in the adopted outline for this report, and discussions of human rights should be deleted throughout the report. The IPCC is not the proper body to undertake assessments of human rights. [United States of America]	Noted: human rights are not assessed in SR1.5, but their relevance to any discussion of equity and ethics must be noted.
58686					In finalizing this Special Report, we encourage the authors to: (1) clearly identify (in the SPM and in Chapter 2) the mitigation strategies that are an essential feature of 1.5°C pathways, and distinguish these from mitigation strategies that are common features of many 1.5°C pathways; (2) identify (in the SPM, Chapter 2, and/or Chapter 4) for policymakers a set or range of plausible combinations of mitigation strategies that would be consistent with achieving 1.5°C – Tables SPM 2 and 4.1 offer a partial example of how this could be accomplished, although it is difficult to understand how the table was constructed from the results in Chapter 2; (3) provide a specific quantitative assessment of progress in each of the major sectors and technologies that play a role in the 1.5°C pathways, addressing both advancement of key technologies and scale of deployment; and (4) assess in quantitative terms the cost and cost-effectiveness (in \$/ton of CO2e) of various mitigation and response options that would be part of 1.5°C pathways. [United States of America]	Taken into account. In this revision, specific attention has now been given to highlight these aspects as far as the assessment allows. Chapter 2, Table 2.5, highlights key characteristics of 1.5°C pathways, which are also reflected in the SPM, particularly under section C. Chapter 2 highlights four illustrative pathways, which allow to better understand internally consistent combinations of the ranges of measures provided throughout the chapter. Plausibility and feasibility of these combinations ventures in areas that depend on societal and political value judgments, which the IPCC cannot make. Wherever possible Chapter 4 provides an assessment of various mitigation measures. However, due to space constraints this information cannot be exhaustively included in the SPM. Finally, the cost and cost-effectiveness of specific measures is a topic which is not 1.5°C specific and would be too broad for the rather narrow scope of the report.
58694					It is impossible to evaluate this report in the usual manner to ensure that it is policy-neutral and not policy-prescriptive. Although the report is not explicit in stating any specific policy must be implemented, that is simply a consequence of phrasing. Throughout, it discusses certain policies that are "needed" to achieve the 1.5°C goal. These policies go well beyond technology adoption or carbon pricing mechanisms and address intergovernmental cooperation, behavior change, transformation of financial institutions, and equity. It incorporates discussions of factors that support climate policies, including core values and political preferences (e.g., p. 4-65, lines 8-19). Even so, this is an important report. The more technical chapters (particularly 2 and 3) provide a tremendous amount of information, and summarize the gaps in our understanding. The report appropriately notes that many of the findings are based on the results from models that have significant limitations in their ability to incorporate many of the complexities of the real world. These limitations are not always reflected in the key messages in the Summary for Policymakers, which can imply considerably greater confidence in the findings than is appropriate. [United States of America]	Thank you for the constructive reflection, the points are well noted and efforts have been made to reflect the confidence in the findings in a balanced way, based on the available evidence
58696					It is notable that the report does not make any effort to address the net costs or benefits associated with efforts to achieve the 1.5°C goal compared to the 2°C goal. There are clearly many different pathways to achieve each, but equally clear that there have been estimates of costs and benefits for each. Chapter 2 goes into considerable detail regarding costs and investments, but these are not explicitly compared to the costs of a 2°C goal. It is understood that addressing net costs or benefits has not been a core component of previous IPCC reports, although the topic has been discussed. In this report, this point is likely to be a key issue. Whether it is explicitly addressed here is a question that needs to be raised. [United States of America]	Taken into account. Chapter 2 now assesses the limited available literature that compares investment costs for 1.5°C and 2°C in the energy system. Monetizing benefits is much more complex as this involves value judgments regarding, for example, the value of a specific ecosystem or culture/society. For a discussion of the costs of mitigation of 1.5°C and 2°C pathways, see Section 2.5.2, as well as cross-chapter box 5.
58704					Why have the authors placed such a heavy emphasis on the Sustainable Development Goals (SDGs)? "Linkages between achieving SDGs and 1.5°C" is mentioned once in the Chapter 5 outline, yet references to achieving the SDGs are found throughout the SPM and all underlying chapters. Such an emphasis on a specific policy regime goes against the IPCC's tenet not to be policy-prescriptive. Not every country and municipality are using the SDG targets and framework to guide national development planning. The consistent and often exclusive references to the SDGs (which is often used synonymously with sustainable development) limits the relevance of the report. Suggest limiting references to the SDGs as one example to the relevant chapter text as agreed in the Special Report outline. [United States of America]	In chapter 5 in revised version the SDGs serve as an analytical framework for the assessment of the different sustainable development dimensions. Latter extends beyond the time frame of the 2030 SDG targets and is now explicitly mentioned in SPM 4 caption to make it explicit. Also, it is clearly now mentioned that the overall synergies and trade-offs in the 1.5°C pathways will depend on the selected technology portfolio, the design of the mitigation policy, and the local circumstances and context.
58708					The Paris Agreement should be referred to as such. "Agreement" should be capitalized. Other names such as "Paris Accord" are incorrect. [United States of America]	Noted.
58710					The SPM implies that all temperature change above pre-industrial levels is human-induced. However Chapter 1 (p 16, line 26) states that "the years 1880-1900 are subject to strong but uncertain volcanic forcing, but the net impact of this forcing...appears to be small." It is important to state the presence of this uncertainty and the assumptions implicit in treating warming since the pre-industrial period as entirely human-induced. This should be stated consistently through the report. [United States of America]	Noted, thank you.
58712					Release all information that is based on scientific evidence. Ignore politics. Tell the truth. [United States of America]	Noted.
58716					There is significant repetition in different chapters and sections of the report. The report needs to be streamlined and coordinated throughout to be more concise, cohesive, and readable. In addition, some of the graphs in the report are hard to read and should be either improved or removed. [United States of America]	Noted.
58718					If anything, the assessment bends over backwards to ensure that it does not seem overly aggressive. For example, the document repeatedly talks about delay in policies followed by dramatic actions to try to catch up as increasing the risk of stranded asset, when in fact stranded assets are inevitable. [United States of America]	The assessment was based on knowledge in the available and relevant literature.
58714					There is no global warming, mostly just warming above 60°N. You can see the correct land-based NOAA graph of temperature increase by latitude here: http://cctruth.org/wp-content/uploads/2017/12/warming-2017-e1515193960246.jpg It is said the sea level is rising. This is technically true (see the blue line satellite data continues on the same slope as previous data.) About 10 inches since 1870. As the oceans rise the surface area expands and the evaporation rate increases due to warming oceans and dilution of glacier water. The increasing evaporation is mitigating all the ocean rise due to glacier melt. This increase is also responsible for increased weather and storm clouds. Previously the clouds blocked 20% of the sun's energy from warming the earth. Now that is increasing with more clouds and soon the temperature increase will stabilize. [United States of America]	The assessment was based on available relevant literature and concluded at present day there is 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. The present day level of global warming is defined as the average of a 30-year period centred on 2017 assuming the recent rate of warming continues.

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58720					The document does not adequately communicate the EXTRAORDINARY changes required in order to reduce emissions to levels consistent with limiting average global surface temperature to 2°C or substantially lower. The report paints a far too optimistic picture. The report implies that if immediate action were taken that stranded assets – the retirement of plant and equipment before the end of its physical life, or the reduction in value of natural resources – could be avoided. This is simply impossible to avoid. While technically possible, the 1.5°C goal requires an immediate and complete change in development strategies around the world. While it may be technically feasible to make the transition, the required social, institutional, and financial market changes that would be required are beyond anything that societies have been able to do outside of war times. And the commitment to achieve a 1.5°C outcome must be sustained for a century or more. And the changes are not limited to the energy sector. A complete change in agriculture and land use would also be needed immediately. [United States of America]	Noted, thank you. The assessment was based on available relevant literature published by the 15th May 2018.
58722					BECCS is comprised of two components: bioenergy production and use, and carbon capture, utilization, and storage (CCUS). Bioenergy production and use might be done without CCUS, and CCUS may be applied to a number of different energy production facilities, including those using biomass. Each of these components is discussed separately in this report. Suggest focusing on these two component parts throughout the report, rather than treating BECCS as a unique technology. [United States of America]	Noted. Bioenergy and CCS are discussed separately in the context of the energy transition (e.g. SOD Chapter 2, Section 2.4.2) and in their combination (BECCS) in the context of CDR (e.g. SOD Chapter 2, Section 2.3.4). This adequately reflects their various roles in these two contexts.
58724					Way too long!!! The document has at least twice as many pages in every section of the report as are needed. These extra pages are filled with repetition. [United States of America]	Noted.
58726					Many of the figures violate the Jim Skea Rule: Keep it simple. Many are overly complex and try to cram way too much information into a single figure. [United States of America]	Noted.
58728					Extensive duplication of coverage among chapters and length of text detracts from the utility of the special report. The draft report is 822 pages, though the IPCC plenary approved target length was 225 pages, making the report many times longer than called for (even if references don't count!). A comparison of the key messages from the 5 chapters provides perspective on the where the duplication exists. [United States of America]	Noted and the preparation of the SPM has been very helpful for cross-chapter coordination.
58730					The draft has extensive duplication of coverage among chapters. Several key findings in Chapter 1 overlap with key findings in other chapters, which is indicative that sections of text are also duplicative. [United States of America]	Noted and efforts have been made to reduce duplication.
58732					A very thorough copyedit is needed, as the grammar and English-language errors in this document make large sections of the text illegible. The errors are not minor; in many places they alter the scientific meaning of the sentence. [United States of America]	Copy edited
58734					The report should be refocused to only report impacts where the difference between 1.5 and 2°C are significant. Discussion of every climate impact projected is redundant to AR5 and eventually to AR6, which are the appropriate reports for such findings. For example, if literature does not exist that demonstrates a significant avoided impact under 1.5 compared to 2°C, then that impact does not need to be covered in this report. Emphasis should be placed on where differences can be quantified. The report would be greatly improved by a simple table with each row listing an area of impact and each column detailing the projected impact under 1.5 and 2°C so that comparisons under the two temperatures can be easily made. [United States of America]	Noted, thank you.
58736					SDGs should only be referred to in this report where there is peer-reviewed literature assessing impacts on, or relation of climate change to, these policies. Such reference to SDGs seems appropriate only for Chapter 5. Effort should be given to refocus this text to the purpose of a technical, scientific assessment. [United States of America]	Noted, thank you. The assessment was based on available relevant literature published by the 15th May 2018.
58746					The discussion of SRM and RMM should use consistent terminology and scope throughout the report. [United States of America]	This has been implemented.
62228					The SPM will be the highest profile and most read section of the SOD. The key messages and subpoints in the SPM must do a better job of accurately and fairly represent the underlying chapters. [Shaye Wolf, United States of America]	Noted and efforts have been made to make the language of the SPM as clear as possible, referencing all statements to the underlying chapters.
62234					The SPM and SOD must discuss intergenerational justice issues—that is the shifting of damages and threats to future generations—with respect to 1.5C overshoot scenarios. [Shaye Wolf, United States of America]	The assessment was based on knowledge in the available and relevant literature.
62952					Caribbean SIDS authors should be cited in the report. Although there may be research gaps some peer-reviewed literature does exist on several thematic areas in the various chapters that should be highlighted. [Michelle Mycoo, Trinidad and Tobago]	All authors are cited in the report and contributing authors and expert reviewers are acknowledged.
62954					Putting SIDS in a box may be good in that it highlights the challenges faced by these highly vulnerable states. However, there is also the risk that non-SIDS experts may simply glance at the box or not even pay attention to it. [Michelle Mycoo, Trinidad and Tobago]	Noted, thank you.
58738					The underlying presumption in this report [i.e., that the world is on a path to keep the global average temperature increase below 1.5 or 2°C (without serious overshoot) and that the emissions paths for this to occur are far below the Paris agreement commitments] needs to be very clearly stated. Just picking up this report, it is not made obvious enough that the world has to do much more to be at a point of considering 1.5 versus 2 C, and this needs to be done so that there is much better context for some of the milder comments about what lies ahead. For example, suggesting that coastal regions and low lying islands can adopt policies based on relatively low likelihoods of significant rise in sea level sound far too reassuring for what leaders in those regions seem very likely to face given the commitments nations have made and the urgent actions that are needed for the situations in this report to be applicable. [United States of America]	Noted, thank you. The assessment was based on available relevant literature published by the 15th May 2018.
58740					It really needs to be indicated early in the setting up of the report's content that the analyses in this report are based on Solar Radiation Management not being a viable option, either on a regional scale (e.g., to cool the Arctic, etc.) or on a global basis to shave off peak warming and/or impacts. The seriousness of the situation does point to the need of undertaking strong and timely research on SRM to develop it as a possible complement to mitigation, adaptation, and CDR for shaving down peak warming (so not as an alternative to everything else) with the charge to determine the potential for undertaking SRM to limit peak warming to 1.5°C and possibly return overall warming to less than 0.5°C over coming decades. [United States of America]	Taken into account. We flag SRM as a theoretical possibility to shave off peak warming. Pointing out research needs would be considered policy-prescriptive.

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58742					The second order draft of the IPCC 1.5 does not assess critically important publications. Moreover it does not treat or assess some sources appropriately. In particular the failure to assess energy industry reports is a critical failing as the energy sector is currently undergoing rapid and transformative change, change not reflected in the out-of-date academic sources and models employed by the IPCC authors. In this light industry reports would fill a critically important gap in the current draft assessment. Key statements in the SPM do not reflect the material in the underlying chapters, and some key statements in the SPM are policy-prescriptive statements. The final sentence in the final high-level statement in the SPM, section 1.2 (page 4, lines 6 and 7), is policy-prescriptive as it presumes patterns of investment that are heavily dictated by policy choices. Moreover, given the large volume of literature documenting the shortcoming in integrated assessment models, presenting model results (page 4, lines 6 and 7) without qualification in a high-level statement is inappropriate in the extreme. Despite being wide, the scenario set is incomplete and thus cannot be considered the basis for a robust high-level conclusion such as this. The statement appears to critically depend upon one paper in the literature (Kriegler et al.). While one paper is informative, it does not provide the high level of confidence required to make such a statement. It is not consistent with the potential of technological innovation and recent developments discussed in Chapter 4, sections 4.2.2 (lines 38-45) and 4.4.4.1 (lines 1-17). Throughout the document, authors employ the term "risk" as a close synonym for costs. However, the plain English meaning of "risk" relates more to uncertainty. SPM boxed statement 2.6 is an example of this misleading framing. SPM section 3 invokes the potential of CO2 removal in overshoot without acknowledging the intergenerational inequity of such a policy. That context is critically important for any high-level discussion of overshoot scenarios and, as such, should be included in all SPM discussion of such scenarios. The SPM highlights discussion of coal use [e.g. section 4.2 (page 21, lines 13-17)], but does not discuss use of natural gas. This imbalance is inappropriate in an SPM meant for policymakers who must make critical decisions about investment in natural-gas infrastructure. [United States of America]	The assessment was based on available relevant literature published by the 15th May 2018.
58744					Chapters 2 and 4 should be more closely integrated. It would help if they could follow a similar organizational scheme. Recognizing the challenges of writing chapters in parallel, there is nevertheless an important potential synergy between the pathways discussed in Chapter 2 and the bottom-up assessment of the state of technology, human and institutional behavior, and systems that should be a core part of Chapter 4. This assessment of "how we are doing" should form one of the core elements if not the most important element of the full report. As it currently stands, Chapter 4 does not build sufficiently on the basis established by Chapter 2, and thus leaves the reader with little concrete sense of the achievability of the pathways described in Chapter 2 or of what concrete measures would be required to achieve them. One counter-example that may be helpful is provided by the discussion of transport on p. 4-25, lines 35-40, which connects an assessment of technical potential to the IAMs and pathways discussed in Chapter 2. This kind of analysis should be extended to other sectors discussed in Chapters 2 and 4. It should also be deepened to discuss the state of technical progress and/or implementation in subsectors and countries/regions. [United States of America]	Taken into account. Although a full restructuring of chapters is not possible at this stage of the report, Chapters 2 and 4 have worked towards a better integration of their assessments by crossreferencing where appropriate, and also by forwarding an overview of key characteristics of 1.5°C pathways from the integrated pathway literature from Chapter 2 to Chapter 4.
49674					From a Political Sciences view, considerations related to appropriate policy instruments appear very techno-managerial and underestimate the role of "the Political" (vested interests, political economy) which strongly discourages rapid decarbonization. I add a few comments and references below where this could be strengthened in the report, beyond chapter 4.4.5 for which it will be most relevant to consider. [Sabine Reinecke, Germany]	Noted, thank you.
58748					In this report, the IPCC is responding to a specific request from the UNFCCC "to provide a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways." This report therefore should focus on what is unique and particular about the 1.5°C level of warming and emission pathways that are consistent with this level of warming. Responding to this request is quite difficult due to the lack of specific information on 1.5°C warming scenarios in the literature. However, it is critical that the IPCC maintains its standards on presenting only the strongest, most robust scientific information, particularly in cases where much is still unknown. The focus of this report should be on assessing the knowledge of the differentials and critical thresholds for natural human systems in 1.5 and 2°C global mean temperature increase scenarios. This is not what this report does now. As written, the report draft takes known information, whether from AR5 or newer literature, and simply extrapolates that, yes, it would be better to contain warming to 1.5 rather than 2°C because any half degree of warming will make things worse. This extrapolation in and of itself does not provide policymakers with any new or useful information to help inform policy decisions and subsequent action. The reader is left with the reaffirmation that less warming is better, which is already commonly understood and recognized. For example, page 10 of the SPM, beginning on line 9, the authors state that the poorest will be most affected by an increase of 1.5°C. However, this concept does not apply only to 1.5°C, but to any increase in global mean temperature, any impact of climate change, and indeed any external shock whether natural, financial, health, or otherwise. Emphasizing this here adds nothing to the understanding of a 1.5°C warming. Issues, such as climate resilient development pathways, various mitigation and adaptation technologies and efforts, projected impacts of warming, and solar radiation management should be discussed only in how they relate to 1.5°C. Unfortunately, the current draft fails in this regard. Too often throughout the chapters, the authors present a detailed discussion of a topic only to finally note that there is no specific information related to 1.5°C available. Broad discussions of topics related to climate change and possible intersections with sustainable development should be reserved for the Sixth Assessment Report (AR6). [United States of America]	Noted, thank you. The report assessed the knowledge in the available relevant literature published by the 15th May 2018, within the timeframe of the report preparation. The assessment will be continue as part of the Working Group reports within the AR6.
58750					Many statements imply greater impacts of climate change at 2 vs. 1.5°C without sufficient empirical basis. It would be useful for the authors to provide specific examples, including explanations of the scientific basis for the concern on how an impact may worsen at 2 vs. 1.5°C. For example, how much worse or more frequent will droughts in the Horn of Africa be with a global mean temperature increase of 2 vs. 1.5°C? If the scientific literature does not support such a finding, then the authors should note the research gap, not speculate over what could be the impact. That said, the report does a credible job indicating where information gaps specific to 1.5°C exist. However, the use of "expert judgement" or searching for "insights" within the general literature confuses the reader as to what is actually known and proven, versus what is hypothesized as likely. A thorough scrub of the report must be made to clearly indicate to the readers what findings have an empirical basis and what findings are the opinion of the authors. [United States of America]	The projections are not based on expert judgement alone. The projections of changes in extremes are derived from climate model simulations, which have been analysed for their response at 1.5°C vs 2°C global warming. In the case of drought, there is a lot of spread in projection depending on the considered model, this is the reason why regional information is limited. More background on the assessment of changes in extremes at 1.5°C vs 2°C global warming is provided in Section 3.2 (methods) and 3.3. (projections)

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58752					<p>There are diverse views on how terms such as equity, fairness, and ethics are applied to climate policy, yet the report appears to present only a single perspective. This is not appropriate for a report of the IPCC which should present a balanced, comprehensive assessment of all views. The way the special report reads now, the reader is left thinking that IPCC representatives agreed to an outline for a report on "Equity and ethics related to sustainable development and the impacts of Global Warming of 1.5°C." However, the only reference to equity and ethics in the agreed outline is under the second bullet of Chapter 1: Framing and Context and the exact language is "with consideration for ethics and equity." As such, the issues of ethics and equity should be raised in this special report to provide context for the readers on the variety of perspectives that may need to be considered in discussions of the impacts of 1.5°C warming and related emission pathways. The authors apply a specific view of equity and fairness into the analysis of the report that does not enjoy broad consensus. For example, the report openly supports the "ethical imperative" for wealth redistribution to compensate the poor for the impacts of climate change and the potential impacts from higher energy costs related to the pursuit of lower emissions. This view has been categorically rejected by a number of Parties to the UNFCCC and the endorsement of this view goes against the IPCC principles of not being policy-prescriptive. The report neglects to consider the very concern that led the United States to not join the Kyoto Protocol, namely that nations that are economic competitors to the United States do not have an obligation to reduce emissions. This consideration of fairness is central to understanding the challenges to achieving global emission reductions consistent with 1.5°C of warming within the climate change negotiations. The report does note, correctly, that emission reductions from all countries are required to limit warming to 1.5°C yet it goes on to emphasize that emissions pathways must be consistent with the principle of common but differentiated responsibilities which many developing countries, including those which contribute the majority of emissions, use to justify their inaction. This contradiction is never addressed or even considered by the authors. Omitting the consideration of such views goes against the IPCC's principles of balance and comprehensiveness. Revise the entire report to reflect what was agreed to in the outline by member governments. The report must avoid applying a specific view of equity, ethics, and fairness onto what should be a specific analysis of the available information on 1.5°C of warming. The authors are welcome to note the consideration of equity that is within the literature on 1.5°C but they must not endorse a specific view in their assessment. Not doing so will risk the acceptability of the report to governments. [United States of America]</p>	Noted, thank you. The report assesses the knowledge in the available relevant literature.
58754					<p>Considerations of human rights are not included in the adopted outline for this report, and discussions of human rights should be deleted throughout. The IPCC is not the proper body to undertake assessments of human rights. Human rights is a body of law that is the subject of numerous international conventions, subject to varying degrees of adoption by IPCC members, none of which establish human rights obligations specific to climate change or the environment. Human rights is distinct from both ethics and equity. Equity is not a legal discipline but refers to general conceptions of fairness that are distinct from any legal rules and disciplines. The purpose of this discussion, which seems to be to address the impact of global temperature increases on human well-being, need not and should not be unnecessarily circumscribed by attempted placement within a human rights paradigm. [United States of America]</p>	Noted, but again we stress that our interpretation of the mandate of the IPCC is to assess the academic literature, and much of this literature situates discussions of equity and ethics in the context of human rights.
62232					<p>The SPM and SOD place a disproportionate emphasis on BECCS for delivering negative emissions, even though the scientific literature indicates that BECCS is unlikely to provide the massive scale of assumed emissions reductions and would have harmful consequences for water, food security, biodiversity, and other basic human needs if deployed at large scale. The SPM must more clearly discuss the limitations and risks of BECCS whenever invoking pathways that rely on large amounts emissions reductions from BECCS. The SPM and SOD must provide alternatives to BECCS, including an assessment of the policy options if BECCS is not available at the assumed scale. For example, the SPM and SOD must include a more complete assessment and evaluation of land-based CDR methods that come with lower risks than BECCS including reforestation, afforestation, and biochar. Changes in agricultural practices and reduction in meat consumption should also be more thoroughly incorporated into 1.5C pathways. We also recommend that the SOD incorporate new scientific research on the limitations of BECCS, specifically Booth (2018) and Heck et al. (2018): Booth, Mary S., Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy, Environ. Res. Lett. 13: 035001 (2018). Heck, Vera et al., Biomass-based negative emissions difficult to reconcile with planetary boundaries, Nature Climate Change 8: 151–155 (2018). As discussed in Booth (2018), the IAMs almost universally treat bioenergy as having zero net emissions (i.e., carbon neutrality), or when used with CCS, as resulting in negative emissions. However, scientific research indicates that bioenergy emissions can have significant net carbon impacts and must be counted. For example, Booth (2018) shows that burning wood residues, including residues assumed to decompose anyway, results in significant net carbon emissions in the US bioenergy and wood pellet manufacturing sectors. Heck et al. (2018) concluded that "large-scale deployment of BECCS would imply significant impacts on many Earth system components besides atmospheric CO2 concentrations" and that "while large-scale BECCS is intended to lower the pressure on the PB [planetary boundary] for climate change, it would most likely steer the Earth system closer to the PB for freshwater use and lead to further transgression of the PBs for land-system change, biosphere integrity and biogeochemical flows." [Shaye Wolf, United States of America]</p>	Noted. The discussion of carbon dioxide removal (CDR) in pathways (Chapter 2.3.4) and by technology (Chapter 4.3.8) highlights the variety of available CDR measures and not only focuses on BECCS. With regard to pathways, AFOLU CDR is discussed alongside BECCS and the fact that 1.5°C pathways not using BECCS (LED pathway) exist is highlighted. This is reflected in the SPM and has been further strengthened in the SOD of the SPM. Heck et al. is discussed in Chapter 2.3.4.
62998					<p>In the report is clear that climate change do not have the same effect all over the world and differences between several areas as the Mediterranean Sea, Artic, tropic, small islands, Alpine zones, tundra, monsoon, rain forest and boreal forest are detailed. However, climate change impacts show wide regional variability and adaptation happens on smaller scales, "microclimates". As examples you could cite the book by Quante, M. & F. Colijn (2016) about the North Sea region climate change assessment (Springer). Queirós et al. 2015. Global change biology 21(1):130-143; Van Leeuwen et al., 2016. Biogeosciences 13(2):441; Ouellet et al., 2017. J Exp Mar Biol Ecol 497:50-60. Effective marine management, such as that required by the MSFD, must take in account of the existence the different microclimates. [Guiomar Rotllant, Spain]</p>	Noted.

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63120					The structure of the report is awkward. The pathways/scenarios of chapter 2 seem to be the core of the report, yet supporting info is rather scattered, e.g much of underlying modeling/pathways are not explained until chapter 4. Impacts of a 1.5deg and beyond world are explained (Chapter 3) after discussion of ways to achieving a 1.5deg world (Chapter 2). It would seem that impacts of exceeding 1.5deg should be explored first as rationale for limiting warming to 1.5deg. I think the reader is looking for a logical progression of presentation 1) the problem to be addressed with rationale and background including the consequences of failing to limit warming to 1.5deg., 2) the possible approaches needed to limit warming to 1.5deg, with underlying assumptions and uncertainties; and the selection/development of models to explore effectiveness of various combination such approaches, 3) the results of the preceding modeling with accompanying discussion, and 4) implications of findings and recommendations for further work/action. [Greg Rau, United States of America]	Noted, thank you for the suggestions
36598					Inconsistency in the use of qualifiers or confidence statements is an issue throughout the report. [Snaliah Mahal, Saint Lucia]	Taken into account as the chapters have been finalized.
19182					The interactions between climate change and air quality are somehow neglected in the report. There are references (e.g. to issues related to biomass burning, or to short lived climate forcers), but it would be worth including a section on those interactions, co-benefits and trade-offs. Such section could present examples of policies or actions and their impacts (e.g. better insulated homes are even more efficient in reducing air pollution than switching to less polluting fuels). Air quality is a critical elements to mitigate climate change. China, for instance, is more and more involved in mitigation, mainly due to air quality issues and their consequences. [Andrea TILCHE, Belgium]	Air quality has been addressed in the report and is also reported on in the SPM.
19184					The report includes several examples of adaptation/mitigation policies and actions, but very few European, despite of the strong commitment of public authorities at all levels (from EU-level to local) and stakeholders (civil society and enterprises). Is there a particular reason for that? Maybe there is not enough peer-reviewed paper describing an assessing such actions? In our view, more European examples merit to be introduced - and we can provide them if requested. [Andrea TILCHE, Belgium]	The assessment was based on available relevant literature.
19186					Most of the scenarios for staying within a temperature increase of 1.5°C foresee 'overshooting' and count on carbon dioxide removal (CDR) technologies in the second half of the century. There are 2 major drawbacks, a) the technologies do not yet exist or present many issues (as explained in the core report); and b) unique systems such as coral reefs will not survive overshooting 1.5 °C and would most likely not recover in human timescales, even if the CDR technologies were successful in bringing the temperature down again. The same way ocean acidification is irreversible in human timescales. Such issues need to be somewhat addressed in the report. [Andrea TILCHE, Belgium]	Addressed in this report based on the available relevant literature.
5538					Quantitative information on contrast in the pace of deployment of different low carbon technologies (e.g. wind, solar, CCS BECCS, nuclear, biofuels, and bioelectricity) for energy supply between the past decade, and 1.5 scenarios over the next few decades is needed in this report and is not apparent in the summaries. Overall, there is a large contrast in carbon intensity between 1.5 scenarios, and either the NDCs or the past decade. Being more explicit about where the gaps lie by technology would help define where further effort is needed. [Haroon KHESHGI, United States of America]	Taken into account. The summaries have to reflect the assessment available in the underlying chapter. Unless evidence and literature is available that informs this question, it cannot be provided. Growth rates of technologies are provided in Tables 2.6 and 2.7
18756					Among the uses of biomass, only energy use and biochar are preferred. Food is accepted (although should be reduced), but the use of bio-based products (current use or their targeted use for mitigation through substitution) is not considered. The carbon in harvested wood is not mentioned at all. These omissions may not be very important, but they are striking in light of the repeated (but shallow) claims on biochar. The use of biomass for substitution (e.g., in construction) is well developed and described, and offers comparable to much higher benefits than energy use. Biochar is essentially untested and speculative. [Andrea TILCHE, Belgium]	Noted/Taken into account - In chapter 4 different mitigation options are assessed individually based on bottom-up literature, while the substitution effects the reviewer rightly mentions are incorporated in the 1.5°C pathways of chapter 4. Bio-based products (e.g. bioplastics, new materials from biorefineries) are assessed in the industry section, see e.g. Table 4.9.
19188					be consistent with the use of CO2, not CO2 [Spain]	Copy edited
19190					In reference to glossary terms, for the next review cycle we would like to be able to send comments to the glossary since we find some definitions are confusing, incomplete or incorrect. [Spain]	Comments on the Glossary are very welcome and helpful, despite not being formally part of the review. The Glossary was available with the SOD chapters for comment.
19314					Glossary has no entry for Transient Climate Response (the reader is referred to the Climate Sensitivity entry, but it is not explained there). [Andrea TILCHE, Belgium]	Accepted - transient climate response definition added under climate sensitivity.
19316					There is a logical error in the definition of malmitigation [Andrea TILCHE, Belgium]	No longer applicable - definition removed.
45868					It has been an honour to read this work. The comprehensiveness of the report is absolutely phenomenal and I am humbled to have been accepted to review this document. I believe that this report will help to shape climate policy for future decades, and provide add great value to mankind as a whole. [Louis Brown, United Kingdom (of Great Britain and Northern Ireland)]	Thank you.
49916					Thank you for considering my earlier comments on FOD. The report reads very well and is in time to help the UNFCCC facilitative dialogue take the right shape. Since too many policy makers, academicians and researchers are waiting for the report, it is important to address concerns linked to pre-2020 ambition, technology transfer, etc that will decide the future modalities of the Paris Agreement. [Himangana Gupta, India]	Thank you.
50598					I found the report interestingly articulated not only on pure climate change issues but also on sustainable development issues as well. This is an important point if one refers to the initial Climate Convention of 1992 (especially Article 2) which was expressing similar goals and concerns. [Jean-Yves CANEILL, France]	Thank you.
51536					Captions for tables: One inconsistency that I noticed from one chapter to the next is with the labeling of the captions for tables. Sometimes the label was put at the bottom of the table and sometimes its put at the top. I believe that the convention is to label tables at the top, and figures at the bottom (the label for figures did seem far more consistent). [Jason Donev, Canada]	Copy edited.
51538					For reasons that are not clear to me, this document is missing hundreds of spaces in the text. I have been unable to capture all of them, which is probably fine, but I do point out many of them. I apologize if this clogs the system. I am wondering if the problem was actually in the conversion between whatever word processing program is being used and the pdf. Please consult the pdf to see this formatting issue. [Jason Donev, Canada]	Copy edited, thank you for the careful checks.
53882					CO2-eq emissions are abbreviated in some chapters but not chapter 1, where spelled out in full. Glossary has CO2-eq concentrations as well as CO2-eq emissions. CO2-eq concentrations are never used in the report, nor should they. They are very confusing. Please can we delete the glossary entries? [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Accepted. Definition for CO2-eq concentration removed.
53900					The technical annex in Chapter 1 is a good idea, Chapter 2 and 3 could consider doing something similar and moving out their technical bits [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Implemented

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53912					The old chestnut of confidence language needs careful hamonising. I think we should only use this language where we have explicitly made an expert assessment within the chapters. In their ESes. Chapter 1 hardly uses it. Chapter 2 has a confidence statment in most paragraphs. Chapter 3 uses some likelihood and high confidence statements but not a huge many. Chapters 4 and 5 use calibrated language a lot with but different languages though (Chapter 4 talks about agreement, Chapter 5 confidence). To me Chapter 1 and/or Chapter 3 seem to be the most readable and convincing. Why don't we only use it whwn we have a real purpose? [Piers Forster, United Kingdom (of Great Britain and Northern Ireland)]	Noted and improved during completion of the report.
33928					The report should give essential information about mitigation GHG pathways especially in 2030 since the decision in Paris COP (see para 17 in dec. 1/CP.21; fccc/cp/2015/10/add.1) asked IPCC to address the level of emissions in 2030 which will be consistent with a 1.5 degree global warming. Since this decision also refer to the emission level that are consistent with below 2 degree warming it will be important that IPCC also update the number for 2 degrees to make them comparable. Information that is relevant can be found in Table 2.7 we suggest that you present information from this Table in the SPM e.g. those numbers that are most relevant to the Paris agreement for example 2030 and 2050 annual emissions for Kyoto GHG for "Return 1.5 66" and "Below 2C 66". [Norway]	Noted and implemented in the SPM
57506					Please ensure consistent spelling of particular terms (e.g. preindustrial vs. pre-industrial) [Hans Poertner, Germany]	Copy edited.
49774					This special report presents the clearest picture yet of the risks posed by uncontrolled climate change under global warming of 1.5°C. Through case studies and user comprehensive diagrams and statistics, reader is able to understand that the consequences of climate changes that have already occurred are profound. It emphasizes that continued emissions of greenhouse gases at 1.5 ° C , will cause further, long-lasting changes to our climate system, increasing the risks for people and ecosystems. the report is well illustrated and informative, and most of all, important ecscientific document delivering a significant contribution to the body of climate change concerning both mitigation and adaptation but also governance as it provides a wide guidelines to decision makers to face climate change impacts with respect to vulnerable regions in the world. By the end I want to congratulate all authors, reviewers and editors for this great report. [Rachid MOUSSADEK, Morocco]	Thank you.
51532					On the whole, this is a big improvement over the first order draft. I'm impressed with the work done and the scope of the project. I'm still quite concerned that nuclear power isn't being treated seriously though. The authors have a clear bias against nuclear power and have not done their due diligence in researching what is currently being done within nuclear power, especially Small Modular Reactors. They are a game changer for nuclear power. Running a nuclear power plant emits absolutely no carbon dioxide and that must be considered seriously as part of a path towards limiting our warming to 1.5C. We must do our best to set aside our prejudices and consider the contributions that nuclear power is currently making and the added difficulty of keeping our warming to 1.5C if we phase out the nuclear power that we already have, and don't build more. There are a number of co-benefits of nuclear power, including cleaner air (no air pollution), reliable electricity (no grid storage problems) and medical isotopes for improving human health. I implore you to assign someone to sit down and talk with an expert on nuclear power, myself or any of my dozens of colleagues. The threat of climate change is too great for us to ignore any part of the solution and nuclear must be seriously considered as part of the solution. Even if you disagree with me, which is your right, please do so from a position of knowledge, which at the moment this document is not doing. Climate change already kills more people every year than all of the nuclear accidents in history combined. Nuclear IS scary, but climate change is dangerous and we must not confound those two ideas. [Jason Donev, Canada]	Taken into account. Nuclear is taken into account seriously, based on the peer-reviewed literature on it. An assessment on multiple dimensions of feasibility was done just like with other mitigation options. It is part of integrated assessment models. The text in section 4.3 is balanced, in our view, highlighting the reality of nuclear - embraced in some countries, abandoned in others. Very variable public perception, high investment costs, long lead times.
51534					There is a tendency in the literature to think of 'renewable energy' as being 'wind + solar', with geothermal and tidal power possibly thrown in. People harvest far more energy from hydropower for electricity than wind, solar, geothermal and tidal power combined. While new hydropower projects are unpopular, we must not confuse unpopular with unhelpful. We need all of the electricity that humanity can create, with as little greenhouse gas emissions as possible. Hydropower, like nuclear power, is an incredibly important contributor to this and it must be included in a more fulsome way in this report. While the electrical industry has tapped many of the best hydropower resources, we have not yet tapped all of them. There are trade-offs with hydropower, including, at times, environmental devastation. There are, however, also synergies and co-benefits like reduction of risk of flooding. Maintenance, improvement and expansion of hydropower must be considered extensively in this document, it is far too important a part of our energy mix to treat in the cursory fashion that this document has. We must beware of our own prejudices. It is easy to become enamored with solar and wind power to the exclusion of other parts of the solution like hydropower and nuclear power, but we must consider all of our energy sources with an objective eye. [Jason Donev, Canada]	Noted. Hydropower is indeed renewable energy, like biomass is a renewable fuel. We don't have a specific treatment because of limited space in this particular report and not much in terms of new and 1.5C-relevant developments since AR5. AR6 will give a fuller update.
51540					I suspect that this is a problem with the draft, rather than something fundamental, but many of the pictures were hard to read. I've made mention of many of these problems throughout the text, but don't know that I caught all of them. Of specific concern is text within the pictures. Please be aware that this text is often microscopic when presented in this format. Many people will, sadly, not read the document, but will scan through and look at the figures, figure captions and tables. While this is unfortunate, this document must play to the readers that it has. The pictures are of paramount importance in communicating this important information, please treat the readability of the pictures with the needed care. [Jason Donev, Canada]	High resolution figures are available for the published report.

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51542					<p>Is 1.5C possible or not? The entire document exists for only one purpose: to answer this question, but the document does not answer the question. Different authors have different opinions, and the overall message of the report suffers gravely as a result. I recognize that coordinating this many authors is a herculean task and I applaud the work of both the authors and editors in this. The report, however has one thesis question that underlies the whole report, and is, to a certain extent, a yes/no question. Is it possible to limit our warming to 1.5C or not? If so, what do we need to do in order to do that? In the first order draft it seemed clear that we would have to have overshoots. This opinion has been revised in this draft (which is fine, I suspect that many reviewers pushed back on the tone of the first order draft, I am of the opinion that the overshoot is unavoidable, but will defer to my anonymous colleagues who know more about this than I do). That being said, parts of this document seem to indicate, still, that a 1.5C limit is "not" possible, some imply that the overshoot is unavoidable and parts imply that if we roll up our sleeves and get to work we will be able to limit the warming to 1.5C. I shudder to think what getting substantial unanimity would be like for a paper of this scope, but the whole point of this document is, in fact, this very question. The answer to the question must be: 1. Clearly stated at the outset, and repeated throughout. 2. Consistently stated throughout the document. There can be nuance to the view. An overly simplistic example of what I mean by nuance is: "Physically, we can limit our warming to 1.5C but the economic and political consequences are so steep that this limit is not practically feasible." There can also be uncertainty in the view, as an example, "By aggressively pursuing dramatic reduction of our GHG emissions in all sectors we can create a track where there is a 50% probability that we keep our warming to 1.5C. There must not be ambiguity to the view; what I mean by ambiguity: "After reviewing all of the evidence we think we have some paths that might limit warming to 1.5C. We aren't certain whether or not these paths are feasible, so we don't think it's really possible to limit warming to 1.5C, but it might be." The scientists (both social and hard), economists and all of the other myriad disciplines represented in this document face an insurmountable political difficulty: any ambiguity in this document will be seized upon as an excuse to do nothing. This committee has been given a task of monumental importance, craft an authoritative and complete, but understandable report on this question, and has not yet achieved that one goal (but it can). To sum up: agree on what you wish to say, say it clearly with no wiggle room, and then make sure the entire document is consistent with what it is that you have agreed to say. This report is only as powerful as that consistency. [Jason Donev, Canada]</p>	The assessment was based on knowledge in the available and relevant literature including assessing the dimensions of feasibility, finding for example that it is geophysically possible to limit global warming to 1.5oC.
58514					<p>In my comments on chapter 1, I state that with regard to framing the report around "ethics and equity", in my view as a social scientist, the authors have done a good job.</p> <p>A positive comment, is that I think the document does a good job of anchoring this material to UN documents and agreements.</p> <p>On the other hand, other ethical perspectives exist, and other conceptualizations of equity exist. (These are not acknowledged.)</p> <p>My own ideological orientation is consistent with the position given in the document. I can imagine, however, other readers who might not accept at face value the framing in terms of ethics and equity.</p> <p>I would like to add to the above comment here, with regard to chapter 5 in particular (but also chapter 1, and possibly elsewhere). The "elephant in the room" that is not talked about in the report is political ideology. (Which is somewhat odd, given that "governance" is talked about.) Differences in political ideology is one of the largest barriers to implementing effective policy. Many actors with an economic conservative political ideologies do not accept the "ethics and equity" framing offered in this report. There are some vague comments in the report about governments at different levels needing to do a better job to coordinate. But, the fact is, they often they fail to coordinate because they have ideological differences.</p> <p>As somewhat of a neophyte to participation in UN processes, I am not sure what the normative expectations are about discussing political ideology.</p> <p>But a major disconnect of the report is that it offers a "lefty" policy prescription (which I happen to agree with) without talking about differences in ideological perspectives, and the fact that ideological differences is a major barrier to progress.</p> <p>In my comments on chapter 1, I note that an additional empirical justification for the "ethics and equity framing" is that if "justice issues" are not addressed in the context of policy solutions, then some actors will be less likely to "buy-into" or embrace the policy solutions proposed.</p> <p>It seems likely that some conservative actors will be less likely to support the "ethics and equity" framing if it is presented purely in moral terms. Pragmatic arguments (like that suggested above) might facilitate the adoption of this framing.</p> <p>A related comment is the issue of tradeoffs. In various parts of the report, qualifications are given that negative outcomes (or tradeoffs) may occur if mitigation and/or adaptation are pursued in the absence of "ethics and equity" concerns. This is true. However, it might also be emphasized, that the need to act is urgent, and delaying in the name of "ethics and equity" will also involve negative outcomes (or tradeoffs). [Tindall David, Canada]</p>	Noted and thank you for the constructive reflections.
410					Amazingly, this draft is even better than the first one. Great job. [HARRY SAUNDERS, United States of America]	Noted
8096					(Almost) all figures are all really hard to read. Overall, it feel that they are trying to say too much. [Quentin Perrier, France]	Noted and efforts have been made to make the figures as informative and relevant as possible.
10268					We recommend to introduce a planned monitoring process in the document. It would be worth carrying out a monitoring activity within 2-5 years to examine whether the diagnosis and conclusions stated in this Special Report were right, what new research results have been published about the effects, the scale and course of impacts, the current mitigation and adaptation costs, innovations and based on this review suggesting new scenarios. [Hungary]	Noted, the AR6 will extend the assessment of topics addressed in the SR15 based on new knowledge published in the literature.

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10270					The quality of the figures could be improved, as many of them are not informative enough, confusing or illegible. The comprehensibility of the figures are especially important for the SPM. [Hungary]	Noted and efforts have been made to make the figures as informative and relevant as possible.
14148					I was pleased to see the SOD of this special report have a great forward in advance in a very short time, even if there are very few studies in 1.5 and 2 degree projections. To this regard in the projections of 1.5 or 2.5 degree and their impacts, it might still have few evidences and deep uncertainty; therefore, some conclusion in the report should be very cautious, e.g., SPM, p4, 128-31. [Rongshuo Cai, China]	Noted.
18752					General comment on the whole report: Compiling this report in the time available has clearly been a challenge for the scientists involved. We fully appreciate the effort and time devoted to the draft. The report contains a great deal of useful information but is in need of substantial editing taking a holistic (rather than chapter-specific) approach. * many chapters cover material beyond their individual scope. In particular the interlinked nature of the themes has so far led to substantial duplication. e.g. framing material is contained in Ch2 & Ch3 as well as Ch1, the separation of focus between between Ch4 (response) and Ch2 & 3 (mitigation, impacts & adaptation) is not clear. It may be useful to undertake a cross-chapter search for duplicated insights in order to identify where specific findings should be placed, what should be merged/moved/deleted etc. * perhaps because of the above, the report is too long [Andrea TILCHE, Belgium]	Noted and efforts have been made to reduce duplication. The process of preparing the SPM has been helpful in terms of cross-chapter coordination.
18754					General comment on the whole report: The SPM as well as the chapters can benefit from adding information on how 1.5C relates to well below 2C. This includes when discussing relative impacts, efforts costs, benefits and opportunities for both mitigation and adaptation. Presently it is not always clear what the relative differences are. This includes implication of timing, to what extent for instance climate neutrality impacts temperature change in below well 2C scenarios also after peak temperature is achieved. The whole report misses also information that can provide information at regional scale, which seems needed to provide for policy relevant detail. [Andrea TILCHE, Belgium]	Noted: the report has focussed on 1.5°C scenarios, contrasting these with 2°C scenarios, as we interpreted our mandate. The problem with "well-below 2°C" scenarios is that the definition is ambiguous, and at the time of writing of the report does not appear to have reached consensus. Where possible, more information has been provided at regional scale.
24094					The good idea of FAQ in each chapter helps reader so much. It looks like clear and bold conclusions of each chapter which may be used as 'primer' used for educating non-experts. It may necessary to indicate reference points in main report to lead them to scientific confidence. [Shuzo Nishioka, Japan]	Thank you. The FAQs do not include the use of confidence statements since they do not include an assessment.
24096					Executive Summary of Chapter 2 has, in its top, key questions the Chapter would like to respond and answer. This helps reader clear the issues to understand and check the following summary correctly responds them. It is recommendable that other chapters also have this key questions part on the top of each Executive Summary. [Shuzo Nishioka, Japan]	Noted, thank you for the suggestion.
28960					Please describe the scenarios used in this report; are there real 1.5 degree target scenarios or are the results from other scenarios at the level of 1.5 or 2.0 °C. As stated in Ch 1 this will result in different climate conditions. Please clarify. [Germany]	The scenarios assessed in the report are described in Chapter 2.
28962					We have strong concerns regarding the current over-use of lengthy boxes across the report (in particular in chapters 3 and 4, but also 1 and 5). Boxes and Cross-Chapter Boxes are often very lengthy, spanning several pages - from our perspective, the idea of a Box would be to have a concise description of a cross-cutting topic, or a more in-depth discussion of a relevant example to principles highlighted in the text. The aggregated boxes currently add considerable length to the report, and put an additional challenge to reviewers and authors concerning volume and consistency. Please consider removing some of the boxes, and reducing the length of those that run over more than 2 pages substantially. Also, it is vital to ensure that material in boxes is subject to the same high standards of scientific integrity as the rest of the report, and the topics are selected in a way transparent to the reader and with a clear link to the plenary approved outline and the content of the chapter. Finally, please clarify the difference between a Cross-Chapter Box and a simple Box. The concept behind it is unclear. [Germany]	Noted. Cross-chapter boxes treat topics that are addressed by more than two chapters. Boxes in general provide a highlight on certain focused topics that are included, for example, to help the reader know more background relevant for the chapter assessments, or to give more detailed information from case studies. This is very much in line with your note that they can provide a 'concise description of a cross-cutting topic, or a more in-depth discussion of a relevant example to principles highlighted in the text'.
28964					We are deeply concerned that the analysis of the sustainable development implications of mitigation pathways in line with 1.5°/2°C provided mainly in Chapter 5 and also in Chapter 2 does not adequately account for the sustainable development benefits of lower levels of climate change, lesser and fewer risks and avoided impacts at 1.5°C compared to 2°C and especially a baseline case of substantially higher warming. We do understand the limitations of the literature here, and commend the authors and the scientific community for their efforts to enhance our understanding of the SD implications of different mitigation pathways. However we call upon the authors and the SPM drafting team to find ways to highlight this caveat and frame their findings in a way that precludes isolating perceived sustainable development risk and trade-offs of 1.5/2C pathways from both co-benefits of mitigation and the benefits of reduced climate risk. This applies first and foremost to the suggested graphics (e.g. current SPM 5, 6, and 7) but also to the wider discussion and the Executive Summary. [Germany]	The section 5.2.2 of the final draft of chapter 5 assesses the literature discussing the benefits of lower levels of warming for sustainable development given avoided impacts under 1.5°C compared to 2°C. Section 5.4 discusses both synergies and trade-offs of mitigation actions with sustainable development. These aspects are explicitly reflected in the executive summary of chapter 5 and in the final SPM
28966					We are very concerned that the important content currently to be found in many of the cross-chapter boxes, in particular CC box 3.1 and 4.1, may not be adequately represented in the SPM and amplify consistency issues across the report. Most Cross-Chapter Boxes address issues crucial to the mandate of the SR1.5, many of which have been highlighted in this review. We'd strongly urge the author team to diligently cross-reference the content found in those boxes, remove redundancies with chapter text to the extent possible, improve consistency between chapter text and Cross-Chapter boxes and make sure that the relevant findings are lifted to the SPM and as well as to one of the chapters' executive summaries in order to make sure these findings will be included in the technical summary. [Germany]	Noted and also implemented in further developing the SPM.
28968					We urge to clarify the different concepts and definitions of 1.5°C warming and the associated risks and impacts across the different topics of the report. Currently, the various references could cause confusion that might weaken the confidence in the report as a whole. [Germany]	Noted and also implemented in the Glossary and key concepts provided in the SPM
28972					We want to recall that this report is an addition to the assessment reports and not a comprehensive stand-alone volume, as it may appear otherwise considering the overall length, content and rather broad scale of each chapter. We strongly recommend the authors to focus on further streamlining, avoiding duplications and focussing on findings central to the outline and mandate of the report. [Germany]	Noted and efforts have been made to focus the chapters and reduce duplication.
28980					Please provide qualifications of confidence or likelihood (using the IPCC uncertainty language) to all major statements across the report including in summaries of high level statement. Please use the same units across the report, e.g. not mixing Tg and Mt. [Germany]	Noted and implemented in the development of the report.
28982					The Executive Summaries need to be shortened, and written in a style that is accessible for experts across disciplines because they will be collated into the Technical Summary. [Germany]	Noted and efforts have been made to make the Executive Summaries as coherent in style.
32208					Inconsistency in the use of qualifiers or confidence statements is an issue throughout the report. [Jamaica]	The level of confidence associated with each key finding is reported using the IPCC calibrated language

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33296					there needs to be a convention when using comma with more than 3 items. [Sergio Aquino, Canada]	Noted.
40372					I think it would be wise to devote a small part to geoengineering [Jonathan Gómez Cantero, Spain]	Related topics have been addressed in the report based on the available relevant literature.
40374					Consumer products and nearby products [Jonathan Gómez Cantero, Spain]	Related topics have been addressed in the report based on the available relevant literature.
40376					<p>Comments on the entire report</p> <p>1. About social sciences and the understanding of climate change: The social dimension of climate change and transdisciplinary knowledge</p> <p>Indeed, it is important to highlight that this is the first report that includes an extensive literature in social sciences. This is consistent with the fact that in global academic debates the understanding of climate change is increasingly being shown not only as a scientific fact but as a process of profound social implications. However, since climate change is a complex phenomenon, complex solutions that emerge from new understandings (beyond disciplinary approaches) are also required, so it would be advisable to consider the importance of moving towards «transdisciplinary knowledge» to meet the challenges of global climate disorder.</p> <p>In this regard, it should be noted what was pointed out by Pope Francis, in Laudato Si. On care for our Common Home: «(110) The specialization which belongs to technology makes it difficult to see the larger picture. The fragmentation of knowledge proves helpful for concrete applications, and yet it often leads to a loss of appreciation for the whole, for the relationships between things, and for the broader horizon, which then becomes irrelevant. This very fact makes it hard to find adequate ways of solving the more complex problems of today's world, particularly those regarding the environment and the poor; these problems cannot be dealt with from a single perspective or from a single set of interests. A science which would offer solutions to the great issues would necessarily have to take into account the data generated by other fields of knowledge, including philosophy and social ethics; but this is a difficult habit to acquire today. Nor are there genuine ethical horizons to which one can appeal. Life gradually becomes a surrender to situations conditioned by technology, itself viewed as the principal key to the meaning of existence». [Cf. Francis. Encyclical Letter Laudato Si' of the Holy Father Francis On care for Our Common Home. Vatican City: Vatican Typography, 2015].</p> <p>2. About climate justice, ethics, intergenerational equity and future generations</p> <p>We consider that the report deeply asserts when including initial references to climate justice, intergenerational ethics, intergenerational equity and future generations. This is reinforced when it is explicitly pointed out that among those most affected by asymmetries in the impacts and vulnerability of climate change are our «future generations».</p> <p>The Stockholm Declaration (1972) referred to intergenerational equity in Principles 1 and 2. Subsequently, the World Commission on Environment and Development (1987) set out the definition of sustainable development, and then various international instruments have alluded to the principle of intergenerational equity, including the Declaration on the Responsibilities of the Present Generations Towards Future Generations of the United Nations Educational, Scientific and Cultural Organization (UNESCO) of 12 November 1997 [Cfr. United Nations. Yearbook of the International Law Commission, 1998 (vol. II, part one). New York and Geneva: United Nations, 2010].</p> <p>Indeed, from the concept of sustainable development emerges two fundamental issues that must be considered in the design and implementation of global sustainability policies: 1. The inexorable cause-effect relationship between the decisions that the present generations make and their implications for future generations, considering the accumulated impacts over time. From this premise arises the need to build a global policy of intergenerational equity which traverses multilateral environmental agreements, 2. The limits imposed by nature on the economy. The Earth is not infinite: it is not possible to continue acting under the paradigm of infinite material welfare, on a finite planet. This is turning the concept of sustainable development into an oxymoron.</p> <p>For this reason, we consider that for addressing the old ethical dilemmas posed by climate justice and the notion of equity of the United Nations Replace CO2 with CO₂ (with 2 as subscript) through the report [Neelam Singh, United States of America]</p>	<p>Thank you for the constructive reflection, the points are well noted. The assessment was based on the available relevant literature. Such topics will also be addressed more comprehensively in the WGII AR6.</p>
40944					Replace CO2 with CO ₂ (with 2 as subscript) through the report [Neelam Singh, United States of America]	Copy edited.
44070					In chapter 2 as well as others the labels used on multi-framed Figures is both a,b,c, (Figure 2.25) and left-right-top-bottom panel (Figure 2.27). Perhaps there is a need for more uniformity. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Copy edited.
44290					I do not have the time, before the 25th of February deadline, to read the whole report, especially chapters 1 and 3. However, from that which I have, there are two typos. 1) In many places CO2 is not written in subscript and is joined to the next word without a space. 2) In many places after a citation there is no space before the next word. [Moshe Kinn, United Kingdom (of Great Britain and Northern Ireland)]	Copy edited.
45414					There are several topics that are duplicated both within and across chapters. Individual examples are illustrated in separate comments [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]	Noted.

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28970					<p>We are deeply concerned by the undifferentiated categorization of Carbon Dioxide Removal (CDR) technologies as mitigation options in the SR1.5. CDR is considered by the AR5 to fall under Geoengineering, whereas in this report it is considered a mitigation option without further explanation. However, as also stated in the AR5, CDR technologies can be both, depending on the scale and intent of the application and the individual technology (See IPCC AR5 Glossary on Geoengineering provided below). Therefore, categorization is both technology- und scale-specific and CDR should neither be defined as pertaining to one category only, nor be unduly equated with conventional greenhouse gas abatement options such as renewable energy, energy efficiency improvements etc. We therefore strongly urge the authors not to generally assign CDR to mitigation. In addition, it would be helpful to clarify what methodologies and measures are considered a CDR-option, and which are not. Throughout the report (particularly in Chapter 4, but also 2 and 5) there is reference to various terms in relation to negative emissions. Not all of them are defined in the glossary and some of them seem to overlap. It is furthermore not clear if all technologies or approaches that can contribute to negative emissions (or remove CO2 from the atmosphere), e.g. from the AFOLU sector, are defined here as CDR. As stated above, some of the technologies considered in the report under CDR as mitigation technologies also fall under the definition of Geoengineering in the literature. These ambiguities cause confusion and may explain what have seemed like inconsistencies between Chapters 2 and 4. To ensure a common understanding and to avoid confusion for readers, we therefore find it necessary to offer further explanation of the categorization and definitions of terminology falling within the realm of negative emissions. Specifically, it would be useful to include a figure, showing what measures belong to mitigation, CDR and Geoengineering as well as if there are overlaps between these areas. Additionally we suggest including a definition in the glossary of all related terms which gives clarity to how they differ from each other, including: AFOLU-CDR, terrestrial-CDR, land-CDR, technical-CDR. If some of the terms are identical in meaning, we suggest only referring to one term across the report to improve consistency and readability. Finally, figures that include CDR and SRM options, such as Fig SPM.7, should specify clearly that these are not "mitigation options". [Germany]</p>	<p>Noted. It is clear that what is mitigation develops over time. In AR3, CCS was still considered geo-engineering, which is now firmly in the mitigation category, contested by no-one. If a technology or practice directly reduces atmospheric CO2 concentrations across the life cycle, it is CDR, so AR is part of that. AR has also been known as mitigation for a long time already. The definition of mitigation is also consistent with all CDR options. When CDR is not automatically classified as mitigation, one quickly enters a grey zone of some techniques at some scale being mitigation and the same technique at another scale not being mitigation. We have clarified this further in the Glossary and in the list of terms associated with the SPM.</p>
28974					<p>We are very concerned about the lack of clarity of the concept of risks in this report and the inconsistent use across the report.</p> <p>The definition given on page 43 of the Glossary ("The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. In this report, the term risk is often used to refer to the potential, when the outcome is uncertain, for adverse consequences... ") provides three interpretations and therefore lacks clarity. In addition it is not consistent with the definition of the SREX and the AR5 that included exposure and vulnerability.</p> <p>Ch 1, in contrast, provides additional, different definitions of risk: "Risk can refer to the probability of a projected change in the climate system; can be defined within a traditional risk management context as probability times consequence; or can be defined as a function of hazard, exposure, and vulnerability."</p> <p>We strongly encourage the authors to clearly explain the risk concept of the SR1.5 upfront in the SPM, also highlighting the change from AR5 (should there be any) and make sure one coherent approach is used throughout the report. In particular, please avoid the use of the term "risk" to refer to likelihood. There also needs to be some calibration across chapters regarding the use of qualifiers like "high risk", "very high risk", moderate risk etc., especially for the envisaged synthesis products (e.g. RFCs, regional risk map), the underlying analysis of changing hazards, and the approach of Chapter 5. [Germany]</p>	<p>Accepted - exposure and vulnerability added to definition. Different usages of the term now clarified in the definition and in the report.</p>
45416					<p>Section 3.6.2.1.1 "Land use changes in mitigation scenarios" covers the same ground as Section 4.3.8.1 "Bioenergy with Carbon Capture and Storage (BECCS)" - different numbers, mostly different references. [Skea Jim, United Kingdom (of Great Britain and Northern Ireland)]</p>	<p>Noted.</p>
46364					<p>In the report, text words are mixed (space is absent) at some places. Final report requires this type of correction. [Ijaz Ahmad, Pakistan]</p>	<p>Copy edited.</p>
46366					<p>In the report, at some places, symbol of degree with C (oC) is missing and warming is written in the form of 1.5C. So there is need search in the document and to fix these editorial errors. [Ijaz Ahmad, Pakistan]</p>	<p>Copy edited.</p>
50666					<p>A greater emphasis on risks from ongoing climate change and human abstraction of fresh-water from terrestrial and aquatic ecosystems would be desirable [Jagdish KRISHNASWAMY, India]</p>	<p>Noted, the chapters have been developed based on the available and relevant literature.</p>
28976					<p>We are concerned that the FAQs in their current format (with the exception of those by Ch 1) seem to be focused on key findings from the report instead of providing background information, key concepts and methods that are required for the understanding of the report. The key messages of the report should be primarily dealt with in the Summary for Policymakers, and not be pre-empted by FAQs which may be easily perceived as policy prescriptive, because they are taken out of context, do not contain confidence language and a simplified writing style. While we appreciate the approach of the report to deliver well-written, clearly accessible FAQs on central topics of the report, we urge the authors of Ch 2-5 to revise their FAQs in the light of what is being said above. [Germany]</p>	<p>Noted, efforts have been made the FAQs as informative as possible to support the use of the report and its dissemination.</p>
28978					<p>Comments to the Glossary: We appreciate the establishment of a well-written, clearly accessible glossary on central terms used in the SR1.5. Some of the definitions in the SR1.5 glossary deviate from those provided in the AR5 and we strongly recommend the authors to clearly identify those cases and to provide appropriate explanations for the modifications. When revising the glossary please consider relevant comments on definitions and concepts we are providing in our review on the SR1.5. These include "1.5°C warming" (comment on Ch1), "carbon dioxide removal (CDR)", "negative emissions" and their categorization as mitigation (comment on the entire report), "hazard", "impact", and "risk" and their distinction (comments on the entire report and on Ch1, p 35, l 11), "Carbon budgets" (comment on SPM p 5, l 8), "equity", "justice", and "fairness" and their distinction (comment Ch1, and Ch 5). In addition, the link to "Industrial Revolution" seems not to be sufficient. We recommend to describe that the climatology in this report is based on the 51-year period 1850-1900. [Germany]</p>	<p>Thank you. 1850-1900 added to glossary definition for global warming. The other comments have been considered.</p>

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28984					We commend the author team on finalizing this second order draft of the Special Report on Global Warming of the 1.5°C. We highly appreciate the huge effort and commitment in the light of the particular challenges for this report, including the extremely tight time-line, the scarcity of information specifically addressing 1.5°C warming, the large volume of new literature late in the process, and the integration across scientific disciplines. We find this report extremely relevant and we are looking forward to another high quality IPCC report that will provide crucially important scientific information in support of climate policy at all levels, but in particular for the Talanoa Dialogue under the Paris Agreement at the upcoming UNFCCC COP24 at the end of the year. We are also grateful to the wider scientific community who has worked hard to provide additional evidence and is putting resources into reviewing and improving the author's work. We also want to express our gratitude to the Working Group Co-Chairs and the Bureau members for their scientific and personal leadership. We also thank the Technical Support Units and the Secretariat for their dedication and support. [Germany]	Noted.
28986					<p>We are very concerned about the lack of clarity of the concept of impacts in this report and the inconsistent use across the report.</p> <p>The definition given on page 29 of the Glossary ("Effects on natural and human systems. In this report, the term impacts is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts and sea level rise, are a subset of impacts called physical impacts.") lacks clarity if this would include attribution to anthropogenic climate change or not (inconsistent treatment of impacts in WG1 and WG2 in AR5). The SPM, in contrast, provides a different concept of impacts: "Impacts will depend on the level of vulnerability of human and natural systems, their capacity to adapt to changing conditions, and the stage of differential national development trajectories." that is conceptually unclear, see our comment on the SPM.</p> <p>We strongly encourage the authors to clarify the approach to impacts across the SR1.5 and to explain upfront in the SPM, also highlighting the change from AR5. [Germany]</p>	Definition of impacts added to SPM definitions box, to be subject to direct plenary approval.
50668					Cite a diversity of well-received papers on climate dynamics and ecosystem responses in different regions. [Jagdish KRISHNASWAMY, India]	Noted, the chapters have been developed based on the available and relevant literature.
52664					The length of the draft could be substantially reduced by avoiding repetitions. The number of pages of the draft is far beyond what was approved by the Panel. Chapter 1. Chapter 1 was meant to provide the framing and context for issues addressed. However, it contains statements and summaries that are repeating the findings from Chapters 4-5. Chapters 2 and 4 are overlapping on issues of feasibility, technological options, behavioral change, etc. [Iulain Florin VLADU, Germany]	Coordination across chapters has been implemented with framing in Chapter 1, reducing duplication with other chapters.
52808					Use consistently headers to organize the the executive summaries of the five chapters [Iulain Florin VLADU, Germany]	Copy edited.
28988					The clear definition and consistent application of concepts and terminology is central for robust and transparent results. We are concerned about the lack of guidance currently provided by Chapter 1 on central concepts and terminology, and the lack of consistency across the report regarding central concepts. Please ensure that the final report uses the same concepts and definitions, and that those concepts are introduced comprehensively in Chapter 1, with consistent definitions provided in the Glossary. For cases where the underlying literature uses varying concepts that can not be harmonized in the assessment, we urge the authors to clearly state this caveat. If concepts deviate from approaches of earlier reports, this should be highlighted, and reasons stated for this change. [Germany]	Noted and implemented in the preparation of Chapter 1, the Glossary and also in the inclusion of a key concepts box in the SPM
29490					<p>The IPCC 1.5 SR will be crucial for policy-makers willing to implement the Paris Agreement (PA). The countries' collective progress towards the long-term goal of the PA will be assessed by the Global Stocktake, which will essentially compare countries' estimates (from GHG inventories and other reports within the "enchanted transparency framework") with the 1.5C and 2C trajectories. It is obvious that these trajectories should be "conceptually comparable" to what countries report under the PA. A recent study observed a 3 GtCO₂/y discrepancy in land-related emissions between country GHG reports to UNFCCC and scientific studies, largely due to different approaches in estimating the "anthropogenic" forest sink (Grassi et al. 2017). In other words, comparing today land-related scientific estimates (including those currently presented in IPCC 1.5 report) with countries' ones would be like comparing "apples and oranges". This discrepancy will need to be reconciled to ensure a meaningful global stocktake in 2023. While the IPCC 1.5 report can't address this issue (all calculations use models whose approach to estimating the forest sink is different from the one used by countries), it is important at least to note the discrepancy above, because it would give further motivation to address it in the near future, e.g. in the AR6, and would enable a meaningful global stocktake. Below I suggest a possible text for your consideration. Essentially, a clear "disclaimer" should be added somewhere saying that, since land use GHG emissions reported by countries to UNFCCC have a different approach in estimating the "anthropogenic" sink compared to the global carbon modelling community (Grassi et al. 2017), the land-related estimates included in this report are not necessarily directly comparable with countries' estimates. Given the relevance of land-related sink in this report, I think this "disclaimer" is really needed. Below I suggest some possible places where this concept may be added in Ch 2, but also Ch1 can be a good place for this text.</p> <p>REF: Grassi G., House J., Dentener F., Federici S., den Elzen M., Penman J. (2017) The key role of forests in meeting climate targets requires science for credible mitigation, Nature Climate Change, doi:10.1038/nclimate3227. [Giacomo GRASSI, Italy]</p>	Accepted. This importance difference is highlighted where land-use emissions are discussed in Chapter 2.

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33004					The report captures well the moral, economic, social and scientific imperative to reach the 1.5oC goal. Chapters 1 and 5 in particular focus on the equity, justice and ethics aspects of 1.5oC transitions. but these issues are not as well addressed in chapters 2, 3, and 4. The report's strong messages on making 1.5 pathways fair, just and effective would be strengthened if better reflected across ALL chapters. The international human rights framework provides a reservoir for the supply of legal imperatives with which to frame morally appropriate responses to climate change, rooted in equality and justice. Greater emphasis on human rights throughout the report would strengthen the focus on justice, equity and ethics in the report. While the report does shed some light on the human rights implications of adaptation and mitigation actions - it does not send a clear message that human rights must be repected in all climate action (as per the preamble of the Paris Agreement) in order to avoid these negative effects and capture the opportunities for climate actions to benefit people and their rights. Another issue requiring further attention throughout the report is gender equality - the differentiated impacts of climate change and climate action on men and women and the need for gender equality, women's empowerment and women's participation to inform all climate action (as per the Paris Agreement). [Tara Shine, Ireland]	Noted and this topic has also been addressed in the SPM.
55754					There are a number of opportunities to improve the consistency across the report. (2/X). Somewhere a clear exposition should be provided of current, INDC-projected, and 1.5C-consistent and 2.C-consistent of levels of emission for years 2016/2018, 2030 and 2050 should be provide for both CO2 and all GHG (CO2e). [David Cooper, Canada]	Noted and addressed in Chapter 2 based on the available literature.
55756					There are a number of opportunities to improve the consistency across the report. (3/X). A clear labelling of models and scanrio classes used in chapter 2 and consistency across chapters. [David Cooper, Canada]	Coordination across chapters on the use of models and scenarios has been framed in Chapter 1 and documented in the subsequent chapters.
55758					The report needs to include a better treatment of the true GHG abatement potential of bioenergy (with and without CCS), taking inot account direct and indirect land use change, noting that AR5 failed to provide clear assessment in this regard. [David Cooper, Canada]	Taken into account. Taking into account the direct and indirect land-use emissions of bioenergy is an important issue to consider when assessing the GHG abatement potential of bioenergy. Due to the limited scope and length of this report, the SR1.5 cannot carry out a full assessment of this issue. Moreover, the IPCC is also preparing a Special Report on Land which provides a much better landing spot for this issue.
37268					In general, the report tends to characterize RMM in ways that fail to communicate the considerable potential such technologies have to reduce harms from climate change. Multiple passages suggest that the risks of RMM outweigh the benefits, yet the state of knowledge regarding RMM is insufficiently developed to allow for such a conclusion. Specifically, no paper directly compares aggregate direct benefits with risks, where "direct" means the physical impacts rather than indirect social impacts. Risks and benefits are specific to choice of geoengineering scenario, and many of the claims about risk are about scenarios that are manifestly sub-optimal. Recent publications highlight the flexibilities of RMM methods to address multiple climate objectives simultaneously in the context of evolving mitigation and adaptation efforts. Further, the GeoMIP results show temperature and precipitation changes are reduced over a high fraction of the planet, and there are no equivalent papers showing risks. The only basis for the claim that risks outweigh benefits would be "social risks", but they are ill-defined and no literature compares them directly with physical risks so there is no basis for the claim. Overall, the draft systematically downplays the value RMM might provide in reducing some of the most serious harms from climate change. RMM may be uniquely suited to reduce damages from temperature rise, extreme weather events, sea level rise, and other climate change impacts that will disproportionately affect vulnerable populations. For this and other reasons, we regard the relatively marginal consideration given to RMM in a report dedicated to exploring whether and how the 1.5C target might be achieved as a missed opportunity. While research on RMM is still at a preliminary stage, there is high confidence that RMM, specifically stratospheric aerosols, would be capable of limiting warming to this level, albeit with side effects. Although we do not advocate this approach, we believe that excluding serious consideration of RMM as part of broader efforts to meet the 1.5C target imposes unnecessary limits on our ability to counter climate change, and fails to take account of the full breadth of available scientific research. We recognize the constraints associated with the specific terms of reference for this report, yet we believe it would be greatly improved by a more balanced and comprehensive treatment of RMM. [David W. Keith & Douglas G. MacMartin, A temporary, moderate and responsive scenario for solar geoengineering, Nature Climate Change volume 5, pages 201–206 (2015); Kravitz, Ben, Douglas MacMartin, Alan Robock, Philip Rasch, Katharine Ricke, Jason Cole, Charles Curry, et al. 2014. "A Multi-Model Assessment of Regional Climate Disparities Caused by Solar Geoengineering." Environmental Research Letters 9. https://doi.org/10.1088/1748-9326/9/7/074013] [Joshua Horton, United States of America]	Taken into account. We don't state that the risks of SRM outweigh the benefits, indeed, as there is insufficient literature. This comment is balanced by comments that find the treatment of RMM too extensive. We are citing the papers mentioned, if they are peer-reviewed (not all commentaries, even in journals like NCC, are)
38410					I've only read through the SPM, Chapter 1 and Chapter 2 and I should like to state that, overall, the text presents a comprehensive analysis of the state of the knowledge on the topic in question, which is written based on the highest standards of quality. The authors have done a commendable job in bringing together a robust overview of the best available scientific information and analysis of policy options. They indeed deserve praise for being successful in responding to the request of UNFCCC Parties for such information for action. Irrespective of future decisions by policy makers the report will definitely represent an invaluable resource for senior governmental and non-governmental experts for years ahead. On the dark side, I need to note that the text is difficult to read, even for readers who have solid expertise in this field and are fluent in English. At a later stage, the Assessment Team might wish to engage a good editor (or/and a scientific writer) to improve the readability of the underlying report and ensure that their readership are able to read and comprehend what the authors try to communicate. The SPM reads well to me, though. [Volodymyr Demkine, Kenya]	Thank you for the supportive comments. Efforts have been made to make the text as accessible as possible, scientific editors have contributed to the preparation of the FAQs, SPM and Executive Summaries.
55760					The report needs to better address the dangers of thresholds leading to loss of ecosystem resilience and the advantage of staying under 1.5C to minimise this risk [David Cooper, Canada]	Noted and addressed in Chapter 3 based on the available literature.

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55752					There are a number of opportunities to improve the consistency across the report. (1/X). The way that AFOLU measures are addressed. AFOLU measures include "A/R" which has been integrated (alongside BECCs) previously into models and scenarios; and broader a broader range of ecosystem-based approaches, including reducing deforestation and forest degradation, ecosystem restoration, reducing loss and degradation of wetlands, peatlands, coastal ecosystems, and better management of agricultural crop and pasture lands, including soil management. Many of these have a potential for positive co-benefits for biodiversity. (1) Need to be more consistent in use of terminology. Unless there is a good reason to restrict the terminology, broader terms such as AFOLU or ecosystem-based approaches may be used (the latter could include oceans). Use of A/R should be limited to those cases where the range of measures is indeed so limited (as in some models). (2) AFOLU or ecosystem approaches include both "traditional" mitigation approaches and CDR approaches. There is generally a continuum rather than a sharp divide here. This is indeed well explained in chapter 2 (see Figure 2.17) but there is an unnecessary, often confusing, and sometimes incorrect misleading division between mitigation and CDR AFOLU in Chapters 4 and 5. [David Cooper, Canada]	Taken into account - reference to A/R is now restricted to the CDR assessment (which focused indeed on A/R, as SRCL will go into more detail with respect to others), while the land use section (4.3.2) now distinguishes between agriculture & food, forestry & ecosystems, and coastal systems.
62064					This special report presents the clearest picture yet of the risks posed by uncontrolled climate change under global warming of 1.5°C. Through case studies and user comprehensive diagrams and statistics, reader is able to understand that the consequences of climate changes that have already occurred are profound. It emphasizes that continued emissions of greenhouse gases at 1.5 °C, will cause further, long-lasting changes to our climate system, increasing the risks for people and ecosystems. the report is well illustrated and informative, and most of all, important scientific document delivering a significant contribution to the body of climate change concerning both mitigation and adaptation but also governance as it provides a wide guidelines to decision makers to face climate change impacts with respect to vulnerable regions in the world. By the end I want to congratulate all authors, reviewers and editors for this great report. [Rachid MOUSSADEK, Morocco]	Thank you.
63094					The Second Order Draft (SOD) of the Special Report on Global Warming of 1.5°C (SR15) is a well written policy document on climate change. This SOD document emphasizes on quantitative dimensions related to the main base of data analyses, adaptation finance, technology, economic growth, and sustainable development. Because of this focus, the document fails to recognize properly the qualitative aspects of knowledge existed in localities specific to a culture and history. This preference describes the priority of a specific group of people who are urban elite and has the major agenda with climate change investment. Because of this agenda, it fails to include representation of the marginalized groups of people who are majority people and target of climate change policy. It is also important to mention here that the document recognizes some major concerns like environmental degradations but it did not identify the root causes. It emphasizes on the governance approach but it fails to describe the process of inclusion of the marginalized groups of people. Therefore, the current form of SOD can be termed as the continuation of the previous adaptation approach. [Mohammad Anwar Hossen, Bangladesh]	Thank you for the thoughtful comments. Different knowledge systems are assessed in the report to the extent that there literature available, studies based on local case studies have been assessed, for example in Chapter 5. Such topics may also be addressed in other reports of the sixth assessment cycle (AR6) of the IPCC, based on the available relevant literature.
53272	1	1	1	1	The text in many figures is too small to be readable. Many figures need to be enlarged. For instance, figures in Chapter 4, page 87 are completely unreadable. [Mary Booth, United States of America]	Copy edited.
53274	1	1	1	1	While the report is improved from the FOD, there is still far, far too much jargon, and the report is much too long. Simplifying language will do everyone a favor – the authors, and the readers. [Mary Booth, United States of America]	Noted and efforts have been made to make the language as clear as possible.

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53290	1	1	1	1	<p>Booth, M. S. (2018). "Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy." Environmental Research Letters 13(3): 035001.</p> <p>Climate mitigation requires emissions to peak then decline within two decades, but many mitigation models include 100 EJ or more of bioenergy, ignoring emissions from biomass oxidation. Treatment of bioenergy as 'low carbon' or carbon neutral often assumes fuels are agricultural or forestry residues that will decompose and emit CO2 if not burned for energy. However, for 'low carbon' assumptions about residues to be reasonable, two conditions must be met: biomass must genuinely be material left over from some other process; and cumulative net emissions, the additional CO2 emitted by burning biomass compared to its alternative fate, must be low or negligible in a timeframe meaningful for climate mitigation. This study assesses biomass use and net emissions from the US bioenergy and wood pellet manufacturing sectors. It defines the ratio of cumulative net emissions to combustion, manufacturing and transport emissions as the net emissions impact (NEI), and evaluates the NEI at year 10 and beyond for a variety of scenarios. The analysis indicates the US industrial bioenergy sector mostly burns black liquor and has an NEI of 20% at year 10, while the NEI for plants burning forest residues ranges from 41%–95%. Wood pellets have a NEI of 55%–79% at year 10, with net CO2 emissions of 14–20 tonnes for every tonne of pellets; by year 40, the NEI is 26%–54%. Net emissions may be ten times higher at year 40 if whole trees are harvested for feedstock. Projected global pellet use would generate around 1% of world bioenergy with cumulative net emissions of 2 Gt of CO2 by 2050. Using the NEI to weight biogenic CO2 for inclusion in carbon trading programs and to qualify bioenergy for renewable energy subsidies would reduce emissions more effectively than the current assumption of carbon neutrality.</p> <p>Booth, M. S., et al. (2006). "Soil-mixing effects on inorganic nitrogen production and consumption in forest and shrubland soils." Plant and Soil 289(1): 5-15.</p> <p>Soils that are physically disturbed are often reported to show net nitrification and NO3 loss. To investigate the response of soil N cycling rates to soil mixing, we assayed gross rates of mineralization, nitrification, NH4 + consumption, and NO3 consumption in a suite of soils from eleven woody plant communities in Oregon, New Mexico, and Utah. Results suggest that the common response of net NO3 flux from disturbed soils is not a straightforward response of increased gross nitrification, but instead may be due to the balance of several factors. While mineralization and NH4 + assimilation were higher in mixed than intact cores, NO3 consumption declined. Mean net nitrification was 0.12 mg N kg⁻¹ d⁻¹ in disturbed cores, which was significantly higher than in intact cores (0.19 mg N kg⁻¹ d⁻¹). However, higher net nitrification rates in disturbed soils were due to the suppression of NO3 consumption, rather than an increase in nitrification. Our results suggest that at least in the short term, disturbance may significantly increase NO3 flux at the ecosystem level, and that N cycling rates measured in core studies employing mixed soils may not be representative of rates in undisturbed soils.</p> <p>Booth, M. S., et al. (2005). "Controls on nitrogen cycling in terrestrial ecosystems: A synthetic analysis of literature data." Ecological Monographs 75(2): 139-157.</p> <p>Creutzig, F., et al. (2015). "Bioenergy and climate change mitigation: an assessment." GCB Bioenergy 7(5): 916-944.</p> <p>Domke, G. M., et al. (2012). "Carbon emissions associated with the procurement and utilization of forest harvest residues for energy, northern Minnesota, USA." Biomass and Bioenergy 36: 141-150.</p> <p>Interest in the use of forest-derived biomass for energy has prompted comparisons to fossil fuels and led to controversy over the atmospheric consequences of its utilization. Much of the debate has centered on the carbon storage implications of utilizing whole trees for energy and the time frame necessary to offset the carbon emissions associated with fixed-life bioenergy facilities. Forest harvest residues may provide a cost-effective, carbon friendly alternative; however, robust empirical estimates of the carbon consequences of utilizing this feedstock are needed to inform policy and</p>	<p>Taken into account - Many of the references have been included in the assessment, as far as appropriate and not overlapping vastly with SRCCCL.</p>
53232	1	1	1	1	<p>The following comments on the IPCC "1.5" SOD report are submitted by Mary S. Booth of the Partnership for Policy Integrity. Our comments primarily lay out arguments for a more serious treatment of bioenergy and BECCS, drawing on specific examples from Chapters 2 and 4 of the report. The comments focus on what a serious treatment would look like, and the ways that the report falls short. Citation recommendations follow general comments. Some of these comments are repeats from comments we submitted on the FOD. We also provide a few editorial comments at the end. We searched the whole report. We could not find any real acknowledgement that a variety of peer-reviewed studies have shown that bioenergy can increase net carbon loading to the atmosphere. We found no discussion of the fact that harvesting forests for biomass, as is now occurring, is a net source of carbon. The closest thing we found to a discussion of carbon emissions from bioenergy was the following section in Chapter 4, page 58, lines 36 – 45: that people "misperceive climate impacts of energy sources. For example, some people think natural gas is a renewable energy source or think bioenergy is a fossil fuel as it involves burning materials, which can inhibit choices for low GHG emission options."</p> <p>This is condescending, and it is ignorant. Bioenergy and BECCS are fundamental to the climate scenarios discussed in this report, yet the report ignores nearly all the literature that points out the real-world problems with these technologies, passing these concerns off as the concerns of a few people too dumb to tell the difference between fossil fuels and biomass. We suggest that if the IPCC can't get this right and credibly discuss the abundant peer-reviewed science on carbon impacts of bioenergy – almost none of which appears in this report - its credibility as an independent broker of scientific information is in serious jeopardy. The report's continuing failure to cover these issues suggests prejudice on the part of the current authors. We suggest the IPCC find authors that will do justice to these very real issues. [Mary Booth, United States of America]</p>	<p>Taken into account - The bioenergy section contains this paragraph now, which constitutes a third of the section and caveats in the BECCS section remain as well: "The carbon intensity of bioenergy, key for both bioenergy as an emission-neutral energy option and BECCS as a CDR measure, is still a matter of debate (Buchholz et al., 2016; Liu et al., 2018) and depends on management (Pyrölä et al., 2014; Torssonen et al., 2016; Baul et al., 2017; Kilpeläinen et al., 2017); direct and indirect land-use change emissions (Plevin et al., 2010; Schulze et al., 2012; Harris et al., 2015; Repo et al., 2015; DeCicco et al., 2016; Qin et al., 2016); the feedstock considered; and time frame (Zanchi et al., 2012; Daioglou et al., 2017; Booth, 2018; Sterman et al., 2018), as well as the availability of coordinated policies and management to minimize negative side effects and trade-offs, particularly those around food security (Stevanovi? et al., 2017) and livelihood and equity considerations (Creutzig et al., 2013; Calvin et al., 2014) ."</p>
13548	3		3		glossary - albedo - suggest to include a numerical percentage range [Sergio Aquino, Canada]	Rejected. This extra information is not key to the definition
13550	6		6		glossary - Business as usual [Sergio Aquino, Canada]	Taken into account. The glossary refers Business as usual (BAU) to the Baseline scenario definition.
13552	7		7		glossary - carbon dioxide - A naturally occurring gas, CO(2) is also a ... [Sergio Aquino, Canada]	Editorial

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31140	7		7		<Glossary> As has been the case in AR5, the Glossary is very important in order to have a common ground for substantive scientific discussions among the WGs. For instance, to illustrate one example of such connotative term, the word 'carbon budget' will be taken up for the first time in the IPCC Glossary. As such, it is requested that the description should not only focus on the differences between the four terms but should also elaborate on the basic concept in an easy-to-understand manner. Please note that 'carbon budget' has been used exclusively for a different meaning. As can be seen in the American Meteorological Society's Glossary, this term is defined as the change in the amount of carbon in a reservoir via fluxes of carbon into and out of the reservoir. http://glossary.ametsoc.org/wiki/Carbon_budget [Japan]	Taken into account. The definition has been edited to reflect these different meanings.
8624	7	19	7	19	changes in ... precipitation extreme indices is an odd phrasing. Do you mean "changes in ... indices of extreme precipitation"? "changes in ... indices of precipitation extremes"? Rephrase for clarity [Pauline Midgley, Germany]	Noted.
13554	9		9		glossary - CDM - developing countries (Non-Annex B) [Sergio Aquino, Canada]	Editorial
41498	9	39	9	39	suggest to standardize the way 2 degrees celcius is displayed: 1.5 oC and 2.0oC [Sergio Aquino, Canada]	Copy edited
13556	10		10		glossary - climate compatible (no hyphen) [Sergio Aquino, Canada]	Editorial
13558	13		13		glossary - COe quivalent (no hyphen) [Sergio Aquino, Canada]	Editorial
53352	14		14		Glossary: "Decarbonization: The process by which countries or other entities aim to achieve low-carbon existence, or by which individuals aim to reduce their consumption of carbon." should be "The process by which countries, individuals or other entities aim to achieve zero fossil carbon existence." Fossil carbon is not consumed (biological carbon is), and full decarbonization means zero (fossil) carbon, not low carbon. [Kjell Kühne, Mexico]	Taken into account. The definition now reads: "The process by which countries, individuals or other entities aim to achieve zero fossil carbon existence. Typically refers to a reduction of the carbon emissions associated with electricity, industry and transport."
33332	15	2	15	2	convention missing - italics - high confidence, etc, need to be standardized [Sergio Aquino, Canada]	Copy edited
31832	18	22	18	22	large eruptions and "large climatically significant eruptions" are not synonymous [Keith Shine, United Kingdom (of Great Britain and Northern Ireland)]	Noted: we think the text has been disambiguated on this point.
33300	18	55	18	55	glossary - define adaptive capacities [Sergio Aquino, Canada]	Accepted.
37066	19	35	19	43	There are huge uncertainties on global emissions trajectories based on current national pledges (NDC pathway) since many developing countries use intensity target. Total GHG emissions will significantly vary depending on their actual GDP level. Since 4.1 presents a gap between NDC pathway and 1.5 degree pathway, there should be clear reference to these uncertainties. [Jun Arima, Japan]	Accepted. This uncertainty is fully acknowledged and discussed in Cross-Chapter Box 9 in Chapter 4, and highlighted in the Executive Summary of Chapter 2.
33368	20	21	20	21	glossary - include CDA [Sergio Aquino, Canada]	Rejected. Author has not given the term for the acronym nor can the term be found in the text.
33326	26	14	26	14	convention missing - spacing - SDG7 or SDG 7 [Sergio Aquino, Canada]	Copy edited
45076	26	22	26	30	In case of countries with economy upon oil and gas revenues, international financial supports, technology transfer and capacity building are needed to pass from energy supply by fossil fuel to renewable energy. [Iman Babaeian, Iran]	Noted.
4572	27	25	27	26	This comment is about the glossary. I feel SR 1.5 really needs to go through some of the definitions given in the glossary. In Glossary-27, heat wave is defined as "A period of abnormally and uncomfortably hot weather". How do you define what is "uncomfortable"? This is a copy-paste definition from Wikipedia. The definition should be on a quantitative/statistical sense, for example - the departure from mean and the number of days it has occurred - or on the percentile values. See the glossary definition for "extreme weather event". [Roxy Mathew KOLL, India]	Taken into account. The definition now reads "A period of abnormally hot weather. Heat waves and warm spells have various and in some cases overlapping definitions."
11028	34	1	34	2	Table 2.7 shows substantial deployment of CCS with fossil energy next to BECCS where in the overall narrative and key messages the urgency of development and deployment of CCS is under represented (amongst others compared to BECCS as CDR). CCS role and urgency requires specific key messages paragraphs in SPM and the different chapters. [Wilfried Maas, Netherlands]	Partially agree with Wilfried, but CCS really only surfaces in the BECCS context (and a bit with industry) in the SPM. Suggest the following: Noted - the widespread adoption of CCS in many 1.5°C pathways has been elevated to chapter 2's executive summary. However, as the important role of CCS had already been highlighted for the 2°C target in AR5, the SPM does not repeat that this remains relevant for 1.5°C and rather focuses on the differences, esp. with respect to BECCS, DACCS and the role of CCS in industry decarbonization.
13560	38		38		glossary - Paris Agreement - add date and number of signatories [Sergio Aquino, Canada]	Accepted
13562	39		39		glossary - poverty - mention one arbitrary definition - family lives with less than \$x a day [Sergio Aquino, Canada]	Rejected. A qualitative definition has been left for the report and specific quantifications are referred to in the text, if appropriate.
48276	43		44		Under 1.4.4 Governance, it is suggested to add one pragraph or some revising in existing paragraphs concerning the constitutional gaps that is require to improve in some developed and developing countries. [Iran]	Noted: this section highlights the importance of governance considerations, but in a chapter on Framing and Context, we are limited in providing details of governance concerns.
33214	48	52	48	53	add a reference: Mary Robinson Foundation – Climate Justice (2015b). Zero Carbon Zero Poverty the Climate Justice Way: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Available online at https://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	We believe the content of this reference is captured in, e.g., Robinson and Shine (2018), and where possible have cited peer-reviewed publications.
33240	48	52	48	53	add a reference: Mary Robinson Foundation – Climate Justice (2015b). Zero Carbon Zero Poverty the Climate Justice Way: Achieving an equitable phase-out of carbon emissions by 2050 while protecting human rights. Available online at https://www.mrfcj.org/pdf/2015-02-05-Zero-Carbon-Zero-Poverty-the-Climate-Justice-Way.pdf [Tara Shine, Ireland]	We believe the content of this reference is captured in, e.g., Robinson and Shine (2018), and where possible have cited peer-reviewed publications.

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5648	52		53		Taking the occasions of Chapter 4 page 52-53 f Box 4.3. here, but intending the comment to be about the entire report. Again, it is good and important that indigenous peoples are named here. However, it seems that they are just relevant in terms of the knowledge they have. It is positive that in line 35- 37 it is mentioned that there is a challenge on how to address and include indigenous populations in the adaptation process. However it would be even more important that they be included in the decision making processes going forward and not just used as a source of knowledge to harvest by others. This is something that would be important to show throughout. the entire report. The pressure on ethnic and cultural identity through climate change and how indigenous populations are especially vulnerable and therefore need to not just be considered as passive providers of information but as active partners in working towards plans for access in the North, as well as adaptation, energy policies and energy infrastructure. In the European North the Sami of Northern Norway, Sweden and Finland are marginalized in multiple ways, both within the country and as populations primarily living in the Arctic where climate change will be two to three times more intense. This is also true for the indigenous populations of Alaska and Canada, as well as Russia. In line 46-48 this is talked about in regards of the Maya and that is good, but what about the peoples of the Arctic North? Also, having this is a box may make it more marginal as it comes to text.Does a box have the same status as that which is in the regular text? How can these issues be given enough weight in the text, either here or elsewhere in the report. Essentially the same question can be asked for religious communities and their relationship and work regarding climate change. Where is religion as a factor in societal adaptaion and denial discussed, other than very marginally here and there. The chapters that deal with societal action and community adaptation should include this in a clear and strong enough fashion rather than just mention it in half a sentence. Religion is a factor in shaping peoples attitudes in various ways, sometimes hindering and sometime supporting work to live sustainably on the planet. This report is incomplete if it does not recognize and take seriously this factor in a more than casual manner. [Marion Grau, Norway]	Noted. The boxes are means by which topics can be highlighted or expanded on in terms of definitions, in support of the chapter material. They are also part of the assessment. Religious communities were not identified as part of the scoping of the report.
13564	52		52		glossary - references - viii in Artic Council (2013) seems wrong [Sergio Aquino, Canada]	Editorial
33462	52	47	52	47	glossary - define green-style projects [Sergio Aquino, Canada]	Rejected. This term is used only once and the definition can be understood from reading the citation that accompanies it.
5650	54	49	54	53	Appreciate the inclusion of the impact of financial instruments in pushing the reduction of emissions. This is well stated. [Marion Grau, Norway]	Noted.
62406	61	11	61	11	Please, instead of writing "(HTM) (broadly defined as ~10–5 kyr before present (BP))", write "(HTM; broadly defined as ~10–5 kyr before present (BP))" [JACQUES-ANDRE NDIONE, Senegal]	Noted.
62128	83	12	85	4	This interesting box lacks the information of the status of policies tested in the studies: decided? Included in National contributions? Contemplated poicies? Maybe include an introductory sentence on this. [Antoine Bonduelle, France]	Noted and introduced in Chapters 1 and 2
39188	115	12	115	15	If it were clear that holding temperature rise to 1.5C would save hundreds of thousands to millions of lives, and we think it would, then climate action would not be about optional, 'value-based choices', but about saving lives, and in this, policies to transform activities at the root cause of anthropogenic climate change would be as necessary as other life-saving policies. If profound suffering and lives are at stake due to insufficient climate action, make this clear, because it is harder for policy makers to ignore, let alone unethical to ignore. [Lindsey Cook, Germany]	Noted.