

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
78401	0	0	0	0	This was overall a satisfying well-written chapter in my view.	Thanks	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
363	0				The second order draft is improved. It provides better organization and coverage of the subject matter than the first order draft.	Thanks	Michael Kennish	Rutgers University	United States of America
365	0				Numerous acronyms are used throughout Chapter 4. They should be compiled in the front of the report after the Table of Contents. Without a page listing the acronyms and their meanings, readers will be flipping from page to page in the report to determine what they mean. In many cases, the acronyms are only defined one time in the text of the report.	Editorial. To be corrected in FGD.	Michael Kennish	Rutgers University	United States of America
1903	0				Chapter 4 draws on an important and broad strand of literature to cover all relevant aspects and is generally very well written. There are important linkages to chapter 3, some of which are specifically explored including in the cross-chapter box relating to the emissions gap. Other linkages are less well explored and in some cases cross-referencing could be improved. This is particularly the case with respect to section 4.2.5, which complements the top down assessments in chapter 3 really well. It would be interesting to have a cross chapter box exploring this further as it could help bring about strengthened messaging. The chapter can be improved in terms of how the SDG and development pathway issues are dealt with. There is limited attention to synergies and tradeoffs with respect to the SDGs and there is a somewhat artificial separation of the discussion relating to the SDGs and development pathways.	Taken into account. Thanks for the considered comment, and as you note, there is already a cross-chapter box with chapters 3 and 4 (box 3 in the Second Order Draft). On other linkages, rather than starting a second box, and considering also other comments on section 4.2.5 (300 in total), we have revised that section to integrate better with the systems / sectoral chapters 6-12. Chapter 17 draws together information on the SDG, with a detailed table.	Anne Othoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
14953	0				Please ensure that the entire chapter assessment meets the scientific standards of IPCC reports. Some sections (e.g. 4.2.5), including the last part of the ES are written in an unscientific and sometimes even policy-prescriptive way. This has to be addressed as part of the SOD revisions.	Noted. The comment does not provide specific elements. Sections will be reviewed again for scientific robustness and to avoid any policy prescriptive language.	Government of Saint Kitts and Nevis	Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements	Saint Kitts and Nevis
19657	0				Equity in relation to countries' mitigation efforts is critical to addressing climate change and achieving the Paris Agreement temperature goal. This is addressed throughout the report, specifically in the Chapters 4 and 14). In this context, comments were submitted on the First Order Draft, on the crucial importance of including in the report an assessment of the literature on frameworks to assess the fairness of countries' mitigation efforts. These comments have unfortunately not been addressed in the Second Order Draft. In several places the draft refers to the scientific literature that provides these frameworks (4.2.2.6, 4.5, 14.3.2.3), but it still lacks any assessment of the results in the literature. It is essential that the report includes this assessment, which is available in the literature (Climate Action Tracker and Rajamani et al, submission under review).	Noted. This is a comment on the chapter as a whole. The matter of 'fair shares' of mitigation is contested, including in courts, and including by the reviewer's organisation. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant, but not policy-prescriptive. The CLAs of chapter 4, together with others, sought advice from the co-chairs on this matter. Based on this advice, the chapter continues the approach of outlining frameworks, but not presenting results for individual countries. See response to comments 19903; and we also point to the treatment of fair shares in the chapter on national policy, 13.4.2 on 'shaping climate governance through litigation', and internationally, including 14.3.2 on elements of the Paris Agreement relevant to mitigation and 14.5.3 on civil society and social movements, and their involvement in litigation	Dennis van Berkel	Urgenda Foundation	Netherlands
19659	0				[continued] This assessment can be placed in either Chapter 4 of Chapter 14, which is why the following comments are addressed to both these Chapters. The following will first address why this assessment needs to be included in the AR6 report. After this, comments will follow on the elements that should be reflected in the results of this assessment. The importance of equity in countries' mitigation efforts for achieving the Paris Agreement long-term target is emphasised throughout the report (for instance at 4.5, line 3, 4-91, line 19, as well as 14-23 line 36).	Noted (continuation from earlier comment 19657)	Dennis van Berkel	Urgenda Foundation	Netherlands
19661	0				[continued] In addition, the Paris Agreement Rulebook obliges parties to provide information on the fairness consideration of the level of ambition in their NDC (14-22, line 19). Chapter 14.3.2.3 concludes that due to political challenges there is little scope within the climate change regime to assess the adequacy of countries' NDCs based on agreed upon equity principles (14-25, line 12). For this reason, such assessment needs to be developed by actors outside of the regime (14-25, line 14), whereby the onus lies on the scientific community to generate methods to assess fairness (14-25, line 23). Deliberation and decision making at the country level on the fairness of a country's mitigation effort can only take place meaningfully in the presence of scientific standards on equitable mitigation levels, which is why it is critical that an assessment of these standards is included in the report	Noted (continuation from earlier comment 19657) - this part relates more to ch 14 than ch 4	Dennis van Berkel	Urgenda Foundation	Netherlands
19663	0				[continued] It is particularly important in this context that the report notes that domestic and regional courts are scrutinising the adequacy of countries' contributions to achieving the Paris temperature target and that it is only in relation to a country's "fair share" that this adequacy can be assessed by courts. (14-25, line 23) Courts however cannot make this scientific assessment themselves. As the report notes in chapter 13.5.5 (13-35 line 10), courts have relied on the reporting of the IPCC for the assessment of the fairness levels of countries mitigation efforts. The report thus clearly emphasises the crucial importance of having a framework on the basis of which countries' emission levels can be assessed against equity standards, but fails to operationalise this. For this reason, such a framework on a country per country level should be included in the report.	Noted (continuation from earlier comment 19657)	Dennis van Berkel	Urgenda Foundation	Netherlands
19665	0				[continued] The report currently stops at merely mentioning studies that have proposed different interpretations of equitable contributions (at 4.2.2.6, 4.5, 14.3.2.3). In contrast, the next draft should report on the studies that provide assessments of the different categories of effort sharing methods, as was done in AR5. These assessments, that were updated since AR5 exist in the literature (Climate Action Tracker and Rajamani et al, submission under review)	Noted (continuation from earlier comment 19657)	Dennis van Berkel	Urgenda Foundation	Netherlands
19667	0				[continued] The results of the assessment should include the following: •The emission reduction ranges should be provided for 2030 and 2050. In connection with this, the individual carbon budget ranges for these countries should be provided, in order to provide countries with policy options to vary the timing of their emission reductions while staying within the emission limits that are necessary to stay below the Paris long-term target.	Noted (continuation from earlier comment 19657)	Dennis van Berkel	Urgenda Foundation	Netherlands
19669	0				[continued] •The report should identify fair and equitable emission reduction ranges per country that are in line with holding global warming "well below 2C" and "1.5 C". Due to the ambiguities with regards to the interpretation of the long-term temperature goal of the Paris Agreement, the report should also provide results for a higher likelihood than 66% chance of holding warming below 2C.	Noted (continuation from earlier comment 19657)	Dennis van Berkel	Urgenda Foundation	Netherlands
19671	0				[continued] •The results should make a clear distinction between effort sharing methods that are based on international environmental law principles (particularly CBDR-RC and the precautionary principle) and methods that reflect countries' practices. In connection with this, the individual ranges should be provided such that if all countries reduce at the bottom of their range, that the Paris temperature target would still be in reach. Ranges that would not be in line with this would run counter to the international law principles.	Noted (continuation from earlier comment 19657)	Dennis van Berkel	Urgenda Foundation	Netherlands
19673	0				[continued] •Specifically, there is a suggestion to include a table in the Annex to Chapter 4 that provides such ranges for all countries linked to either section 4.2.2.6, 4.5, or 14.3.2.3.	Noted (continuation from earlier comment 19657)	Dennis van Berkel	Urgenda Foundation	Netherlands
20673	0				Please consider further analyzing the blue carbon potential, as it is only holding few lines in Chapter 4 when it can really be of great interest to structure short to mid-term development pathways	Accepted. Additional discussion on blue carbon provided in 4.4.2.	Government of France	Ministère de la Transition écologique et solidaire	France
20675	0				We support the authors' suggestion to update their analyses of the NDCs at the end of 2020/early 2021. It is also suggested to add an analysis of the progress made in between the two rounds (2015 and 2020), which could also be studied vis à vis the emission gap to 2030.	Accepted.	Government of France	Ministère de la Transition écologique et solidaire	France
24915	0				The executive summary and most of the chapter look clear and useful - great job!	Thanks	Giacomo Grassi	Joint Research Centre, European Commission	Italy

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31051	0				The role of military contributions to greenhouse gas emissions are mostly missing from Chapter 4. Since global military emissions are so large, a detailed treatment ought to be included here. It's absence erodes trust in the ability of the report to do its work.	Noted. This is a comment for Ch2.	Daniel Helman	College of Micronesia-FSM	Micronesia, Federated States of
31091	0				Chapter 4 is weak in presenting a coherent solution or family of solutions to the climate crisis in the nearterm. There ought to be a special section that presents a viable two year transition plan to zero anthropogenic carbon release, with several alternatives. It is unreasonable for the authors to assume that governments will be able to put this together themselves without a roadmap.	[Accepted. FGD to provide more focus on near term, literature permitting.]	Daniel Helman	College of Micronesia-FSM	Micronesia, Federated States of
47437	0				Overall, several sections of the chapter come with issues regarding scientific quality, adequate language or policy-prescriptiveness (e.g. p5.1.14-1.35, section 4.2.5, FAQs). Please revise accordingly and make sure that the sections meet the scientific standards of IPCC assessment reports. Please also ensure that there is full cross-chapter consistency when 1.5°C pathways are assessed on a global or regional/national level.	Noted. Will revise for scientific robustness and policy prescriptive language.	Government of Saint Lucia	Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Development	Saint Lucia
61673	0				The chapter refers to "renewable energy" throughout in regards to climate mitigation, even though it would be much more accurate and scientifically correct to use "low carbon". Renewable energy includes unsustainable and problematic – even high climate impact – energy sources while it also excludes one of our most potential low-carbon energy source nuclear energy. See more on the problems of the term "Renewable energy" and why "low carbon" should be used instead from Harjanne and Korhonen, 2018, https://doi.org/10.1016/j.enpol.2018.12.029	Partly accepted. In instances where the text refers to several 'lower carbon' technologies (e.g. nuclear and renewable energy technologies) we revise to use that term. However, the literature which we assesses extensively uses the terms "renewable energy" - the topic of an IPCC special report - and "nuclear"; where the specific energy source is meant, we retain the specific terms. Please refer to responses in specific instances.	Rauli Partanen	Think Atom	Finland
64151	0				Literature on national pathways reviewed in Subsection 4.2.5 for Japan cover only at most half of the articles reviewed in the report (8 according to Table 4.1). Some paragraphs only refer to a single article while there are other articles providing equally relevant insights.	Noted. Section 4.2.5 does not intend to present a full coverage of the literature for all countries (beyond the scope of the report), but rather to illustrate broad families of accelerated mitigation pathways.	Diego Silva Herran	National Institute for Environmental Studies	Japan
66881	0				Nuclear Safety: Taken in context of full lifecycle impacts, nuclear technology shows an excellent safety record. The highly publicized nuclear accidents over the years have been taken with extreme seriousness and long-term responsibility by the nuclear power sector, as they absolutely should be. But the impact of those accidents does not dilute the extremely good overall safety record of the nuclear industry, and its low impact on the health and safety of workers and the public. The nuclear industry and its record have been heavily scrutinized by jurisdictions and institutions including the World Health Organization. For example, the Fukushima accident was investigated by world safety and health organizations, and it was found that no deaths were directly attributable to the radioactive release from the accident. Since Fukushima, the nuclear power sector has carried out nuclear safety stress tests at plants around the world, and has incorporated safety measures to provide the fullest assurance of safe operation. Reference, for example: Nuclear Power 10 Years After Fukushima: The Long Road Back, by Henri Paillere and Jeffrey Donovan, IAEA, March 2021	Noted. But we do not discuss risks associated with nuclear energy in Ch4. Detailed assessment of energy supply, including nuclear, is in chapter 6	Jerry Hopwood	President, UNENE (University Network of Excellence in Nuclear Engineering)	Canada
66883	0				Nuclear Affordability: Nuclear power plants have continued to be built around the world over the last decades, with a wide range of costs and cost escalation. The Reference below is a review of costs, cost drivers and opportunities to improve affordability. It notes that, while there are high profile examples of cost over-runs at some recent projects, other projects are being completed with excellent cost and schedule delivery. The reasons for the variance in conventional projects are not associated with the technology, rather with project structure and management, and level of design completion. The report also notes that the lessons in cost reduction from renewable project experience can equally be applied for future nuclear projects. It notes that advances in nuclear technology, including the development of smaller modular reactors, can benefit equally from these lessons, using the virtues of replication. Affordability is also a function of the scale in absolute dollars of build projects; and again, nuclear power technology has adapted to this to allow smaller-scale power units to be delivered with less enterprise risk to the power organization. Finally, it should be noted that life-extension of existing nuclear units offers extremely cost competitive future energy supply, below the real costs of most new build of any technology; and nuclear units, as base-load and dispatchable supply, require far less additional, costly grid infrastructure than unpredictable intermittent energy sources. Reference for example: Energy Technology Institute Cost Drivers Project, full technical report, by Eric Ingersoll, Kirsty Gogan, John Herter, Andrew Foss, September 2020	Noted. But we do not discuss the costs associated with nuclear energy in Ch4.	Jerry Hopwood	President, UNENE (University Network of Excellence in Nuclear Engineering)	Canada
66885	0				Nuclear readiness for deployment; The timeline for development and delivery of nuclear projects can be long; however, a significant number of projects are well-advanced in the planning pipeline; for example, a project I am familiar with, constructing units 3 and 4 at the Cernavoda power plant in Romania, has been in preparation for 20 years and awaits financial approvals rather than technology development. Obstacles to new build are frequently of a political, opinion-based nature and often unstated. Where political will to safely deliver new build exists then projects can proceed. New technologies to deliver advanced designs are based on an extensive body of existing scientific and engineering knowledge, and pilot projects are already under way. While the timescale between now and 2030 is short for projects starting with no pre-planning, the IPCC report clearly notes that continuing to decarbonize energy supply from 2030 to mid-century is essential. And nuclear projects can realistically be expected to contribute in a major way.	Noted. But we do not discuss nuclear readiness in Ch4.	Jerry Hopwood	President, UNENE (University Network of Excellence in Nuclear Engineering)	Canada
66891	0				Nuclear and misinformation; I have been a practitioner in nuclear technology for over 45 years, and during that time, nuclear power technology has been subjected to a continuous and uniquely intense level of scrutiny and criticism. As a novel technology dealing with hazardous materials, and with its origins including discovery of severe adverse consequences of radiation exposure, such scrutiny has been warranted. However, in parallel, large-scale misinformation has been levelled at the nuclear technology and community, and this has been damaging to world welfare. One example represents this in microcosm – the reaction to the Fukushima accident. As noted above, this was a serious accident on a world-scale, with billions of dollars in damage and immense disruption. However, despite the deficiencies in design and planning for the (beyond national planning base) tsunami, the nuclear accident itself caused no loss of life. And yet, the message that was communicated to the local population and to the world, and is still communicated today, is a misleading one of some vague but immense danger. Two glaring examples illustrate this.	Noted (continuation from comment 66885)	Jerry Hopwood	President, UNENE (University Network of Excellence in Nuclear Engineering)	Canada
66893	0				Last week, on the 10th anniversary of the Great Eastern Earthquake and tsunami that lost more than 18,000 lives killed or missing, the UK digital news outlet Channel 4 News used a digital headline: "Fukushima 10 years on: Japan remembers the tsunami and nuclear disaster that killed 20,000 people" to anchor an article about the earthquake, tsunami and nuclear meltdown. Only after protracted protest was this headline removed. The result of this and many other mis-messaging examples is that many people actually believe the falsehood that the death-toll of thousands was caused directly by a nuclear accident. Less well-known is another consequence of excessive fear of nuclear technology. At the time of the Fukushima accident, prudent safety procedures included extensive evacuations from nearby communities. Subsequently, these turned into very long-term restrictions from returning, and relocation of community members, beyond the level necessary for public safety. The prolonged evacuation and relocation themselves caused excess deaths estimated at These casualties and other health effects were largely impacts "of despair", resulting from chronic or acute illnesses such as heart disease or stroke, driven by fear, disruption, dislocation etc. (see excerpt from UNSCEAR report on Fukushima, below). While an accident that causes large-scale evacuation is a serious event, much of this consequence must be put down to an excessive "fear of nuclear" that is not justified by the facts. This fear continues to be fanned by mis-messaging. Our view is that active communications by the scientific community to emphasize the factual evidence around the pros, and cons, of nuclear technologies is not just a "nice to have"; it is crucial to enabling the best possible global response to the climate change crisis.	Noted (continuation from comment 66885)	Jerry Hopwood	President, UNENE (University Network of Excellence in Nuclear Engineering)	Canada

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66895	0				Addendum: Excerpt from UNSCEAR report on Consequences of the Fukushima accident. In summary, the conclusions of UNSCEAR concerning the first issue, related to the observation of health effects of the (Fukushima) accident, were: a) "No radiation-related deaths or acute diseases have been observed among the workers and general public exposed to radiation from the accident"; b) "The doses to the general public, both those incurred during the first year and estimated for their lifetimes, are generally low or very low. No discernible increased incidence of radiation-related health effects are expected among exposed members of the public or their descendants". UNSCEAR also noted that: "The most important health effect is on mental and social well-being, related to the enormous impact of the earthquake, tsunami and nuclear accident, and the fear and stigma related to the perceived risk of exposure to ionizing radiation. Effects such as depression and post-traumatic stress symptoms have already been reported".	Noted (continuation from comment 66885)	Jerry Hopwood	President, UNENE (University Network of Excellence in Nuclear Engineering)	Canada
69443	0				This chapter would strongly benefit from building on the IEA 2020 World Energy Outlook's Chapter 4 "Achieving net zero emissions by 2050" which focuses entirely on the actions to be undertaken by 2030. The Chapter 11 Industry quotes it extensively, but the IEA 2020 covers all sectors. It notes the critical role over the current decade in determining the pathway to 2050, as total CO2 emissions would need to fall by around 45% from 2010 levels by 2030, and CO2 emissions from the power sector would need to decline by around 60% since 2019. Worldwide annual solar PV additions should expand from 110 GW in 2019 to 500 GW by 2030, and virtually no subcritical and supercritical coal plants (without CCS) should be operation at that time. The share of renewables in global electricity supply should rise from 27% in 2030 to 60% in 2030, the share of coal with no CCS falling from 37% to 6%. Power sector investment should triple from \$760 bn in 2019 to \$ 2200 bn in 2030. Close to half of the existing building stock in advanced economies should be retrofitted by 2030. Over 50% of passenger cars sold in 2030 should be electric. Around 25% of total heat used in industry should come from electricity (mostly) and low-carbon fuels such as hydrogen (but maybe mostly as reductant for iron ores in steelmaking). Some behaviour changes should also happen, such as flights under one hour being replaced with low-carbon alternatives, cycling or walking for trips under 3 km, reducing road traffic speeds by 7 km/h.	Noted. IEA World Energy Outlook 2020 cited. Section 4.2.5, however, has focused on country-level mitigation pathways.	Cédric PHILIBERT	Institut Français des Relations Internationales	France
78119	0				The chapter needs significant attention in terms of scientific quality and language used. It is highly policy-prescriptive in various sections. Please make sure to clearly distinguish projections and facts throughout the chapter (eg "X is needed" ... not in line with an accurate scientific description).	Noted. The comment does not provide specific elements. Sections will be reviewed again for scientific robustness and to avoid any policy prescriptive language.	Charlotte Plinke	Climate Analytics	Germany
85309	0				It would be very valuable to have, in Chapter 4, a quantitative assessment of fairness that analysed literature on equity and resulting fair shares for countries or country groups, consistent with international environmental law principles, providing benchmarks for existing and new nationally determined contributions under the Paris Agreement, informing the global stock-takes. The relevant sub-chapter for this would be 4.2.2.6. or 4.5. The importance of this is highlighted by the finding in Chapter 4 (page 9, lines 6-8). One suggestion for literature: Rajamani, Jeffery, Höhne, Hans, Glass (submission under review): National 'fair shares' in reducing greenhouse gas emissions within the principled framework of international environmental law.	Partially accepted. Instead of "mid-term mitigation strategies", "mid-century mitigation strategies" will be used. Rajamani et al. paper referenced. Desire for quantitative assessment of fairness is noted. See responses to comments number 19903 and 19905.	Kaisa Kosonen	Greenpeace	Finland
85313	0				I wonder if the Chapter 4 could consider to what extent the current NDCs & development plans have captured the cost reductions of solar, wind and batteries (See also SPM finding E.6.3)? Most of the current NDCs were finalised in 2015, assumingly based on 2014 data and assumptions - or older. By now, the assumptions on several key technologies and their expected cost curves will have changed quite profoundly, along with market developments for coal. Could there be a para considering this? For example in 4.2.5?	Rejected. IPCC is not policy prescriptive, and thus cannot comment on whether current NDCs do enough to take advantage of reductions in mitigation costs.	Kaisa Kosonen	Greenpeace	Finland
66771	0		0			Noted	Navroz Dubash	Centre for Policy Research	India
66773	0		0		The ES is very tight and has a strong narrative story line running through it. Well done! My only suggestion is that it would be easier to read if you could break up some of the larger paras into smaller bite size pieces. And some of the headline statements, notably "Accelerated mitigation may run into obstacles" is too terse - a rare phenomenon in IPCC ES statements which normally have the opposite problem. Here a bit more in the bold statement would help. But the ES, overall, is in good shape.	Noted	Navroz Dubash	Centre for Policy Research	India
11125	1	1	1	1	I really liked this chapter. I haven't read chapter 3 yet, now I am curious as to what it can actually cover that is interesting. If, as this chapter suggests, so many countries are now putting in place policies aimed at getting to net zero emissions by 2050, which is defined as near term, then what is there to think about w.r.t long-term? Perhaps this chapter could say what is left for the long term if the 2050 net zero targets expand to all countries and are actually achieved? Is the long term all about negative emissions?	Noted. This is a comment for Ch3.	Anthony Patt	ETH Zürich	Switzerland
47677	1	1	148	19	It would be good to more details on the medium term effects of the COVID-19 pandemic and the resultant fiscal stimulus (green recovery) on long term trends in emissions. To my understanding a number of papers have already been published on this, and more are in the works. https://link.springer.com/article/10.1007/s10640-020-00454-9 https://www.nature.com/articles/s41558-020-00977-5 https://www.nature.com/articles/s41558-021-01001-0 https://academic.oup.com/oxrep/article/36/Supplement_1/S359/5832003?login=true	Accepted. Effects of COVID-19 and opportunities/risks associated with recovery packages are discussed in Cross-Chapter Box 1, Section 4.2.2.4 on 'estimated impact of COVID-19 and governmental responses on emissions projections', and in section 4.4.3.	Vassilis Daioglou	Utrecht University	Netherlands
7525	1	1	96	33	Chapter 4 is outstanding. It reads really well, the main messages are very clear and the structure is quite well thought-out. It is a necessary chapter, an awesome read for people who focus on the national level like myself. And you have delivered, met expectations spot on. I just have few comments to try to make the executive summary crisp.	Thank you	Lilja Caiado Coelho Beltrao Couto	University College London	United Kingdom (of Great Britain and Northern Ireland)
7527	1	1	96	33	Can you please try to enhance the quality of all figures? They are currently hard to read due to low resolution.	Accepted.	Lilja Caiado Coelho Beltrao Couto	University College London	United Kingdom (of Great Britain and Northern Ireland)
61247	1	1	96	33	Consider replacing or amending the term "renewable energy" by "low-carbon energy." "As noted in Harjanne and Korhonen 2019, "renewable" by no means equals "sustainable" or even "low carbon" energy. Furthermore, there are good reasons to believe that the confusion permitted by equating "renewable" with "sustainable" and "low carbon" has helped and will help those parties who have a vested interest in promoting technically renewable but actually problematic if not downright unsustainable energy sources and practices, most prominently large scale bioenergy use (op. Cit.) Reference: Harjanne, A. & Korhonen, J. M. (2019). Abandoning the concept of renewable energy. Energy Policy 127, DOI: 10.1016/j.enpol.2018.12.029	Partly accepted. In instances where the text refers to several 'lower carbon' technologies (e.g. nuclear and renewable energy technologies) we revise to use that term. However, the literature which we assesses extensively uses the terms "renewable energy" - the topic of an IPCC special report - and "nuclear"; where the specific energy source is meant, we retain the specific terms. Please refer to responses in specific instances (while page numbers are entered, this spans the entire chapter 4)	Janne M. Korhonen	Lappeenranta University of Technology	Finland

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
80609	1		162		How does the discussion of shifting development pathways address the linkages between development objectives and near-term climate impacts due to near-term warming? Do any of the studies and pathways considered in this chapter yield faster avoided warming in the near term? It appears that all studies and figures are presented in CO2eq GWP100 terms rather than temperature trajectories. With the exception of Section 4.2.5.15, most mentions of temperature reference long-term temperature. How does this approach address the impacts of near-term warming, such as the risk of triggering feedbacks and crossing tipping points in the climate system (e.g. Lenton et al., 2019), or more proximally, exceeding the limits of human survivability in the tropics (Zhang et al., 2021). Note that wet-bulb 35°C conditions have been observed in the sub-tropics, decades before projected (Raymond et al., 2020). These impacts are correlated with near-term warming, not long-term temperature goals, and directly impact sustainable development goals and equity. CITATIONS: Lenton T.M., Rockström J., Gaffney O., Rahmstorf S., Richardson K., Steffen W., & Schellnhuber H.J. (2019) Climate tipping points — too risky to bet against, Nature 575(7784): 592–595. Accessed at https://www.nature.com/articles/d41586-019-03595-0 . Zhang Y., Held L., & Fueglistaler S. (2021) Projections of tropical heat stress constrained by atmospheric dynamics, NATURE GEOSCIENCE 14(3): 133–137. Accessed at https://www.nature.com/articles/s41561-021-00695-3 . ("Our results imply that curtailing global mean warming will have a proportional effect on regional TWmax in the tropics. The maximum 3-hourly TW (ERA-Interim) ever experienced in the past 40 years by 99.98% of the land area within 20° S–20° N is below 33 °C. Therefore, a 1.5 °C or 2 °C warmer world will likely exempt the majority of the tropical area from reaching the survival limit of 35 °C. However, there exists little knowledge on safety thresholds for TW besides the survival limit11, and 1 °C of TW increase could have adverse health impact equivalent to that of several degrees of temperature increase.") Raymond C., Matthews T., & Horton R.M. (2020) The emergence of heat and humidity too severe for human tolerance, Science Advances 6(19): eaaw1838. Accessed at https://advances.sciencemag.org/content/6/19/eaaw1838 . ("Humans' ability to efficiently shed heat has enabled us to range over every continent, but a wet-bulb temperature (TW) of 35°C marks our upper physiological limit, and much lower values have serious health and productivity impacts. Climate models project the first 35°C TW occurrences by the mid-21st century. However, a comprehensive evaluation of weather station data shows that some coastal subtropical locations have already reported a TW of 35°C and that extreme humid heat overall has more than doubled in frequency since 1979.")	Rejected. Impacts of climate change are discussed in WG2. Short-term impacts of climate change on mitigation action in near- to mid-term not discussed in literature assessed.	Durwood Zaecke	Institute for Governance & Sustainable Development	United States of America
80753	1		162		How does the discussion of shifting development pathways address the linkages between development objectives and near-term climate impacts due to near-term warming? Do any of the studies and pathways considered in this chapter yield faster avoided warming in the near term? It appears that all studies and figures are presented in CO2eq GWP100 terms rather than temperature trajectories. With the exception of Section 4.2.5.15, most mentions of temperature reference long-term temperature. How does this approach address the impacts of near-term warming, such as the risk of triggering feedbacks and crossing tipping points in the climate system (e.g. Lenton et al., 2019), or more proximally, exceeding the limits of human survivability in the tropics (Zhang et al., 2021). Note that wet-bulb 35°C conditions have been observed in the sub-tropics, decades before projected (Raymond et al., 2020). These impacts are correlated with near-term warming, not long-term temperature goals, and directly impact sustainable development goals and equity. CITATIONS: Lenton T.M., Rockström J., Gaffney O., Rahmstorf S., Richardson K., Steffen W., & Schellnhuber H.J. (2019) Climate tipping points — too risky to bet against, Nature 575(7784): 592–595. Accessed at https://www.nature.com/articles/d41586-019-03595-0 . Zhang Y., Held L., & Fueglistaler S. (2021) Projections of tropical heat stress constrained by atmospheric dynamics, NATURE GEOSCIENCE 14(3): 133–137. Accessed at https://www.nature.com/articles/s41561-021-00695-3 . ("Our results imply that curtailing global mean warming will have a proportional effect on regional TWmax in the tropics. The maximum 3-hourly TW (ERA-Interim) ever experienced in the past 40 years by 99.98% of the land area within 20° S–20° N is below 33 °C. Therefore, a 1.5 °C or 2 °C warmer world will likely exempt the majority of the tropical area from reaching the survival limit of 35 °C. However, there exists little knowledge on safety thresholds for TW besides the survival limit11, and 1 °C of TW increase could have adverse health impact equivalent to that of several degrees of temperature increase.") Raymond C., Matthews T., & Horton R.M. (2020) The emergence of heat and humidity too severe for human tolerance, Science Advances 6(19): eaaw1838. Accessed at https://advances.sciencemag.org/content/6/19/eaaw1838 . ("Humans' ability to efficiently shed heat has enabled us to range over every continent, but a wet-bulb temperature (TW) of 35°C marks our upper physiological limit, and much lower values have serious health and productivity impacts. Climate models project the first 35°C TW occurrences by the mid-21st century. However, a comprehensive evaluation of weather station data shows that some coastal subtropical locations have already reported a TW of 35°C and that extreme humid heat overall has more than doubled in frequency since 1979.")	See response to comment 80609	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
4427	2	21	2	21	pt. 4.4 _have Title as 'Shift Development pathways and accelerate the pace'(only)	Rejected. No argument given for proposal	Alka Bharat	Maulana Azad National Institute of Technology (An Institute of National importance), Bhopal	India
4429	2	25	2	25	pt. 4.4.4... Add best practices	Rejected. There is no section 4.4.4	Alka Bharat	Maulana Azad National Institute of Technology (An Institute of National importance), Bhopal	India
4431	2	25	2	25	pt. 4.5 .. Add 'inclusive'	Taken into account. We refer to 'inclusive just transition' in section 4.4.3.5, but have not changed the heading of the section	Alka Bharat	Maulana Azad National Institute of Technology (An Institute of National importance), Bhopal	India
7529	3	1	4	34	The executive summary is quite dense. Particularly in the first half, main messages could probably be presented in a clearer, neater, crisp way as suggested in comments relating to particular paragraphs below.	Accepted	Lilia Caiado Coelho Beltrao Couto	University College London	United Kingdom (of Great Britain and Northern Ireland)
2489	3	1	5	35	There is one very important omission in/limitation of this chapter and this is the international dimension of mitigation. Imports and exports account for a very important portion of consumption and production plus the production and trade linked to Global Value Chains. The patterns how economies and societies integrate in the global economy is a decisive characteristic of development pathways - and it matters very significantly for mitigation pathways (imagine Brazil or Indonesia would decide to no longer export agricultural commodities). There are very important policies (or policy packages) that are omitted from the discussion in this chapter. This includes, but is not limited to trade and investment policies, (new) sustainability due diligence regulation, cross-border carbon tax adjustments etc. I understand that the chapter needed focus, but I would probably suggest to state more clearly in the introduction/exec summary that these aspects received little/no attention.	Noted. Importance of trade issues noted in discussion of structural change in 4.4.1.7.	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
55127	3	1	5	36	The Executive Summary of the chapter completely omits discussion of forest and land use, which can play an important role in mitigation, as well as any form of carbon removal, which the modeling shows is critical for 1.5°C scenarios. This is a major oversight. These removal pathways/options should be included in the Executive Summary.	Partially accepted. AFOLU mitigation options are mentioned in revised ES.	Government of United States of America	U.S. Department of State	United States of America
20591	3	3	3	3	"at national scale": please consider using a more local point of view in this analysis, beyond national scale	Accepted. ES discusses mitigation potential of sub-national and non-state actors.	Government of France	Ministère de la Transition écologique et solidaire	France
43045	3	6		16	Note that: "The emissions gap is exacerbated by an implementation gap. The magnitude of this emission gap calls into question whether current development pathways and efforts to accelerate mitigation are to achieve the Paris mitigation objectives."	Noted	Graeme Taylor	BEST Futures	Australia

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55129	3	7	3	28	The text distinguishes between an emissions gap and an implementation gap. Several reviewers did not understand the distinction. To some it became clear as they read further, to others like this reviewer the distinction never became clear -- despite reading the paragraph five times they seem to mean the same thing. That distinction needs to be clarified and (because the terms are so critical) that clarification needs to appear immediately when the terms are introduced.	Accepted. Distinction made clearer in FGD.	Government of United States of America	U.S. Department of State	United States of America
71373	3	7	3	28	This paragraph needs a clear statement near the start about the cut-off assumptions underpinning these gap estimates. The gap is changing all the time as countries update NDCs (the implementation gap is also changing constantly, but this is harder to monitor).	Accepted. Cut-off assumptions included.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
60323	3	7	3	8	"An emissions gap persist" is unfortunately a significant understatement. Höhne et al (https://www.nature.com/articles/d41586-020-00571-x) show that the emissions gap has four folded in the last 10 years.	Noted.	Niklas Höhne	NewClimate Institute	Germany
65713	3	7	3	9	The acronym NDC has not been defined in this chapter yet.	Noted.	Eero Hirvijoki	Aalto University	Finland
14955	3	10			Please derive confidence statements for the assessed levels of evidence/agreement as per uncertainty guidance note for IPCC authors. In this case, "high confidence" can be attributed to the assessed information. This holds for all instances in the chapter where evidence/agreement statements are used.	Accepted.	Government of Saint Kitts and Nevis	Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements	Saint Kitts and Nevis
7829	3	10	3	17	To calculate emission gaps described here is rather difficult even with Cross-Chapter Box 3, Figure 1. It may be reader friendly if a TABLE is accompanied here for us to confirm those emission gaps.	Accepted. Reference given to sections where emissions gap is calculated.	Mitsutsune Yamaguchi	Research Institute for the Innovative Technology for the Earth (RITE)	Japan
18105	3	13	3	15	The sentence states that there is a "median estimated emissions gap of 14-23 GtCO2eq for limiting warming to 2°C and 25-34 GtCO2eq for limiting warming to 1.5°C relative to mitigation pathways" but this is hard for a layperson to visualise - is this big? The next sentence refers to the "magnitude" of this problem so could the authors give the size of the gap relative to the reductions that current policies would achieve here in order to contextualise the problem?	Noted. The median estimated emissions gap should be compared with the global GHG emissions that current policies lead to in previous sentence.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
367	3	13	3	17	Determination of the emissions gap and implementation gap is a function of NDCs. The gaps rely heavily on the efficacy of NDCs, but there are problems with the NDC database. For example, NDCs vary in scope and content in different countries (4.2.2.8)	Noted. Section 4.2.2 provides detailed assessment of literature on NDC, including a discussion on uncertainty in estimates (4.2.2.8)	Michael Kennish	Rutgers University	United States of America
29849	3	15	3	17	Please check if there is missing a word before "to achieve the Paris mitigation objectives." at the end of the sentence. It reads better in our view if either "sufficient" or "enough" were included.	Accepted. Word "adequate" added.	Government of Norway	Norwegian Environment Agency	Norway
66775	3	17	3	28	The explicit mention of an implementation gap is useful, and complements Ch 13. However, the definition becomes a bit murky here (and admittedly it is not clear in Ch 13 either). Is it a policy gap between current policies and those required for NDC pledges or is it implementation of policies - the ex ante-ex poste gap in setting and achievement of targets? Or both? The first is a policy gap. The second could also be due to lack of implementation of policies, although they exist. I think a more comprehensive notion that covers setting of necessary policies, ensuring their implementation, adequate revision as needed, all of which likely needs institutions that do all this.	Accepted. Definition of implementation gap now included in the Executive Summary.	Navroz Dubash	Centre for Policy Research	India
62065	3	26	3	27	Significant: The impact of COVID-19 could be a reduction in the order of 4-7% below pre-COVID projections, but in case of a rebound to fossil fuels it could even be above pre-COVID levels. The studies are limited, but UNEP Emissions Gap 2020 report (Chapter), papers in the pipeline confirm this.	Accepted. Post-COVID literature is assessed in section 4.2.2.4.	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
20593	3	26	3	28	Could you please consider also present the crisis as a potential opportunity to instigate structural transformations through the economic recovery plans?	Accepted. Discussion of COVID-19 crisis as opportunity discussed in x-Chapter Box 1 and 4.4.3.4.	Government of France	Ministère de la Transition écologique et solidaire	France
60325	3	29	3	41	The paragraph could include the now prominent idea of the need for exponential transitions following an S-curve as a key to close the gap. The gap is so huge that fast transition is necessary and possible with exponential growth. The idea of sector transformation points, breakthroughs, and S-curve shaped transitions has now been covered by a series of reports: - World Economic Forum http://www3.weforum.org/docs/WEF_the_speed_of_the_energy_transition.pdf - Exponential Roadmap https://exponentialroadmap.org/ - The Race to zero breakthrough campaign by the UNFCCC High Level Champions https://racezero.unfccc.int/breakthroughs/ - The Paris Effect by Systemiq https://www.systemiq earth/paris-effect/ - Transformation points by the climate action tracker: https://climateactiontracker.org/publications/transformation-points/	Rejected. Detailed discussion of the dynamics of transition (including S-Curve) can be found in Cross Chapter Box 14 in Chapter 16.	Niklas Höhne	NewClimate Institute	Germany
60753	3	29	3	41	highly informative in terms of enhancing National Action Plans (NAPs) and Nationally Determined Contributions (NDCs)	Noted	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
369	3	32	3	35	Include quantitative values of demand reductions through efficiency and reduced activity, rapid decarbonization of the electricity sector, and low-carbon electrification of buildings, industry and transport.	Accepted.	Michael Kennish	Rutgers University	United States of America
9689	3	32	3	35	transformative and institutional changes can't occur in the short term -- they are usually long term processes.	Noted. Timing of action discussed more extensively in revised Executive Summary.	Mustafa Babiker	Saudi Aramco	Saudi Arabia
29851	3	42	3	47	Chapter 4 highlights the role of non-state actors and international initiatives in reducing emissions and gives an estimate of their emission reduction potential. This potential is of course uncertain and partially overlapping with NDCs. However, please consider to include this in the SPM as well, to give policymakers an idea of the order of magnitude of contribution from these types of initiatives. These initiatives have become increasingly important for climate mitigation.	Accepted	Government of Norway	Norwegian Environment Agency	Norway
61549	3	42	3	47	latest date: 43+ countries now have net zero targets (with different dates)	Noted.	tom howes	International Energy Agency	France
7531	3	42	4	10	It would help the reader if you could consider separating this block into different paragraphs with the main messages. I would suggest: 1. mitigation strategies and their uncertainty; 2. non-state actors; 3. the threat to SDGs with the examples of GDP and employment modelling results.	Rejected. We chose to limit number of headline statements within the Executive Summary.	Lilia Caiado Coelho Beltrao Couto	University College London	United Kingdom (of Great Britain and Northern Ireland)
20595	3	43	3	43	Could you please specify that as per art 4.19 of the Paris Agreement, 2050 strategies fit within the category of "long term strategies", contrary to the definition used by the IPCC, in order to avoid confusion?	Accepted. This point is made in Section 4.2.4.1.	Government of France	Ministère de la Transition écologique et solidaire	France
83071	3	43	3	44	Maybe better to avoid the "neutrality" concept here and say "aim at net zero GHG or CO2 emissions", to indicate early on that there's an important difference (see also my more general "net zero" comment on the entire chapter)	Accepted	Geden Oliver	German Institute for International and Security Affairs	Germany
55131	3	45	3	45	Delete "wide"	Rejected. "Wide" used to characterize large number and large diversity of actions by non-state actors.	Government of United States of America	U.S. Department of State	United States of America
52061	3	45	3	47	claiming that non-state international collaboration could lead to 20 gt/co2 is a questionable specially with the non binding nature of the collaboration	Taken into account.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
55133	4	1	4	1	Define SDG here.	Accepted	Government of United States of America	U.S. Department of State	United States of America
71375	4	1	4	5	Equating mitigation "without precaution" to negative GDP results from modelling is itself rather careless. The paragraph should be revised to ensure it refers to indicators that reliably point to 'reckless' mitigation implementation. A modelled GDP reduction in itself is not one of these indicators. Modelling tends to show that even optimal mitigation outcomes lead to negative GDP compared to a counterfactual. As Ch3 explains this is often due to failure to account for avoided impacts, co-benefits and factors like positive economic spillovers from R&D, learning-by-doing, increased investment etc. Yet none of these things are 'mistakes', it is just that few modelling approaches are able to incorporate all of these, while being sufficiently granular for policy relevance and sufficiently conservative for scientific robustness.	Rejected. "without precaution" refers to the fact that in most literature reviewed, policy design can significantly modify mitigation policy impacts (4.2.6).	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium

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18107	4	1	62	42	Given that the most likely publication date for WGIII will be 2022, there is an issue throughout the report regarding the appearance of using obsolete data i.e. the most recent emissions data used in the report will be from 2018 and none of the policies described as "current policies" will include anything from COP26 or, most likely, after Nov 2020. As a result, we request that authors ensure that it is very clear which data are being used in any analysis or discussion. In particular, we propose that "current policies" is not used at all and that it is replaced with "2018 policies" or similar so that there is no confusion regarding the basis of WGIII analyses.	Partially accepted. Date at which data was collected is clarified. "Current policies" is used throughout report.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
17787	4	2	4	10	(4 ES) Useful contribution to discussion on whether climate action perpetuates poverty (see comments on 2-7/19-20 and 3-10/1-2). This should all be brought up into messaging and talking points.	Noted.	Jonathan Lynn	IPCC	Switzerland
18109	4	3	4	5	Recommend removing or editing the sentence: "For example, most country-level mitigation modelling studies in which GDP is an endogenous variable report negative impacts of mitigation on GDP in 2030 and 2050, relative to the reference," as it is too technical for the executive summary. Indeed, the next sentence explains clearly the essence of this sentence without using overly technical terms.	Rejected. The qualifier is necessary because a large part of the mitigation literature assessed in the report treats GDP as exogenous, and thus does not report changes in GDP relative to business as usual.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
20597	4	3	4	5	for example...reference. Could you please insert a caution? This could be inaccurate and misleading. Many models rely on an hypothesis that the economy is on its efficiency frontier, thus they can only represent net costs of mitigation compared to a reference. On the other hand, it is misleading to talk about mitigation costs in relation to a reference that will not take into account the impacts of climate change. (See paragraph chapt. 4, page 60, lines 10-17 and Grubb 2014, Planetary Economics, Routledge)	Accepted. This point is made in Section 4.2.6.	Government of France	Ministère de la Transition écologique et solidaire	France
7533	4	3	4	6	You could possibly cross refer to chapter 15 where some assumptions of such models are discussed.	Rejected. It is not the place in the executive summary to cross reference.	Lilía Caiado Coelho Beltrao Couto	University College London	United Kingdom (of Great Britain and Northern Ireland)
55135	4	4			"... studies in which GDP is an endogenous variable report negative impacts of mitigation on GDP...". This phrase will be very easy to take out of context. Suggest including caveats about what the reference case actually is (i.e., it does not include GDP effects of actual physical climate change impacts). Consider using a simpler adjective than "endogenous".	Noted. Caveats introduced in section 4.2.6.	Government of United States of America	U.S. Department of State	United States of America
18111	4	6	4	8	Recommend rephrasing this sentence to state that "the effect of mitigation policies on jobs tends to be limited on aggregate but significant at sectoral level" - use of terms like "employment effect" in the Exec Summary is too technical in my opinion.	Noted. "employment effect" kept for precision.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
52063	4	7	4	8	According to literature findings, mitigation measures might have sectorial impact on employment, such measures will effect the employment level for some states. This needs to be highlighted.	Noted. Sectorial impacts of mitigation detailed in section 4.2.6	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
7535	4	11	4	34	I would suggest dividing this block into its main ideas: 1. How a country develops determines how mitigation and other goals are achieved (up to line 18) 2. Policies to shift pathways (line 18 to 24) 3. These policies' influence on mitigative capacity (line 24 to 30) 4. How 4.4.1 examples differ (line 30 to 34).	Rejected. Editorial choice made to keep number of headline statements limited in Executive Summary.	Lilía Caiado Coelho Beltrao Couto	University College London	United Kingdom (of Great Britain and Northern Ireland)
71377	4	11	4	34	Comment on the "development pathways" terminology. See our general comment on Ch1.4. Somewhere in this report, there needs to be clear explanation of the difference between mitigation pathways and development pathways, and how sustainability fits in. The glossary makes clear that these two types of 'pathway' are very different concepts, even though they share a name. "Development pathways" appear to refer simply to an outcome, whereas the other uses of the term are more in keeping with the scenario/narrative/model-based potential future idea of previous reports. This is important because the idea of a 'sustainable development pathway' (i.e. a 'panacea' scenario of a Paris-consistent modelled emissions path that also achieves SDGs) is strongly implied by the current terminology - yet I don't think WG3 contains such a product.	Noted. Chapter 4 does not describe a "sustainable development pathway", but rather discussed options to make development pathways more sustainable (see e.g., cross-chapter Box 7).	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
52065	4	17	4	18	incremental changes to meet mitigation goals have less damage and impact from the accelerated shifting. This needs to be highlighted.	Noted. Incremental refers to changes at the margin of current development pathways. Impacts of accelerated mitigation are discussed in 4.2.6	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
18113	4	18	4	18	After this sentence "Yet meeting ambitious mitigation and development goals cannot be achieved through incremental change, hence the focus on shifting development pathways (robust evidence, medium agreement)." I recommend inserting this sentence (from page 65, lines 19-20): "There is compelling evidence to show that continuing along existing development pathways is unlikely to achieve rapid and deep emission reductions"	Rejected. Additional sentence not included to keep executive summary short.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
55137	4	19	4	19	Delete "wide"	Rejected. "wide" used to emphasize large number of actors involved.	Government of United States of America	U.S. Department of State	United States of America
78003	4	21	4	21	Suggested edit: sentence to: "The literature suggests ... net zero or negative CO2, including ... than today." Rationale: Baiman suggested edits for Chapter 4: Mitigation and development pathways in the near-to mid-term. See other	Rejected. Unclear what the suggested edit is.	Ron Baiman	Benedictine University	United States of America
371	4	25	4	28	The goal of countries to accelerate mitigation and achieve other sustainable development objectives depends on the accuracy of NDCs. However, there is considerable uncertainty in the NDC estimates.	Taken into account. Section 4.2.2.8 deals with uncertainties, including those around NDCs. (see also response to comment number 327). However, the "practical options to shift development pathways" refer not only to NDCs, but many other measures too	Michael Kennish	Rutgers University	United States of America
18115	4	28	4	28	Before the sentence that starts, "Concrete examples." I recommend including the following two sentences: "Shifting development pathways entails fundamental changes in energy, urban, building, industrial, transport, and land-based systems. It also requires changes in behaviour and social practices" lines 5-6 p67, and "Coordinated policy mixes would need to coordinate multiple actors – i.e., individuals, groups and collectives, corporate actors, institutions and infrastructure actors – to deepen decarbonisation and shift pathways towards sustainability. Shifts in one country may spill over to other countries" lines 29-32 p67	Accepted	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
45857	4	34	4	34	It is proposed to specify "development" in this para e.g. unsustainable development, agricultural development, economic development, development of (urban) infrastructure etc. The reason for this is that the SPM of the IPBES Global Assessment also states: "Least developed countries, often rich in and more dependent upon natural resources, have suffered the greatest land degradation [...] Therefore, development in its general understanding can hardly be the reason per se for why land degradation occurs."	Noted. Text has been extensively revised, keeping in mind to point to specific unsustainable development practices.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
7537	4	35	5	2	Can you try to help the reader see it crisp and clear what the five categories of enabling conditions are? One suggestion would be bringing forward what you say in page 6 line 42 to 45.	Rejected. A few lines down, we refer to "five conditions", and point the reader to section 4.4.1 and Fig 4.8, where the five conditions are illustrated and described.	Lilía Caiado Coelho Beltrao Couto	University College London	United Kingdom (of Great Britain and Northern Ireland)
18117	4	35	5	2	This paragraph does not mention political will / political leadership as a necessary factor/component within the enabling conditions that this paragraph focuses on. Could the authors please consider including such a discussion here?	Rejected. Political will does not fit within the typology of enabling conditions that we use in this Chapter (which stems from SR1.5). In addition, reference is already made in the Executive Summary to the wide range of actors that can influence development pathways (including, but not limited to, political leaders).	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
5109	4	37	4	37	Explain policy integration. Integration of/into what?	Rejected. Policy integration discussed in 4.4.1.2 where there is more space to elaborate than in summary.	Lina Hollender	n/a	Germany
43379	4	42			I suggest some of the actors should be highlighted in the sentence	Rejected. To limit word count of executive summary.	Henry Tantoh	University of South Africa	South Africa
71379	4	46	5	1	Add a little to this sentence to explain the main caveats around the 20 Gt figure. The 'limited evidence' label is not very informative. As I understand it, the main doubt regarding the total contribution of NSA/ICI initiatives is the fact that it is difficult (perhaps conceptually impossible) to accurately account for the overlaps between these initiatives and their additionality compared to national targets (esp NDCs).	Partly accepted. Caveats surrounding the 20 Gt of CO2eq figure explained in details in section 4.2.3. Summarized here through the "limited evidence, medium agreement" confidence statement.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
43377	4				The sentence on page 4, line 42.....various actors have developed..... I suggest some of the actors be highlighted.	Rejected. To limit word count of executive summary.	Henry Tantoh	University of South Africa	South Africa
55139	5	1	5	2	"The direction of innovation matters." Not clear what it means for innovation to have a direction in the first place.	Noted. The shorthand in the summary points to section 4.4.1.6 where the reader can find elaboration.	Government of United States of America	U.S. Department of State	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
18119	5	2	5	2	I recommend adding two more sentences to conclude this paragraph. After the sentence, "the direction of innovation matters" I recommend adding: "there is no single factor determining such a transformation. Rather a range of enabling conditions can combine in a co-evolutionary process. Amongst the conditions that have been cited in the literature are higher levels of innovation, multilevel governance, transformative policy regimes or profound behavioural transformation" from lines 31-34, p71 and "The necessary transformational changes are likely to be more acceptable if rooted in the development aspirations of the economy and society within which they take place (Jones et al. 2013; Dubash 2012) and may enable a new social contract to address a complex set of inter-linkages across sectors, classes and the whole economy" from lines 1-4 p68	Partially accepted. Second suggested sentence included in summary (to keep summary short).	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
55141	5	3	5	13	Though equity is raised in the Executive Summary, it could use more emphasis. For example, here authors referred solely to Section 4.5; however, the points made in Section 4.3 regarding development pathways and the drivers of emissions are important to include. Suggest bringing those points here or raising this as an equity issue in the Executive Summary paragraph beginning on 4.11 (shifting development pathways...).	Accepted. Text on shifting development pathways revised to refer to just transitions, thereby pointing forward to this paragraph which does explicitly deal with equity	Government of United States of America	U.S. Department of State	United States of America
61551	5	3	5	14	Citing of EU just transition fund and IEA "people centred commission" are good current practice examples.	Rejected. Including examples in summary would make it too long, but examples of just transition, including from the EU figure prominently in section 4.5 and Figure 4.9.	tom howes	International Energy Agency	France
24917	5	9	5	11	The GST is introduced here without any explanation. Maybe worth explaining what it is, and its timing (maybe including that the technical work should start in 2022)	Noted. Unclear what the comment actually points to (possibly wrong page / line number)	Giacomo Grassi	Joint Research Centre, European Commission	Italy
45859	5	12	4	13	Please delete "Hence, equity is an ethical imperative, but it is instrumentally important." since this is a value judgement and thus inappropriate for an IPCC report.	Partly accepted. Rephrased as suggested by another reviewer (comment 55143), so that it is not a value judgement	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
55143	5	12	5	13	What does it mean to say "equity is an ethical imperative"? What information does that add? It seems to be a statement of values and not of fact. Suggest rephrasing as: "Hence, equity is an ethical concept that is instrumentally important."	Accepted. Text revised as suggested (and linked with following clause)	Government of United States of America	U.S. Department of State	United States of America
55145	5	14	5	14	What does it mean to "broaden and deepen mitigation"? Does it mean implement actions to mitigate climate change more aggressively to broader sectors and geographies? Suggest more specific, less abstract language.	Noted. While this alludes to earlier literature, notably Richard Schmalensee at MIT writing on "Greenhouse policy architectures and institutions" that "broaden, then deepen" emissions reduction, we have not cited that article - a) this is a summary and b) it is 1996 literature. We think the following two sentences outline what we mean - one each on deepening and broadening. No textual change made	Government of United States of America	U.S. Department of State	United States of America
373	5	14	5	18	The goal of countries to accelerate mitigation and achieve other sustainable development objectives depends on the accuracy of NDCs. However, there is considerable uncertainty in the NDC estimates.	Noted. We take the point that there is uncertainty in NDC estimates and elaborate on that uncertainty in section 4.2.2.8. (See also response to comment number 371). However, this is not the reason that "practical options to shift development pathways" do not exist, so no change made here	Michael Kennish	Rutgers University	United States of America
9691	5	14	5	18	Need to admit that there are considerable trade-offs between accelerating mitigation and shifting development pathways towards sustainability particularly for developing countries.	Accepted. Text revised, though mention of trade-offs has been placed in previous paragraph, for this summary. Note that management of trade-offs is elaborated further in the cross-chapter box e.g. "However, even with good policy design, decisions about mitigation actions, and the timing and scale thereof, may entail trade-offs with the achievement of other national development objectives in the near-, mid- and long-term."	Mustafa Babiker	Saudi Aramco	Saudi Arabia
10575	5	14	5	18	This paragraph, as it is written, implies that neither "shifting development pathways to increased sustainability" nor "Putting enabling conditions in place" should be considered as immediate tasks. Perhaps this deserves thinking it over.	Accepted. Very good point. Revised text to include "immediate"	Philippe Waldeufel	CNRS	France
55147	5	19	5	26	There should be substantial treatment here of land use, land use change, and land management. Add information about the land sector here.	Accepted. Text revised.	Government of United States of America	U.S. Department of State	United States of America
82341	5	19	5	26	I am wondering that why other sectors, such as mitigation from land and food related sectors are not mentioned here as it has been mentioned in page 4-3 (line 35-36) that "A focus on energy use and supply is essential, but not sufficient on its own – the land sector and food systems deserve attention".	Accepted. Text revised.	Yinlong Xu	Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences	China
61675	5	20	5	21	"1) decarbonising electricity supply to produce net zero CO2, including through renewable energy, 2) [...]". This should be changed to either "low carbon" or "renewable and nuclear energy or carbon capture and storage". Most significant national power grid decarbonisation has been done with significant share of nuclear energy (such as France, Sweden, Belgium, Switzerland, Finland, Ontario in Canada) so it seems biased/unscientific to leave it unmentioned.	Noted. Here, lower carbon energy is implicit in the first clause, the second clause adds specificity	Rauli Partanen	Think Atom	Finland
65715	5	20	5	21	"1) decarbonising electricity supply to produce net zero CO2, including through renewable energy, 2) [...]". This should be changed to "1) decarbonising electricity supply to produce net zero CO2, including through low-carbon energy, 2) [...]". There is no reason why renewables should be promoted over other low-carbon technologies.	Noted. Here, lower carbon energy is implicit in the first clause, the second clause adds specificity	Eero Hirvijoki	Aalto University	Finland
84435	5	20	5	21	"1) decarbonising electricity supply to produce net zero CO2, including through renewable energy" I do not understand the meaning of the word "through" here. Also, the increased use of renewables world-wide is obvious, why mentioning it specifically here? Why not a more general "non-fossil energy" or similar?	Noted. Here, lower carbon energy is implicit in the first clause, the second clause adds specificity	Mattias Lantz	Uppsala university	Sweden
79703	5	21			Through renewable and nuclear energy	Noted. Here, lower carbon energy is implicit in the first clause, the second clause adds specificity	valerie faudon	SFEN	France
5249	5	21	5	21	Add "nuclear" after renewable. Once more, nuclear will have a greater contribution than renewables!	Noted. Here, lower carbon energy is implicit in the first clause, the second clause adds specificity	Michel SIMON	Retraité/ Pdt d'association	France
83073	5	21	5	21	Wouldn't that be better "net zero GHG"? (thinking of CH4 and SF6 here)	Noted. CH4 emissions are discussed in point (6). Most discussion on power generation around net zero CO2.	Geden Oliver	German Institute for International and Security Affairs	Germany
49701	5	22	5	22	Why does it separate between transport and electric vehicles? It would be better to refer to transport in general, because otherwise it might be understood that the main focus is just on road vehicles, we need to accelerate electrification of all transport modes (or other alternative energy sources).	Accepted. "electric vehicles" deleted	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
79441	5	22	5	22	Why does it separate between transport and electric vehicles? Please refer to transport in general, because otherwise it might be understood that the main focus is just on road vehicles, we need to accelerate electrification of all transport modes (or other alternative energy sources).	Accepted. "electric vehicles" deleted	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
5111	5	24	5	26	Setting ambitious targets certainly is important, but how about consequent implementation?	Accepted. Added "and meeting"	Lina Hollender	n/a	Germany
307	5	25	5	25	methane is defined in WGI as one of the short-lived climate forcers.	Accepted. Revised to read "and other short-lived"	Sandro Fuzzi	ISAC CNR	Italy
64271	5	25	5	26	"Setting stronger targets for net zero"	Rejected. This is not the point the ES is trying to make and would be policy-prescriptive	Christian Lelong	Kayros	United Kingdom (of Great Britain and Northern Ireland)
18121	5	27	5	35	Towards the end of this paragraph, I recommend including this sentence: "shifting development pathways and accelerating mitigation involve a broad range of stakeholders and decision-makers, at multiple geographical and temporal scales. They require a credible and trusted process for reconciling perspectives and balancing potential side-effects, managing winners and losers and implementing compensatory measures to ensure an inclusive just transition" lines 32-35, p90	Accepted. The substantive elements have been taken up, though text kept brief (given this is a summary)	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
10577	5	28	5	29	The information content of this sentence is rather weak (this is an understatement!)	Noted. Sentences added afterwards on temporal dimensions of transition.	Philippe Waldeufel	CNRS	France
55149	5	30	5	30	Define SDPS here.	Taken into account. The SDPS acronym is defined 2 paragraphs above. A glossary entry on SDPS has been developed.	Government of United States of America	U.S. Department of State	United States of America
30679	5	34	5	35	It says "In a nut shell, think about climate whenever you make choices about development, and vice versa.", but this message sounds lacks scientific legitimacy.	Accepted. Text revised	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
47197	5	34	5	35	It is not a scientific statement you are expected to find in an IPCC report	Accepted. Text revised	Stuart Minchin	The Pacific Community	Australia
78399	6	3	6	3	only one mitigation (temperature) goal	[Accepted] done	Jim Shea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
55151	6	6	6	9	In order to advance topics related to inclusion, authors might consider adding a fourth question that sign posts their concerns related to this topic, for example: "4) How can we ensure this shift is equitable and adheres to the SDGs?"	Noted. After consideration, we ruled against adding a fourth question, considering that SDGs are already mentioned, and that equity issues figure prominently later in the introduction.	Government of United States of America	U.S. Department of State	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
55153	6	7	6	8	The framing questions for the second item are normative questions that should have no place in an IPCC report: "Where do we want to go? That is, how should the state of affairs shift to tackle the climate crisis and achieve the sustainable development objective?" IPCC reports are supposed to provide an information base for decisionmaking and should not be prescriptive. This question should thus be rephrased as "What would we have to do to attain these objectives?" without providing a normative evaluation of those objectives.	[Rejected] We have framed this in terms of expressly accepted political objectives: Paris goals and SDGs	Government of United States of America	U.S. Department of State	United States of America
55155	6	9	6	9	The word "necessary" should be reserved for logical necessity. The change may be important, desirable, critical, etc., but it is only necessary or required relative to some objective and not in an absolute sense. Statements need to be read as true even to people who do not share the same views on climate and development goals. One possible solution is replace "the necessary change" with "this shift".	[Accepted] done	Government of United States of America	U.S. Department of State	United States of America
83075	6	12	6	12	1.5 and 2C are part of one PA "long-term temperature goal" (LTTG, singular).	[Accepted] done	Geden Oliver	German Institute for International and Security Affairs	Germany
60271	6	13	6	16	LTN: These sentences could be enhanced for clarity. The authors could clarify the type of support. Whether from developed to developing countries or from governments to provide adequate policies to foster innovation or behavioral changes, etc? Support has multiple meanings. Second, the statement on the continuation along the same pathway will not lead to change is a truism, if the authors do not specify what the pathway is.	[Accepted] both done	Leonardo Nascimento	NewClimate Institute and Wageningen University and Research (WUR)	Germany
83077	6	15	6	16	"sufficiently address" might be better (or another qualifier)	Noted. Sentence modified to better qualify what pathway we are talking about here.	Geden Oliver	German Institute for International and Security Affairs	Germany
375	6	23	6	32	Greenhouse gas (GHG) emission pathways compatible with temperature goals of the Paris Agreement may be deficient over the short- and mid-term. More acute transformational changes have been recommended that would advance mitigation and development pathways to achieve these goals. Consideration should be given to adding a section to Chapter 4 dedicated to these proposed transformational changes.	[Rejected. Ch4 precisely discusses more acute "shifts in development pathways" in section 4.4]	Michael Kennish	Rutgers University	United States of America
55157	6	29	6	32	This seems like a point in which the notions of equity can be linked to the SDGs. Though the second question alludes to this, a more explicit mention would be useful. Adding something along the lines of "with the most acute impacts felt by those LDCs, who, traditionally, have had the lowest per capita emissions yet are most vulnerable to the impacts of climate change" citing other chapters as the authors deem appropriate.	Rejected. While equity issues are particularly important, this sentence is only intended to provide a preview of the chapter structure and main messages. Equity issues are discussed later in the introduction.	Government of United States of America	U.S. Department of State	United States of America
66777	6	29	6	32	As a stylistic point, probably need to have citations if there is a confidence statement, no? I realise that the data and assessment comes later, so unclear if one can have the confidence statement up front in the absence of the data and cites.	Noted. This introduction summarizes material (and associated confidence statement) found in subsequent sections.	Navroz Dubash	Centre for Policy Research	India
65477	6	46	6	46	Could you signpost where Just Transitions are explored in the report? I.e. Chapter 17.	Noted. A full section on the treatment of equity and just transition is added at the end of the introduction.	Albertine Pegrum-Haram	European Climate Foundation	United Kingdom (of Great Britain and Northern Ireland)
55159	7	22	7	22	Insert "by" before "a"	Accepted	Government of United States of America	U.S. Department of State	United States of America
71381	8	4	8	4	4.2. Mitigation actions across scales - NDSS - blue contributions (ocean&marine) are not mentioned. According to UNFCCC Climate Dialogues, Ocean Dialogues, several Parties will be including those in their NDCs. Maybe this area needs to be addressed in the report.	[Rejected. Blue carbon is dealt with in section 4.4.2]	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
55161	8	4	9	43	Section 4.2 could be much more concise and informative. It is too much like an introductory text book and not enough like a "here is what is new from the research community" report. Some background is of course needed.	Noted. The comment says 4.2, but page/line numbers indicate 4.2.1. The intention is to provide background, as the reviewer suggests. Material has been added but 4.2.1 has been kept to 1.5 pages only.	Government of United States of America	U.S. Department of State	United States of America
1905	8	5			This section provides a fairly broad and well known overview of NDCs. Are there opportunities for strengthening it?	Noted. Literature on NDCs are new since AR5, and our task is to assess it, bearing in mind that not all readers may have the background.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71383	8	5			This section provides a fairly broad and well known overview of NDCs. Are there opportunities for strengthening it?	Noted. Literature on NDCs are new since AR5, and our task is to assess it, bearing in mind that not all readers may have the background.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
377	8	6	8	45	Nationally Determined Contributions (NDCs) constitute the principal instrument of the Paris Agreement for assessing GHG emissions and building resilience to climate change effects. They are important in framing mitigation options and development pathways. However, there are ongoing problems with the NDC database. As noted by Pauw et al. (Climate Change, 147:23-29, 2018), NDCs are difficult to analyze and compare, while also being uneven in coverage of different emitting sectors. Some studies vary considerably, which affects clarity and effectiveness. They describe mitigation actions but often lack sufficient details on mitigation goals, which also need to be more comparable. In addition, many mitigation actions do not define emission reductions directly, and their effect on emissions is estimated indirectly. NDCs vary in scope and content in different countries and need to be more transparent. Furthermore, they provide insufficient details on costs and implementation financing. These deficiencies, which are significant since they may affect the overall accuracy of projected emission reductions, are not adequately covered in Chapter 4. Discussion of uncertainty of the NDCs (section 4.2.2.7) consists of only two paragraphs. This section needs to be expanded to discuss in more detail the uncertainties of the NDC estimates. The NDCs have profound implications for the remainder of the chapter (see Section 4.2). Section 4.2 reflects the problem and demonstrates that collective mitigation actions will fall short of the Paris Agreement temperature goals. Simply referencing the UNEP GAP Report is not sufficient when discussing limitations of the NDCs.	Noted. Discussion of uncertainty about NDCs (4.2.2.7) has been expanded. Uncertainty in NDC has also been taken into account when estimating aggregate implications of NDCs.	Michael Kennish	Rutgers University	United States of America
75031	8	12	8	17	I believe that the reference (UNFCCC 2015a) do not cover the information (e.g., "by December 2020, the official NDC 15 registry contained 188 first NDCs, equivalent to 99% of total anthropogenic GHG emissions, as of 2019") in the text. From UNFCCC (2021): "The coverage of sectors and GHGs has increased in the new or updated NDCs compared with the Parties' previous NDCs (see figure 3), covering 99.2 per cent (13.86 Mt CO2 eq) of the Parties' total economy-wide emissions in 2017, up from 97.8 per cent (13.72 Mt CO2 eq) previously. The number of Parties communicating economy-wide targets has also increased (by around 7 per cent). UNFCCC, 2021. Nationally determined contributions under the Paris Agreement Synthesis report by the secretariat, Conference of the Parties serving as the meeting of the Parties to the Paris Agreement Third session Glasgow, 1–12 November 2021. Glasgow, Ireland.	Accepted. Sentence and reference revised.	Jesper Pedersen	University of Lisbon	Portugal

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
75035	8	12	8	26	This text is from my Doctoral thesis. Feel free to use text and references: The Parties' commitment to developing and renew NDCs form a key part of the Paris climate agreement, preparing their commitments for the post-2020 period (Levin et al., 2014; UNFCCC, 2016). Prior to COP21, in 2015, about 147 parties submitted their INDCs (Intended Nationally Determined Contributions), including mitigation targets for 2025 or 2030 (UNFCCC, 2015a). INDCs become first NDCs on ratification and/or after national governments' revision (UNEP, 2017). The Parties will undertake their first global stocktake in 2023 and every five years thereafter (UNFCCC, 2015b), measuring their progress on their second NDC objectives, to be submitted by 2020 (UNFCCC, 2015c). By March 2021, the official NDC registry contained 191 first NDCs. Eight of these submitted their second NDC (UNFCCC, 2021a). 191 out of 197 countries cover 92.8 % of total global GHG emissions (ClimateWatch, 2021). As agreed in the Paris Agreement, Countries will take their first stock in 2023. According to UNFCCC, 51 parties submitted the second or renewed their first NDCs by march 2021 (UNFCCC, 2021b), while Climate Watch identified 75 out of 197 countries (comprising about 30% of total global GHGs) (ClimateWatch, 2021). The submitted NDCs vary in content, scope, and background assumptions. 45% of the first NDCs included absolute emission reduction targets. These were expressed as emissions reductions below the level in a specified base year – varying between 1990-2015) and ranging from 9.8% to 75% (UNFCCC, 2016). Their primarily contain mitigation targets, while several also describe national adaptation plans (UNFCCC, 2021c). References: ClimateWatch, 2021. Commitments: Overview [WWW Document]. URL https://www.climatewatchdata.org/ndc-overview Levin, K., Rich, D., Bonduki, Y., Comstock, M., Tirpak, D., Mcgray, H., Noble, I., Mogelgaard, K., Waskow, D., 2014. DESIGNING AND PREPARING INTENDED NATIONALLY DETERMINED CONTRIBUTIONS (INDCs). UNEP, 2017. The Emissions Gap Report 2017. Nairobi. UNFCCC, 2021a. NDC Registry (interim): The Latest Submissions [WWW Document]. URL https://www4.unfccc.int/sites/ndcstaging/Pages/LatestSubmissions.aspx (accessed 3.14.21). UNFCCC, 2021b. Updated or new NDCs submitted [WWW Document]. Process and meetings. URL https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs/ndc-submissions (accessed 3.14.21). UNFCCC, 2021c. Nationally determined contributions under the Paris Agreement Synthesis report by the secretariat, 2021.	Noted.	Jiesper Pedersen	University of Lisbon	Portugal
75033	8	13	8	14	The reference (UNFCCC 2015) do not cover this "INDCs become first NDCs on INDCs become first NDCs on ratification and/or after national governments' revision". I find it for instance in the UNEP Emissions gap report from 2017 stating that 168 countries ratified the Paris Agreement and the INDCs became NDCs. Maybe UNFCCC has a reference for this but not sure? [UNEP, 2017. The Emissions Gap Report 2017. Nairobi.]	Noted. Reference and sentence revised.	Jiesper Pedersen	University of Lisbon	Portugal
55163	8	13	8	23	"which include mitigation targets for 2025 or 2030": Not all INDCs included mitigation targets; some included policies and actions without targets. (Targets used twice, lines 13 and 19)	Noted. There are different views in the literature as to whether targets, for example, to have xxx GW renewable energy, are 'mitigation targets' or not. We elaborate on SOD p8, lines 20 the different kinds of 'mitigation targets'	Government of United States of America	U.S. Department of State	United States of America
55165	8	16	8	16	Not sure what "three second NDC" means.	Noted. We meant second round of NDCs. Text revised.	Government of United States of America	U.S. Department of State	United States of America
74811	8	16	8	16	Add Through decision 1/CP.21 (Paris, 2015), Parties agreed to prepare new/updated NDCs and communicate these to the UNFCCC secretariat by 2020	Rejected. Too detailed for the limited space available here.	Government of Kenya	Kenya Meteorological Service	Kenya
74813	8	16	8	16	Add:Kenya submitted its Updated NDC with a new target of reducing emissions by 32% by 2030 and with internally increased finance support of mitigation actions	Rejected. Section 4.2.1 does not intend to list all Parties submissions.	Government of Kenya	Kenya Meteorological Service	Kenya
74815	8	16	8	16	consider removing the word "second" and replacing it with "New" or "updated"	Accepted.	Government of Kenya	Kenya Meteorological Service	Kenya
55167	8	22			"intensity targets (in terms of GHG, CO2 or energy)": Should specify that this is per unit GDP.	Rejected. Other types of targets do not specify units either, e.g. we do not state that fixed level targets are in Mt or Gt. The relevant variation on intensity is explained in brackets	Government of United States of America	U.S. Department of State	United States of America
55169	8	23			"some developing countries included unconditional targets, while others included conditional ones": This suggests that countries do one or the other, when in fact many do both.	Accepted. Language revised to mention conditional and unconditional "elements" of NDCs.	Government of United States of America	U.S. Department of State	United States of America
55171	8	23			it is not necessarily the case that all conditional targets are more ambitious than all unconditional targets. What is meant is that in cases where a single country includes both an unconditional and a conditional target, the latter is more ambitious, but this is not what the text currently says.	Accepted. Terminology clarified.	Government of United States of America	U.S. Department of State	United States of America
75029	8	25	8	26	Regarding the sentence: "In some NDCs, the additional mitigation is quantified, in others not" Just to be sure, do you mean the additional mitigation from unconditional to conditional mitigation? Please clarify. In several NDCs, mitigation is not quantified. The most common example, China, did not state a specific GHG estimate but a peak-year (2030). However, I like the concise and short descriptions of the NDCs in the chapter!	Noted. This sentence indeed refers to the additional mitigation associated with the conditional elements of NDCs.	Jiesper Pedersen	University of Lisbon	Portugal
55175	8	27			It is not clear what is meant by "all specific sectors," but if this refers to all of the IPCC sectors, the statement is not correct. In the latest ClimateWatch data, 97 NDCs cover all sectors including LULUCF, 16 cover all sectors except LULUCF, 71 do not cover all sectors, and 11 do not specify. Quantitatively, only 49% cover all sectors including LULUCF. Moreover, these data reflect all the recent updates (i.e., revised first NDCs and second NDCs), many of which expanded sectoral coverage, so if you are looking only at first NDCs, the number with complete coverage would be lower still. (Source: https://www.climatewatchdata.org/ndcs-explore?category=mitigation&indicator=coverage_sectors)	Rejected. By context, it is clear that IPCC sectors are meant - this is an IPCC report, we cite IPCC several times in the paragraph and refer to AFOLU, a key IPCC sector.	Government of United States of America	U.S. Department of State	United States of America
24919	8	27	8	27	"including AFOLU and LULUCF" is not wrong, but sounds a little bit strange. An alternative formulation may be "regarding AFOLU (which comprises non-CO2 emissions from agriculture and mostly CO2 emissions from LULUCF)". This could also facilitate the understanding of text later on, when LULUCF is used without explaining the difference with AFOLU	Accepted, text revised.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
55173	8	27	8	27	AFOLU and LULUCF need definitions here.	Rejected. Definitions are in glossary, but text revised.	Government of United States of America	U.S. Department of State	United States of America
5251	8	29	8	29	Replace "renewable" by "low carbon"	Rejected. Many NDCs actually mention "renewables" and not "low carbon"	Michel SIMON	Retraité/ Pdt d'association	France
55179	8	30			This is not only due to uncertainty in LULUCF accounting, but also the fact that rules for clarity, transparency, and understanding had not yet been negotiated; either way, a citation should be provided.	Taken into account. ICTU is assessed on p9, 11-9 of SOD	Government of United States of America	U.S. Department of State	United States of America
55177	8	30	8	33	Did these countries really state unequivocally that the reason they didn't include LULUCF in their NDCs is the uncertainty behind the accounting? Citations for the second half of the sentence substantiating that assertion would be appropriate.	Noted. We ascribe the uncertainty to Grassi and Jian papers, cited	Government of United States of America	U.S. Department of State	United States of America
24921	8	31	8	31	I think it's "Jia et al. 2019" not "Jian"	Accepted. Reference corrected.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
55181	8	34			"few NDCs also include F-gases": 68 NDCs now include F-gases; "few" is not specific, but it probably leads the reader to expect fewer than 68 (source: https://www.climatewatchdata.org/ndcs-explore?category=mitigation&indicator=coverage_gas)	Noted. Few is used in a relative sense. The UNFCCC synthesis report (2021) notes that "In terms of GHGs, almost all NDCs cover CO2 emissions, most cover CH4 and N2O emissions, many cover HFC emissions and some cover PFC, SF6 and NF3 emissions". Fewer include F-gases than CO2	Government of United States of America	U.S. Department of State	United States of America

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15061	8	37	8	45	Due to the differences in the statistical caliber of countries in the world, it is difficult to quantify the emissions of each country in the NDC target year, which requires a unified standard to regulate it. In this regard, the center for energy and environmental policy research of Beijing University of Technology (ceep-bit) has proposed quantitative criteria based on intensity and structure. Considering the uncertainty of NDC target calculation, these two sets of criteria can help to determine the emissions of relevant countries in the target year. Page 8, lines 37-45: This is not mentioned in the literature review on national mitigation paths under NDC objectives. 1. It is suggested to add this point to fully discuss the difficulties and challenges involved in NDC research. 2. It is suggested to add the following after line 45 on page 8: "Considering countries have different statistical caliber that make it harder to calculate NDC emissions targets, CEEP-BIT research community develops carbon emission evolution principle from the perspective of carbon intensity (carbon emission evolution principle by intensity, CEEP-I) and carbon emission evolution principle from the perspective of the relationship between economic development and CO2 emissions (carbon emission evolution principle by structure, CEEP-S) to simulate the Business as Usual scenario in the process of determining each country's target year emissions under NDCs.(Wei et al.2018)" (CEEP-BIT: Center for Energy and Environmental Policy Research-Beijing Institute of Technology) Supporting literatures : Wei, Y. M. et al. An integrated assessment of INDCs under Shared Socioeconomic Pathways: an implementation of C3IAM. Nat. Hazards 92, 585–618 (2018). Rogelj, Joeri, et al. Paris Agreement climate proposals need a boost to keep warming well below 2C Nature 534(7609): 631-639 (2016). Van Beck, Lisette, et al. Anticipating futures through models: the rise of Integrated Assessment Modelling in the climate science-policy interface since 1970. Global Environmental Change 65: 102191 (2020)	Noted.	Guoquan HU	National Climate Center of China Meteorological Administration	China
66779	8	38	8	43	Benchmarking of NDCs against equity benchmarks is another category, including Du Pont et al, Kartha et al, Dooley et al among others.	Noted. Equity dimensions of equity are discussed in section 4.2.2	Navroz Dubash	Centre for Policy Research	India
15377	9	7	9	8	I would also highlight that neither the Paris Agreement nor the Paris Rulebook define the terms "fair" or "ambitious", leaving countries to decide whether and how to define these terms or consider them in setting their NDCs. The citation on line 8 (Winkler et al 2018) delves into how this is problematic in showing the limited numbers of countries who consider equity and science-based targets in these considerations. See for e.g. this sentence in Chapter 14 on page 24 at lines 23-25: "In the first round of NDCs, most Parties declared their NDCs as fair (Robiou du Pont et al. 2017). Their claims, however, were largely unsubstantiated or drawn from analysis by in-country experts (Winkler et al. 2018)."	Noted.	Christie McLeod	Miller Thomson LLP	Canada
64149	9	9	9	16	The number of relevant articles (580) is not consistent with the number of articles per country mentioned in the paragraph according to the percentage values indicated (e.g. if Brazil 125 articles is 20% then the total is around 625)..	Noted. Description of available literature not retained in final government draft for space reasons.	Diego Silva Herran	National Institute for Environmental Studies	Japan
379	9	9	9	19	The peer-reviewed literature on NDCs since December 2019 includes about 580 journal articles, but only 40% of these articles mentions pathways or scenarios, and only a subset of these articles provide quantitative estimates for NDC assessment. In addition, there is nonuniform regional distribution of emitting countries, with large emitting countries being more heavily represented in the database. What deficiencies does these factors play for assessment of databases and mitigation targets at the national and global level? There is no discussion about this in Section 4.2.1.	Noted. Uncertainties about NDCs, including distribution of studies, is conducted in section 4.2.2.7.	Michael Kemish	Rutgers University	United States of America
47351	9	9	9	19	Two suggestions: (1) Box S1 is almost impossible to read. Please improve the resolution. (2) I find it really important to highlight that there is major lack of studies on several top 20 emitting economies (as per e.g. EDGAR database) including Russia and Iran, and that this (regional) knowledge gap can be a serious bottleneck for implementing the Paris Agreement.	Noted. Detailed description of literature dropped from FGD due to space constraints.	Takeshi Kuramochi	NewClimate Institute	Germany
5027	9	14	9	14	The authors write "with some 125 articles..."	Not clear what this comment is about	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
15063	9	21			The definition and scope of NDC proposed by various countries are not uniform, diverse and not comparable. Therefore, different literatures discuss the influence of NDC in different countries on a global scale. It is suggested to increase the datasets and accounting standards for the global NDC, and put forward suggestions for the unified accounting standards that countries can refer to when updating the NDC in the future. This problem has been raised or dealt with in many literatures, for example: 1. Rogelj, J. et al. Understanding the origin of Paris Agreement emission uncertainties. Nat. Commun. 8, 15748 (2017). 2. Vandyck, T., Keramidas, K., Saveyn, B., Kitous, A. & Vrontisi, Z. A global stocktake of the Paris pledges: implications for energy systems and economy. Glob. Environ. Change 41, 46-63 (2016). 3. Aldy, J. et al. Economic tools to promote transparency and comparability in the Paris Agreement. Nat. Clim. Change 6, 1000-1004 (2016). 4. Wei et al. Self-preservation strategy for approaching global warming targets in the post-Paris Agreement era. Nature Communications 11, 1624 (2020). 5. Rogelj, J., & Schlessner, C. F. Unintentional unfairness when applying new greenhouse gas emissions metrics at country level. Environ. Res. Lett. 14, 114039 (2019). 6. Fawcett, A. A. et al. Can Paris pledges avert severe climate change? Science 350, 1168–1169 (2015). 7. Fujimori, S. et al. Implication of Paris Agreement in the context of long-term climate mitigation goals. Springer Plus 5, 1620 (2016).	Rejected. The indicated literature is already part of the review presented in this section.	Guoquan HU	National Climate Center of China Meteorological Administration	China
20599	9	28	9	33	In this paragraph presenting following subsections, could you also consider mentioning section 4.2.2.5?	[Accepted] Section 4.2.2.5 was added.	Government of France	Ministère de la Transition écologique et solidaire	France
1907	9	44			Very good overview of the studies and methods and the different approaches adopted. However, the section does not elaborate on what the implications are for the chapter assessment and if or how these issues have been dealt with/harmonisation has been pursued.	Accepted. New paragraph added just before end of Section 4.2.2.1 to elaborate on implications for subsequent sections.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71385	9	44			Very good overview of the studies and methods and the different approaches adopted. However, the section does not elaborate on what the implications are for the chapter assessment and if or how these issues have been dealt with/harmonisation has been pursued.	Accepted. New paragraph added just before end of Section 4.2.2.1 to elaborate on implications for subsequent sections.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
47367	9	44	10	31	On the first part of Section 4.2.2.2., the authors attempt to discuss several variables altogether (current policies vs NDCs, country-level analysis vs. global analysis, modelling approaches) but because of this the section is rather difficult to read through and understand (especially in para in L21 of P10). It might work better if the national level assessment is discussed first, followed by the global assessment.	Noted. Section revised to make it easier to read.	Takeshi Kuramochi	NewClimate Institute	Germany

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
47371	9	44	10	31	One point worth adding in terms of different quantification approaches for current policies projections is that some studies (e.g. Climate Action Tracker or Kuramochi et al. 2019: https://www.pbl.nl/en/publications/greenhouse-gas-mitigation-scenarios-for-major-emitting-countries-2019-update) use the official GHG inventory data and the NDC emissions/sector coverage and GWPs so that the projections are directly comparable with official numbers on NDCs reported by national governments, whereas other studies use independent historical GHG database (e.g. EDGAR) and cover all GHGs and sectors. This often has major implications for the assessment of countries with large land-use emissions, where the discrepancies between official and independent emission estimates are very large. P10 para from L27 covers the above points partially, but not the motivation behind these different choices.	[Accepted] The use of different GWPs across studies is covered (see third item in Section 4.2.2.2 and footnotes to Table 4.1). This has been complemented by a sentence on different emission inventories.	Takeshi Kuramochi	NewClimate Institute	Germany
47369	9	46	10	2	On the importance of distinguishing official and independent estimates, it is not entirely clear from the subsequent paragraphs why exactly this is the case. For current policies projections, for example, it would be good to note that there may be incentives for national governments to show through their official communications that their NDCs are ambitious by showing a rather inflated current policies projections, or, other way round, to show that they're on track to meet their NDCs by overestimating the impact of implemented policies.	Noted. The majority of studies reviewed as independent.	Takeshi Kuramochi	NewClimate Institute	Germany
9881	9		10		A variety of different methods are used to assess emissions implications of NDCs and current policies over the time horizon to 2025 or 2030. It is important to distinguish between projections explicitly submitted as part of an official communication to UNFCCC (e.g., Biennial Report, Biennial Update Reports or National Communications) and independent studies. Methods that are used in independent studies (but that can also underlie the official communications) can broadly be separated into two groups. • System modelling studies which analyse policies and targets in a comprehensive modelling framework such an integrated assessment, energy systems or integrated land-use model to project emissions (or other indicators) of mitigation targets in NDCs and current policies, either at the national or global scale (noting some differences in the systems), and • Hybridised approaches that typically start out with emissions pathways as assessed by other published studies (e.g., the IEA World Energy Outlook, national emissions pathways such as those specified in some NDCs) and use these directly or apply additional modifications to them.	Unclear what the comment is about. This is text from SOD.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
63577	10	42			AFOLU should be defined on page 8, line 27	Accepted. AFOLU acronym defined when first used.	Government of Canada	Environment and Climate Change Canada	Canada
9883	10		11		Beyond the method applied, studies also differ in a number of dimensions, including their spatial resolution and coverage, their sectoral resolution and coverage, the GHGs that are included in the assessment, the GWPs (or other metrics) to aggregate them, the set of scenarios analysed (Reference/Business-As-Usual, Current Policies, NDCs, etc.), and finally the degree to which individual policies and their impact on emissions are explicitly represented	Unclear what the comment is about. This is text from SOD.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
55183	11	14	11	14	"Fifth", not "Five" -- for consistency in text.	[Editorial] Corrected.	Government of United States of America	U.S. Department of State	United States of America
20189	11	28	11	31	Also consider Yang, X., Pang, J., Teng, F., Gong, R., & Springer, C. (2021). The environmental co-benefit and economic impact of China's low-carbon pathways: Evidence from linking bottom-up and top-down models. <i>Renewable and Sustainable Energy Reviews</i> , 136, 110438.	Accepted. Reference added	Nikas Alexandros	National Technical University of Athens	Greece
61677	11	31	11	32	"[...], the share of low carbon energy (Bertram et al. 2015; Riahi et al. 2015), renewable energy deployment (Roelofsma et al. 2018), [...]". This should instead read "[...], the share of low-carbon energy (Bertram et al. 2015; Riahi et al. 2015; Roelofsma et al. 2018), [...]".	[Rejected] We are reporting here the indicators identified in the literature, one of which is renewable energy deployment.	Rauli Partanen	Think Atom	Finland
65717	11	31	11	32	"[...], the share of low carbon energy (Bertram et al. 2015; Riahi et al. 2015), renewable energy deployment (Roelofsma et al. 2018), [...]". This should read instead "[...], the share of low-carbon energy and deployment (Bertram et al. 2015; Riahi et al. 2015; Roelofsma et al. 2018), [...]".	[Rejected] We are reporting here the indicators identified in the literature, one of which is renewable energy deployment.	Eero Hirvijoki	Aalto University	Finland
1909	11	36	11	36	The large gap between where the table is mentioned and where it is included is undesirable	[Editorial] Will be addressed in final layout.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71387	11	36	11	36	The large gap between where the table is mentioned and where it is included is undesirable	[Editorial] Will be addressed in final layout.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
18123	12	1	12	40	I think this page could be made clearer as not sure what is included in the global studies? The text says that "a range of globally comprehensive studies which estimate aggregate emissions outcomes NDCs", but the NDCs document were also used in the national studies so unsure why they vary so much in some cases?	[Accepted] The studies included in the assessment are described in the first paragraph of Section 4.2.2.3 (p.11) and they are listed in Table S4.1. The sentence highlighted by the reviewer refers back to the assessment of NDCs in SR1.5 which could be confusing. We have adjusted the sentence to more clearly differentiate between AR6 and SR1.5.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
1911	12	18	12	22	These numbers seem somewhat different compared to the estimates for G20 countries provided in the UNEP emissions gap report 2019 (page 12): "If we exclude the 1.6 GtCO ₂ e/year overachievement of unconditional NDCs by India, Russia and Turkey and assume that these countries will follow their current policies trajectory rather than that implied by their unconditional NDCs... then the G20 economies are collectively short of the unconditional NDCs by about 2.7 GtCO ₂ e/year against unconditional NDCs and by about 3.7 GtCO ₂ e/year against conditional NDCs in 2030." This may be because the current policy estimates of the studies underlying the assessment of this chapter are not fully updated. Would be useful to indicate up to when current policies are included.	Noted. The insights are broadly consistent with those of the UNEP gap report. At the same time there are some differences in approaches used by UNEP gap and IPCC report. Some of the studies in the IPCC report were not included in the UNEP gap report. Cutoff dates for current policies are included in Table S4.1.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71389	12	18	12	22	These numbers seem somewhat different compared to the estimates for G20 countries provided in the UNEP emissions gap report 2019 (page 12): "If we exclude the 1.6 GtCO ₂ e/year overachievement of unconditional NDCs by India, Russia and Turkey and assume that these countries will follow their current policies trajectory rather than that implied by their unconditional NDCs... then the G20 economies are collectively short of the unconditional NDCs by about 2.7 GtCO ₂ e/year against unconditional NDCs and by about 3.7 GtCO ₂ e/year against conditional NDCs in 2030." This may be because the current policy estimates of the studies underlying the assessment of this chapter are not fully updated. Would be useful to indicate up to when current policies are included.	Noted. The insights are broadly consistent with those of the UNEP gap report. At the same time there are some differences in approaches used by UNEP gap and IPCC report. Some of the studies in the IPCC report were not included in the UNEP gap report. Cutoff dates for current policies are included in Table S4.1.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
18125	12	23	12	29	It is important that it is clearly stated that the data in table 4.1 and the insights discussed are countries' first NDCs and that since countries have released updated NDCs, this is not the most up to date data. Although, the text has explained this (lines 23-29, page 12), it could be a lot clearer and upfront as it is currently in italics hidden between two other paragraphs.	Accepted. Section 4.2 now differentiates clearly between first NDCs, post-COVID updates, and new and updated NDCs.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
20601	12	23	12	29	We would like to encourage this approach. Although in addition to that, showing the changes between the first and the second round of NDC would also bring helpful and policy-relevant information	[Accepted] The approach will be implemented as suggested.	Government of France	Ministère de la Transition écologique et solidaire	France

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
62071	12	35	12	35	Perhaps some key studies need to be included, to give some credits to the underlying studies of Table 4.1, which have assessed all these national model studies. A key study that forms the basis of the UNEP spreadsheet is: * den Elzen, M.G.J., Kuramochi, T., Höhne, N., Cantzler, J., Esmeijer, K., Fekete, H., Franssen, T., Keramidis, K., Roelfsema, M., Sha, F., van Soest, H., Vandycck, T., 2019b. Are the G20 economies making enough progress to meet their NDC targets? Energy Policy 126, 238-250. A key modelling study is: * Roelfsema, M., van Soest, H. L., Harmsen, M., van Vuuren, D. P., Bertram, C., den Elzen, M., ... & Luderer, G. (2020). Taking stock of national climate policies to evaluate implementation of the Paris Agreement. Nature Communications, 11(1), 1-12. The only multi-model study that have assessed many non-G20 economies, and is also used in Table 4.1: * Kuramochi, T., L. Nascimento, M. Moiso, M. G. J. den Elzen, N. Forsell, H. van Soest, S. Gonzales Zúñiga, F. Hans, L. Jeffery, H. Fekete, T. Schieffer, M. J. de Villafranca Casas, G. de Vivo, I. Dafnomilis, M. Roelfsema and N. Höhne (2020 (under review)). "Greenhouse gas emission scenarios in nine key non-G20 countries: an assessment of progress toward 2030 climate targets." Environmental Science & Policy.	Rejected. Proposed reference are mentioned in Table S4.1.	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
15065	12	36	12	38	The description of statement does not match the fact, which is "For China, global studies show higher projections of current policies and NDCs in 2030 by several hundred MtCO2eq per year compared to national studies, but the ranges across the two groups of studies overlap.". The data in table 4.1 shows that the median value of global research carbon emission forecast is mostly lower than that of China research, and only the maximum value of global carbon emission forecast is higher than that of China research. The reason for this phenomenon is that the global carbon emission forecast contains more studies (32 studies and only 6 studies in China), resulting in a larger range of global forecast values. It is suggested to modify or delete the expression. In addition, in table 4.1, since the Chinese side does not provide the official peak emission specific value, it is suggested to make a certain balance in the number of domestic and foreign related articles to achieve a relatively fair assessment.	[Accepted] While the upper range of the global studies tends to be higher than the range from national studies, it is true that one average, the statement is not in line with the SOD version of the table. The statement has been adjusted to reflect the data shown in Table 4.1.	Guoquan HU	National Climate Center of China Meteorological Administration	China
18127	12	36	12	38	it's not clear what the reference to "ranges across the two groups" means from the following sentence "For China, global studies show higher projections of current policies and NDCs in 2030 by several hundred MtCO2eq per year compared to national studies, but the ranges across the two groups of studies overlap" Could the authors please consider re-wording the sentence to clarify the meaning?	[Accepted] The statement has been adjusted to become clearer and reflect the latest data shown in Table 4.1. While the upper range of the global studies tends to be higher than the range from national studies, it is true that one average, the statement is not in line with the SOD version of the table.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
53719	12	36	12	38	The description "for China, global studies show higher projections of current policies and NDCs in 2030 by several hundred MtCO2eq per year compared to national studies, but the ranges across the two groups of studies overlap" is not consistent with the content in Table 4.1. The data in Table 4.1 shows that most of the median value of global research carbon emission forecasts is lower than the forecast value of Chinese research, and only the maximum value of global carbon emission forecast is higher than the forecast value of China. The reason for this phenomenon is that the global carbon emission forecast contains more studies (32 studies, and only 6 studies in China), resulting in a larger range of global forecast values. It is recommended to modify or delete this sentence.	[Accepted] While the upper range of the global studies tends to be higher than the range from national studies, it is true that one average, the statement is not in line with the SOD version of the table. The statement has been adjusted to reflect the data shown in Table 4.1.	ZHENG XINZHU	China University of Petroleum (Beijing)	China
381	13	3	13	11	Greater sectoral involvement is needed in future NDC assessments to achieve climate goals. For example, only 21% of NDCs are specific targets for the transport sector, 27% for the buildings sector, and 36% for the agricultural sector. These sector measures must be improved in future studies to facilitate positive results for climate goals of the Paris Agreement.	Noted. Next paragraph already notes the importance of "greater sectoral expertise".	Michael Kemish	Rutgers University	United States of America
5253	13	4	13	7	In the Energy sector, the author emphasize the share of renewable energies in the referenced study. This is very ambiguous: what is the share of Hydro?, of biomass? Etc.. And in addition, what is the share of nuclear, since many countries are considering the development of nuclear energy? this has definitively to be improved to give a fair description of te perspectives.	[Rejected] The statement is factual about indicators being identified in the literature.	Michel SIMON	Retraité/ Pdt d'association	France
61679	13	6	13	7	"[...] around 50% of which include a specific target for renewables share (Stephan et al. 2016)." Stephan et al. 2016 also reports 9 countries with plans for increasing nuclear in their INDCs. Notably, India's plan contains 63 GW of nuclear, 100 GW of solar, and 60 GW of wind capacity. Adjusted for capacity factors of different technologies, the added nuclear will provide roughly equal amount of electricity as the wind and solar capacities combined. This should be reflected in the statement, for example: "[...] around 50% of which include a specific target for low-carbon energy share (Stephan et al. 2016)."	[Accepted] The statement has been adjusted to also mention the low-carbon energy share.	Rauli Partanen	Think Atom	Finland
65719	13	6	13	7	"[...] around 50% of which include a specific target for renewables share (Stephan et al. 2016)." The paper (Stephan et al. 2016) also reports 9 countries with plans for increasing nuclear in their INDCs. Notably, India's plan contains 63 GW of nuclear, 100 GW of solar, and 60 GW of wind capacity, respectively. Accounting for the capacity factors, this means that the added capacity of nuclear will provide roughly equal amount of electricity as the wind and solar capacities combined. Therefore the statement should read "[...] around 50% of which include a specific target for low-carbon energy share (Stephan et al. 2016)."	[Accepted] The statement has been adjusted to also mention the low-carbon energy share.	Eero Hirvijoki	Aalto University	Finland
3473	13	11	13	11	It is suggested to add a new paragraph: "For instance, the cement is involved in new initiatives to reach the net carbon neutrality by 2050. Therefore, some roadmaps summarising breakthrough technologies and levers to achieve mentioned target (Sanjuán et al. 2020)" ==> Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. Energies 2020, 13, 3452. https://doi.org/10.3390/en13133452	[Rejected] The level of detail covered by this paragraph stays at the level of sectors. Specific information on cement industry would be more appropriately covered in the industry chapter (11).	Miguel Angel Sanjuán	IECA	Spain
10363	13	11	13	11	It is suggested to add a new paragraph: "For instance, the cement is involved in new initiatives to reach the net carbon neutrality by 2050. Therefore, some roadmaps summarising breakthrough technologies and levers to achieve mentioned target (Sanjuán et al. 2020)" ==> Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. Energies 2020, 13, 3452. https://doi.org/10.3390/en13133452	[Rejected] The level of detail covered by this paragraph stays at the level of sectors. Specific information on cement industry would be more appropriately covered in the industry chapter (11).	Aniceto Zaragoza	Oficemen	Spain
11519	13	11	13	11	It is suggested to add a new paragraph: "For instance, the cement is involved in new initiatives to reach the net carbon neutrality by 2050. Therefore, some roadmaps summarising breakthrough technologies and levers to achieve mentioned target (Sanjuán et al. 2020)" ==> Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. Energies 2020, 13, 3452. https://doi.org/10.3390/en13133452	[Rejected] The level of detail covered by this paragraph stays at the level of sectors. Specific information on cement industry would be more appropriately covered in the industry chapter (11).	PEDRO MORA PERIS	UNIVERSITY	Spain
55185	14	1	14	3	Great table. Legend needs more explanation of how to read it though.	[Accepted] Legend has been expanded to include guidance of how to read/interpret table.	Government of United States of America	U.S. Department of State	United States of America
18129	14	1	16	15	Table 4.1- how were the countries included in the table selected?	[Accepted] In the introduction to Section 4.2.2.3 additional explanation about the selection of countries in Table 4.1 has been provided.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
18131	14	1	16	15	The EU seems to be EU28 (including UK). This should be made clearer, unless the UK and EU27 will be covered separately following updates.	[Accepted] A footnote on the EU definition has been added to Table 4.1.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
9051	14	1	16	17	It would be good to make the lines bold/darker between countries. As it is, it is easy to get the numbers for one country confused with those of the countries above or below.	[Editorial] The table will be edited for better legibility in the final published version.	Singfoong Cheah	Independent consultant, formerly more than 10 years with the National Renewable Energy Laboratory, USA	United States of America
5255	14	1	16	27	Surprisingly, the total emissions including AFOLU as shown in the table are lower -for some countries like USA, EU, SAU... than the emissions due to fossils fuels only. Could you explain?	[Noted] In some countries land acts as a carbon sink which can even overcompensate non-CO2 emissions from land-based activities (e.g., methane and N2O from agriculture).	Michel SIMON	Retraité/ Pdt d'association	France
55187	14	17	14	17	Does AFOLU include both emissions and removals? Need clarification in table heading. For example, the U.S. numbers seem to suggest removals are included as AFOLU reduces the net emissions, whereas China numbers make emissions higher. What's going on? Need consistent reporting to be able to compare.	[Noted] Net emissions, including both sinks and sources are reported. Footnote 1 to Table 4.1 provides an explanation of the difficult data situation regarding FOLU emissions (which is discussed in more detail in Chapter 7 and a cross-chapter box).	Government of United States of America	U.S. Department of State	United States of America
16281	14	17	15	17	The "official" row for most countries including KOR(Republic of Korea) is left blank. The "official" value for KOR was provided in FOD, but it is now deleted. Not sure it was intended. When reflecting the updated NDCs and other UNFCCC information between SOD and FGD, the chapter team will need to pay attention to the table 4.1 and double check all the values in the table.	Accepted. Table checked with latest data at time of writing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
71391	14		14		Please specify whether EU value is EU27 or EU27+UK	[Accepted] A footnote on the EU definition has been added to Table 4.1.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
71393	14		14		Discussion in the parts of the chapter referring to this table should make clear that the difference between current policy scenarios and NDC can mean very different things in different national contexts. If current policies fall short of the NDC, this could indicate a lack of progress on implementation, but also that the target is ambitious (and implementation a work in progress). Conversely when current policy projections already meet the NDC projection, this could be due to good progress on implementation, or simply because the target is not ambitious. These considerations, as well as some discussion on the effect of translating official projections into the AR6 metric, should be included in the text.	[Accepted] A brief description of these differences has been added to quantification of the "implementation gap" in Section 4.2.2.3.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
20603	16	18	16	18	Please specify whether this is EU 28 (with UK) or EU27	[Accepted] A footnote on the EU definition has been added to Table 4.1.	Government of France	Ministère de la Transition écologique et solidaire	France
24923	16	25	16	27	I appreciate the inclusion of the text "Note that FOLU emissions from national GHG inventories and global/national land use models are generally different due to different accounting approaches (Grassi et al. 2018, 2020)(see Section 7.2.3 and Cross-Chapter7 Box 3)". I just suggest small rephrasing: "Note that AFOLU CO2 emissions from national GHG inventories and global/national land use models are generally different due to different approaches to estimate the anthropogenic CO2 sink (Grassi et al. 2018, 2020)(see Section 7.2.3 and Cross-Chapter7 Box 5)". Since FOLU is not defined earlier, AFOLU CO2 sounds better. Box 5 instead of 3. Suggest to mention explicit that the issue is on the anthropogenic CO2 sink (i.e. where the main problem is). Furthermore, I encourage authors to consider adding in the text some additional information on the medium-term implication of box 5 in ch 7. These implications are potentially relevant - i.e. the "remaining GHG budget" as perceived by countries could be reduced when IAMS' results are made "comparable" to country GHG and climate plans - but not well know yet.	[Accepted] Text has been adjusted as suggested by reviewer.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
85759	16	27	16	27	Suggest should be updated to reflect the US re-entry into the Paris Agreement.	Accepted. Footnote has been adjusted.	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
10579	17	1	17	21	This is a critical issue. Subsection 4.2.2.4 will have to be updated and expanded for the final version.	Accepted. Section 4.2.2.4 has been expanded to reflect latest literature on implications of COVID-19.	Philippe Waldeufel	CNRS	France
16283	17	1	17	21	In SOD, 4.2.2.4 subsection has been newly added. However, given the importance and far-reaching impacts of COVID-19 pandemic across the globe, including the significant impacts on major emitting industrial sectors and GHG emissions, current discussion of subsection 4.2.2.4 on less than half page seems apparently insufficient to show that the unprecedented global shock that is relevant to Climate Change Mitigation has been fully taken into account in the newly released IPCC Assessment Report. More recent literature on the impact of COVID-19 on climate change mitigation can be considered in the process of preparing for the FGD.	Accepted. Section 4.2.2.4 has been expanded to reflect latest literature on implications of COVID-19.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
62067	17	11	17	11	Correct reference: Dafnomiilis et al. 2020. FYI: a paper is submitted to ERL, based on UNEP (2020)	[Editorial] Citation of article has been updated.	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
50283	17	11	17	15	These figures would also be supported by the Global Energy and Climate Outlook (GECO) 2020, Keramidis et al (2021) http://dx.doi.org/10.2760/608429	[Accepted] The additional literature has been reviewed and added to the assessment.	Matthias Weitzel	European Commission, Joint Research Centre	Spain
1913	17	11	17	17	Worth pointing out that the effect on 2030 emissions of COVID-19 and associated policy responses may be larger than the effect of the NDCs (if fully implemented).	Accepted. Statement based on updated COVID-19 studies was added.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71395	17	11	17	17	Worth pointing out that the effect on 2030 emissions of COVID-19 and associated policy responses may be larger than the effect of the NDCs (if fully implemented).	Accepted. Statement based on updated COVID-19 studies was added.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
70171	17	17			amount. However this reduction in emissions is heavily dependant on the allocation of pandemic recovery funds. If these recovery funds are funnelled towards fossil-fuel heavy industries, a corresponding increase (up to 16%) of emissions over the 5 years following stimulus injection could result. This could result in necessary upward correction of NDCs. As of January 2021, the majority of recovery funds are committed to fossil fuel related energy sectors.	[Noted] The conditionality on the design of recovery/stimulus packages is highlighted in the last sentence of the section.	Rayner Andersen	Department of Fisheries and Oceans	Canada
20191	17	18	17	21	It is COVID-19 (typo)	[Editorial] The typo has been corrected.	Nikas Alexandros	National Technical University of Athens	Greece
20193	17	18	17	21	Also consider Le Quéré, C., Peters, G. P., Friedlingstein, P., Andrew, R. M., Canadell, J. G., Davis, S. J., ... & Jones, M. W. (2021). Fossil CO 2 emissions in the post-COVID-19 era. Nature Climate Change, 11(3), 197-199.	[Rejected] Le Quere et al. (2021) look at emissions impacts of COVID-19 for 2020 whereas Section 4.2.2.4 looks at implications for emissions projections out to 2030.	Nikas Alexandros	National Technical University of Athens	Greece
55189	17	19	17	19	COVID-19 is misspelled.	[Editorial] The typo has been corrected.	Government of United States of America	U.S. Department of State	United States of America
1915	17	23	17	23	I do not think it is correct to use the word 'Legally'.	[Editorial] Language has been adjusted.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71397	17	23	17	23	I do not think it is correct to use the word 'Legally'.	[Editorial] Language has been adjusted.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
1917	17	23	17	27	Language needs revision	[Editorial] The paragraph has been revised.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71399	17	23	17	27	Language needs revision	[Editorial] The paragraph has been revised.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
74817	17	25	17	25	Add: However support shall be provided to developing countries for the implementation of Article 13 of the Paris agreement and building of transparency-related capacity of developing country Parties on a continuous basis.	[Rejected] The section deals with tracking progress of NDC implementation, not with the various mechanisms to support implementation.	Government of Kenya	Kenya Meteorological Service	Kenya
62077	17	26	17	27	I think Peters et al. should be out, as it is about negative emissions, and not about NDCs.	[Rejected] There is no citation of Peters et al. in the respective sentence. In case the comment is on the citation of Peters et al. 2017 in line 33, that publication is about tracking progress on the Paris Agreement and NDCs.	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
83563	17	28	17	31	Rogelj et al, Nature (2016) also provides an example of tracking whether globally aggregated emissions resulting from the NDCs are in line with limiting warming to specific levels. Rogelj, J., den Elzen, M., Höhne, N., Fransen, T., Fekete, H., Winkler, H., Schaeffer, R., Sha, F., Riahi, K., Meinshausen, M., 2016. Paris Agreement climate proposals need a boost to keep warming well below 2 °C. Nature 534, 631–639. https://doi.org/10.1038/nature18307	[Accepted] Rogelj et al. 2016 has been added to the literature on this statement.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
62069	17	30	17	31	Something went wrong on the references, but none of the citations (van den Berg et al. 2019; Peters and Geden 2017; Höhne et al. 2018) assesses the progress or to collectively impact of NDCs. I would delete (van den Berg et al. 2019; Peters and Geden 2017; Höhne et al. 2018). For tracking progress, there is the UNEP assessment paper: that could be cited, as this study was used for Table 4.1 for many countries (only multi-model assessments): den Elzen, M.G.J., Kuramochi, T., Höhne, N., Cantzler, J., Esmetjer, K., Fekete, H., Fransen, T., Keramidas, K., Roelfsema, M., Sha, F., van Soest, H., Vanduyck, T., 2019b. Are the G20 economies making enough progress to meet their NDC targets? Energy Policy 126, 238-250. In addition, there is the multi-model studies, which was also used for Table 4.1: Roelfsema, M., van Soest, H. L., Harmsen, M., van Vuuren, D. P., Bertram, C., den Elzen, M., ... & Luderer, G. (2020). Taking stock of national climate policies to evaluate implementation of the Paris Agreement. Nature Communications, 11(1), 1-12. Kuramochi T, Nascimento L, de Villafranca Casas MJ, Fekete H, de Vivero G, Lui S, ... , den Elzen, M.G.J., H. van Soest, ... , Gusti M (2019) Greenhouse gas mitigation scenarios for major emitting countries. Analysis of current climate policies and mitigation commitments: 2019 update, NewClimate Institute (Cologne, Germany), PBL (The Hague, the Netherlands), IIASA (Austria).	Accepted. References revised.	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
62073	17	30	3	31	Literature: to which degree the NDCs collectively are sufficient to reach the temperature targets of the Paris agreement, and restricting to multi-model assessment studies: (Rogelj et al., 2016; Höhne et al., 2020; Roelfsema et al., 2020). Höhne, N., den Elzen, M., Rogelj, J., Metz, B., Fransen, T., Kuramochi, T., ... & Schaeffer, M. (2020). Emissions: world has four times the work or one-third of the time. Nature, 579 (7797), 25-28. Rogelj, J., Den Elzen, M.G.J., Höhne, N., Fransen, T., Fekete, H., Winkler, H., Schaeffer, R., Sha, F., Riahi, K., Meinshausen, M., 2016. Paris Agreement climate proposals need a boost to keep warming well below 2 °C. Nature 534, 631-639. Roelfsema, M., van Soest, H. L., Harmsen, M., van Vuuren, D. P., Bertram, C., den Elzen, M., ... & Luderer, G. (2020). Taking stock of national climate policies to evaluate implementation of the Paris Agreement. Nature Communications, 11(1), 1-12.	Accepted. References revised.	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
5029	17	32	17	32	The authors write "G20 conties..." instead of "G20 countries..."	[Editorial] Typo was corrected.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
62075	17	33	17	33	(Peters et al. 2017; Höhne et al. 2018) . I think references are not needed , as it refers to previous statement, but I think Peters et al. should definitely be out, as it is about negative emissions, and not about NDCs. Please check.	[Rejected] Peters et al. 2017 is about tracking progress on the Paris Agreement and NDCs. However, the references in this paragraph had a problem in this paragraph and have been checked and corrected.	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
71401	17	33	17	38	Tracking progress under the Paris Agreement refers to the implementation and achievement of NDCs under Article 4 (mitigation). Monitoring finance occurs in separate parts of the Paris Agreement architecture.	[Accepted] A cross-reference to the finance chapter (15) has been added to complement the statement.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
27637	17	35	17	38	Consider the findings of the first report of the UNFCCC Standing Committee on Finance on the determination of needs of developing countries to implement the Convention and Paris Agreement.	Noted. A reference to the relevant section in Chapter 15 has been added.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
52053	17	41	17	41	"tabular format are due to conclude in 2020" has not yet concluded.	[Accepted] Statement has been checked and revised accordingly.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
10581	17	42	17	43	This sentence is identical to the one on page 12 lines 18-19. You will have to choose!	[Editorial] Language has been adjusted to avoid duplication.	Philippe Waldteufel	CNRS	France
52067	17	44	17	45	Many countries will need to implement additional policies to meet their self-determined mitigation targets as specified under the NDCs. However, policies must always be made by countries due to their circumstances without external pressures	[Rejected] The statement is factual.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
55191	17	44	17	45	This finding warrants mention in the SPM.	Noted.	Government of United States of America	U.S. Department of State	United States of America
19903	18	3	18	29	4.2.2.6 and section 4.5 do not engage in any depth with the "extensive literature on equity frameworks of national emission allocations" (4-91 line 12). At 4-18 line 16, it is mentioned that the equity literature "including quantification of national emission allocations" is assessed in section 4.5. This assessment is however not provided in the current version of section 4.5. As outlined in the previous comments, it is crucial that the report includes this assessment.	Partially accepted. Based on comments by many reviewers, the treatment of fair shares is now 4.2.2.7, and not covered in 4.5 (that cross-references is being deleted). Please also note the response to comment 19657 - by the same reviewer). We have in 4.2.2.7 cited a new study (Rajamani et al 2021), draws on IEL principles of international environmental law, excludes approaches based on cost and grandfathering, narrowing the range of national fair shares previously assessed, and applying this to the quantification of national fair share emissions targets. See also the treatment of fair shares in the chapter on national policy, 13.4.2 on 'shaping climate governance through litigation', and internationally, including 14.3.2 on elements of the Paris Agreement relevant to mitigation and 14.5.3 on civil society and social movements, and their involvement in litigation	Dennis van Berkel	Urgenda Foundation	Netherlands
55193	18	3	18	29	This section is entitled "assessment" but has no conclusions -- no assessment.	Accepted. "assessment of" replaced with "literature on"	Government of United States of America	U.S. Department of State	United States of America
60327	18	3	18	29	The text could be significantly enhanced by describing the literature's result of ambition and fairness of NDCs. This is TH interesting topic around the Paris Agreement. This comparison is not easy, but one could collect information on where the different approaches agree and where they disagree. Under which perspective is country x considered ambitious and fair and under which perspective is it not or unclear? I assume the readers of the IPCC report would expect such an analysis.	Noted. The matter of 'fair shares' of mitigation is contested in various domains. Several reviewers commented on the SOD from various perspectives. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant, but not policy-prescriptive. The CLAs of chapter 4, together with chapter 14 and 13, sought advice from the co-chairs on this matter. Based on this advice, the FGD chapter continues the approach of outlining frameworks, but not presenting results for individual countries. Note further that 'fairness and ambition in NDCs' is now in section 4.2.2.7, and not in 4.5. We have in 4.2.2.7 cited a new study (Rajamani et al 2021), draws on IEL principles of international environmental law, excludes approaches based on cost and grandfathering, narrowing the range of national fair shares previously assessed, and applying this to the quantification of national fair share emissions targets. See also responses to comments 19657 (and continued along several following comments) and 19903 (and identical 19905).	Niklas Höhne	NewClimate Institute	Germany
71403	18	3	18	29	Section "4.2.2.6 Assessments of fairness and ambition of NDCs" is a very important section. It does not add very much to the short section on IPCC SR 1.5C Ch.4 Cross-Chapter Box 11. This section should be expanded to give results of the scientific assessments of the ambition and fairness of current NDCs, as available in literature. This would be very useful to policy makers in the preparation of the revised NDCs in 2025.	Noted. The matter of 'fair shares' of mitigation is contested in various domains. Several reviewers commented on the SOD from various perspectives. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant, but not policy-prescriptive. The CLAs of chapter 4, together with chapter 14 and 13, sought advice from the co-chairs on this matter. Based on this advice, the FGD chapter continues the approach of outlining frameworks, but not presenting results for individual countries. Note further that 'fairness and ambition in NDCs' is now in section 4.2.2.7, and not in 4.5. We have in 4.2.2.7 cited a new study (Rajamani et al 2021), draws on IEL principles of international environmental law, excludes approaches based on cost and grandfathering, narrowing the range of national fair shares previously assessed, and applying this to the quantification of national fair share emissions targets. See also responses to comments 19657 (and continued along several following comments) and 19903 (and identical 19905).	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
72293	18	3	18	29	Section "4.2.2.6 Assessments of fairness and ambition of NDCs" is a very important section. It does not add very much to the short section on IPCC SR 1.5C Ch4 Cross-Chapter Box 11 (worth citing it). This section should be expanded to give results of the scientific assessments of the ambition and fairness of current NDCs, as available in literature. This would be very useful for policy makers in the preparation of the revised NDCs in 2025.	Noted. The matter of 'fair shares' of mitigation is contested in various domains. Several reviewers commented on the SOD from various perspectives. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant, but not policy-prescriptive. The CLAs of chapter 4, together with chapter 14 and 13, sought advice from the co-chairs on this matter. Based on this advice, the FGD chapter continues the approach of outlining frameworks, but not presenting results for individual countries. Note further that 'fairness and ambition in NDCs' is now in section 4.2.2.7, and not in 4.5. We have in 4.2.2.7 cited a new study (Rajamani et al 2021), draws on IEL principles of international environmental law, excludes approaches based on cost and grandfathering, narrowing the range of national fair shares previously assessed, and applying this to the quantification of national fair share emissions targets. See also responses to comments 19657 (and continued along several following comments) and 19903 (and identical 19905).	Bertoldi paolo	European Commission	Italy
85311	18	3	18	29	It would be very valuable to have here (or alternatively in sub chapter 4.5) a quantitative assessment of fairness that analysed literature on equity and resulting fair shares for countries or country groups, consistent with international environmental law principles, providing benchmarks for existing and new nationally determined contributions under the Paris Agreement, informing the global stock-takes. One suggestion for literature: Rajamani, Jeffery, Höhne, Hans, Glass (submission under review): National 'fair shares' in reducing greenhouse gas emissions within the principled framework international environmental law.	Noted. The matter of 'fair shares' of mitigation is contested in various domains. Several reviewers commented on the SOD from various perspectives. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant, but not policy-prescriptive. The CLAs of chapter 4, together with chapter 14 and 13, sought advice from the co-chairs on this matter. Based on this advice, the FGD chapter continues the approach of outlining frameworks, but not presenting results for individual countries. Note further that 'fairness and ambition in NDCs' is now in section 4.2.2.7, and not in 4.5. We have in 4.2.2.7 cited a new study (Rajamani et al 2021), draws on IEL principles of international environmental law, excludes approaches based on cost and grandfathering, narrowing the range of national fair shares previously assessed, and applying this to the quantification of national fair share emissions targets. See also responses to comments 19657 (and continued along several following comments) and 19903 (and identical 19905).	Kaisa Kosonen	Greenpeace	Finland
24925	18	4	18	6	"Methodological differences in LULUCF emission accounting..." suggest "Methodological differences in the accounting of the LULUCF anthropogenic CO2 sink..." (it is more precise)	Accepted. The comment refers to page 19, lines 4-6. The language has been adjusted as suggested.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
84835	18	4	18	6	The text could recall that countries are encouraged to explain the fairness and ambition as part of their NDC. The text could also stress the link between fairness and ambition that shows that fairness is key to assess the total ambition of country's NDC including international support, beyond domestic action.	Taken into account. Section 4.2.1 introduces NDCs, and recalls that countries are invited to explain how they are fair and ambitious	Yann Robiou du Pont	Climate Analytics	France
9885	18	16	18	19	Assessments of fairness and ambition of NDCs. Various assessment frameworks have been proposed to analyse fair share ranges for NDCs. Some studies compare NDC ambition level with different effort sharing regimes and which principles are applied to various countries and regions. Others propose multi-dimensional evaluation schemes for NDCs that combine a range of indicators, including the NDC targets, cost-effectiveness compared to global models, recent trends and policy implementation into consideration. Yet other literature evaluates NDC ambition against factors such as technological progress of energy efficiency and low-carbon technologies the potential to deploy carbon dioxide removal technologies in the future which are to date not mentioned in NDCs.	Noted. Multiple literature are assessed in this section, and some has been added for FGD	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
83565	18	16	18	21	Is it useful to also highlight some of the risks identified in the literature of countries using a grandfathering GWP* emission metric in their NDCs? Rogelj, J., Schlessner, C.-F., 2019. Unintentional unfairness when applying new greenhouse gas emissions metrics at country level. Environmental Research Letters 14, 114059. https://doi.org/10.1088/1748-9326/ab4928	Accepted. Revised text to point to risks; also cited literature on GWP* in section 4.2.5.13 on SLCF. And citing exclusion of 'least cost and grandfathering as a 'principle', from another recent study	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
1919	18	16	18	29	If there is further discussion of fairness and ambition later in the chapter, it would be helpful to cross-reference it here. Otherwise this section is fairly generic and non-specific in terms of detail.	Taken into account. Have restructured material, also in response to other comments, so fairness and ambition in NDC is assessed in 4.2.7. 4.5 assesses literature on equity and just transitions	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
47353	18	16	18	29	Regarding assessments on the ambition of NDCs, it would be useful to add studies that examined the assumptions underlying NDCs, in particular on GDP growth and other activity drivers, which could lead to inflated baselines and thus resulting in a weaker NDC ambition. This has always been a contentious issue in the international climate policy process. I'd assume that there are quite a few studies that examined this issue. One example of relevant studies is Kuriyama et al. (2019), which assessed Japan's NDC using Kaya indicators, with a deeper dive into GDP assumptions by examining GDP per working age population. Kuriyama, A., Tamura, K. and Kuramochi, T. (2019) 'Can Japan enhance its 2030 greenhouse gas emission reduction targets? Assessment of economic and energy-related assumptions in Japan's NDC', Energy Policy, 130, pp. 328–340. doi: 10.1016/j.enpol.2019.03.055. Another example study from OECD is: https://www.oecd-ilibrary.org/environment/accounting-for-baseline-targets-in-ndcs_9a6f5ec1-en	Noted. The matter of 'fair shares' of mitigation is contested in various domains. Several reviewers commented on the SOD from various perspectives. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant, but not policy-prescriptive. The CLAs of chapter 4, together with chapter 14 and 13, sought advice from the co-chairs on this matter. Based on this advice, the FGD chapter continues the approach of outlining frameworks, but not presenting results for individual countries. Note further that 'fairness and ambition in NDCs' is now in section 4.2.2.7, and not in 4.5. We have in 4.2.2.7 cited a new study (Rajamani et al 2021), draws on IEL principles of international environmental law, excludes approaches based on cost and grandfathering, narrowing the range of national fair shares previously assessed, and applying this to the quantification of national fair share emissions targets. See also responses to comments 19657 (and continued along several following comments) and 19903 (and identical 19905).	Takeshi Kuramochi	NewClimate Institute	Germany
71405	18	16	18	29	If there is further discussion of fairness and ambition later in the chapter, it would be helpful to cross-reference it here. Otherwise this section is fairly generic and non-specific in terms of detail.	Taken into account. Have restructured material, also in response to other comments, so fairness and ambition in NDC is assessed in 4.2.7. 4.5 assesses literature on equity and just transitions	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
71407	18	16	18	29	Do any of the studies quoted here offer effort sharing regimes (other than least marginal cost) that the models can successfully implement as a transition pathway at regional level? Several studies such as Robiou du Pont et al. take a global scenario as a starting point and seek to allocate regional emissions on the basis of different fairness rules. But if the results are not then implemented regionally in some kind of internally consistent framework (such as an energy-economy model) their results remain a value judgement rather than a practical solution proposal.	Partially accepted. We cite Robiou du Pont. However, for results, see response to Comment No.71403	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
84837	18	16	18	29	This paragraph is misleading and confusing. The various assessment frameworks are presented as assessing the same object, an NDC. Only the equity metric can assess the ambition of the whole mitigation component of an NDC (domestic action and international support, through finance and/or ITMOs). The other metrics mentioned here are all dealing with domestic implementation: cost-effectiveness, implementation, technological progress, energy efficiency, and synergies with adaptation, and potential CDR. Domestic action and implementation in a developing country can potentially be funded by another country, probably developed. Such internationally funded action should thus not count as the recipient country's effort. Likewise, these metrics can falsely suggest that a developed country's sole responsibility is to manage implementation domestically and given that their extra-territorial contributions would not be accounted there. This would leave developing countries with a disproportionate burden solely informed by energy efficiency and cost considerations, in spite of equity. My point here is that equity and these other metrics do not measure the same thing (total effort vs. domestic action) unlike what the text suggests. That may mislead Parties into picking the metric that is the most lenient for them, thereby leaving additivity aside result into insufficient action and great misunderstanding around country's responsibility beyond their borders.	Noted. We have assessed "some studies" that follow the approach suggested by the reviewer (including their work), as well as "other studies" evaluating a broader set of criteria. Total mitigation effort is one, but not the only metric. We maintain the approach of assessing a range of literature on fair shares.	Yann Robiou du Pont	Climate Analytics	France

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
84839	18	16	18	29	A key summary figure / table is missing in the AR6, as it was in the SR1.5. Both the AR4 and the AR5 contained summary of equity-based mitigation targets for countries or regions. The AR4 indicated fair levels of mitigation for developing and developed countries in table 13.7. Table 13.7 was key to informing the EU 2050 target at the time and informed the Urgenda decision and thereby the Dutch law and its mitigation target. Providing a similar table with up to date information would inform government, courts and diplomats around the world on fair levels of mitigation efforts, beyond the domestic action described in depth in other chapters. Single studies on equity were also used to inform governmental targets; 1) Robiou du pont et al 2017 (https://www.nature.com/articles/nclimate3186) was used the CCC (file:///C:/Users/medac/AppData/Local/Temp/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf , figure 3.9 p 109) in the UK to establish the net-zero target for 2050, 2) Robiou du Pont et al 2016 (https://opscience.iop.org/article/10.1088/1748-9326/11/5/054005) was used to justify the ambition of the 2030 68% reduction target for the UK by the CCC (file:///C:/Users/medac/AppData/Local/Temp/The-Sixth-Carbon-Budget-The-UK-path-to-Net-Zero.pdf), and Meinsausen et al 2018 (commissioned work https://www.climatechange.vic.gov.au/_data/assets/pdf_file/0016/421702/Greenhouse-Gas-Emissions-Budgets-for-Victoria.pdf) informed the subnational targets of the government of Victoria. At the city level, the Deadline 2020 report for C40 informed the mitigation targets of major cities. As it is explicitly mentioned in the WG3 report (CH14 I believe) fairness is the metric for ambition. Fairness is key to formulating asks across diplomatic negotiation teams, it informs both governments and justice cases against governments (and ultimately towards legality). I am really surprised that there isn't a figure to reflect the progress of the literature in this discipline. Regarding my own contributions, Robiou du Pont et al 2017 quantifies approaches representative of the equity categories modelled in the IPCC AR5 in a consistent manner in order to assess the ambition of NDCs across various equity concepts. Figure 1 directly reviews the IPCC AR5 regional level outcomes. Robiou du Pont et al 2018 combines equity approaches in a bottom up manner reflective of the Paris Agreement, where countries can self differentiate in a sovereign self-interested manner, to inform on bottom-up and paris aligned targets, it also provides a single ambition metric, reflective of apparently dissonant equity concepts, to link national emissions targets with corresponding global warming. Pa et al 2016 has offered another cross equity assessment framework while the CSO and Holz et al 2018 suggest a combination of equity approaches to pursue a fairer outcome across and within countries. While these studies have different results, most of their conclusions point out to similar responsibilities and duties across countries. Compiling these results in a useful manner for decision makers with targeted suggestion (such as the ranges provided in the AR4 table 13.7 and unlike the broad results features in IPCC AR5, WG3 figure 6.28) on Paris Aligned mitigation targets. This information will be key to the stocktake process that should happen in 2023.	Noted. The matter of 'fair shares' of mitigation is contested in various domains. Several reviewers commented on the SOE from various perspectives. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant, but not policy-prescriptive. The CLAs of chapter 4, together with chapter 14 and 13, sought advice from the co-chairs on this matter. Based on this advice, the FGD chapter continues the approach of outlining frameworks, but not presenting results for individual countries. Note further that 'fairness and ambition in NDCs' is now in section 4.2.2.7, and not in 4.5. We have in 4.2.2.7 cited a new study (Rajamani et al 2021), draws on IEL principles of international environmental law, excludes approaches based on cost and grandfathering, narrowing the range of national fair shares previously assessed, and applying this to the quantification of national fair share emissions targets. See also responses to comments 19657 (and continued along several following comments) and 19903 (and identical 19905).	Yann Robiou du Pont	Climate Analytics	France
47355	18	25	18	27	The following article also assessed the ambition of Japan's NDC by comparing sector-level indicators (energy efficiency, renewables) with earlier potential assessment studies, including the ones prepared specifically for a national policy formulation process. Suggest adding this study to the literature list. Kuramochi, T., Wakiyama, T. and Kuriyama, A. (2017) 'Assessment of national greenhouse gas mitigation targets for 2030 through meta-analysis of bottom-up energy and emission scenarios: A case of Japan', Renewable and Sustainable Energy Reviews, Elsevier, 77(November), pp. 924-944. doi: 10.1016/j.rser.2016.12.093.	Rejected. Considered this study but did not include as too country-specific.	Takeshi Kuramochi	NewClimate Institute	Germany
27639	18	28	18	29	It is stated that the potential to deploy carbon dioxide removal technologies in the future are to date not mentioned in NDCs. Yet, this is not the case. The text should be revised accordingly.	Accepted. Text rephrased	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
83079	18	28	18	29	To avoid the common misunderstanding (even within the AR6 author team) that a term like "carbon dioxide removal technologies" covers all carbon dioxide removal options, you should indicate that you (obviously) don't talk about ecosystem-based CDR options here, like afforestation, which is part of NDCs. You could do that by adding "like BECCS"	Accepted. Added 'like BECCS'.	Geden Oliver	German Institute for International and Security Affairs	Germany
55195	18	30	19	10	This section has no results; it is all about methods.	Noted. The point of this sections is to indicate uncertainties in the results reported in previous sections, so results are above	Government of United States of America	U.S. Department of State	United States of America
60329	18	30	19	10	The section on uncertainty could include a statement, that despite the identified uncertainties there is multiple evidence and high agreement that the NDCs in aggregate are insufficient to meet the Paris Agreement temperature goal.	Taken into account. Statement on the NDCs being insufficient to reach the Paris Agreement's long-term temperature goals are elsewhere in the chapter, in cross-chapter box 3, Chapter 4 ES and SPM.	Niklas Höhne	NewClimate Institute	Germany
383	18	38	18	46	Some countries may not actively pursue mitigation measures because they are not legally bound to the result of reducing emissions. This is a weakness for mitigation goals and the basis of considerable uncertainty in 2030 emission estimates. Thus, strong mitigation targets in NDCs may not be implemented. The ramifications of these uncertainties should be the subject of greater discussion in Section 4.2.2.7.	Rejected. Further expansion of discussion in this direction were not possible due to word limits.	Michael Kemish	Rutgers University	United States of America
9887	18		19		<ul style="list-style-type: none"> There are many factors that influence the global aggregated effects of NDCs. There is limited literature on systematically analysing the impact of uncertainties on the NDC projections with some exception discusses uncertainties of NDC estimates in some detail. The main factors include variations in overall socio-economic development, uncertainties in GHG inventories; conditionality; targets with ranges or for single years; accounting of biomass; and different GHG aggregation metrics (e.g., GWP values from different IPCC assessments). This uncertainty could be reduced with clearer guidelines for compiling future NDCs and explicit specification of technical details, including energy accounting methods, harmonised emission inventories and finally, increased transparency and comparability 	Not clear what comment is about. This is text from the SOE.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
20605	19	1	19	1	Suggestion to add an additional source here to reinforce this conclusion : Hélène Benveniste et al 2018 Environ. Res. Lett. 13 014022. Impacts of nationally determined contributions on 2030 global greenhouse gas emissions: uncertainty analysis and distribution of emissions	Accepted Reference has been added.	Government of France	Ministère de la Transition écologique et solidaire	France
29331	20	1	20	3	Fig 3.3. What explains the very skewed distribution of models used in this assessment? Some explanation for this in the text would be helpful. If this is due to the screening process, have the authors attempted to contact the modelers whose scenarios did not pass the initial screening, with the goal of increasing representation across modeling groups? The chapter acknowledges the bias generated by this distribution but does not offer any guidance about how to correct for it. It is not clear that users of the database will have the knowledge to correct for such bias, and therefore it would be preferable if the IPCC authors could spend more effort ensuring that the database reflects a reasonable representation of model scenarios.	Unclear what the comment is about. Annex C of the report details scenarios used in the assessment, including the screening process.	Bryan Mignone	ExxonMobil Research and Engineering Company	United States of America
71409	20	1	22	27	the Cross-Chapter Box 3 Comparison of NDCs and current policies with the 2030 GHG emissions from long-term temperature pathways is very similar to the IPCC SR 1.5C Ch.4 Cross-Chapter Box 11. It should also discuss how the gap could be reduced with more ambitious NDCs, possibly providing some assessment framework	Rejected. The purpose of this Box is to provide a place for a handshake between Ch3 and 4. It is not to discuss how to reduce the gap (which is the purpose of the rest of Ch4)	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72295	20	1	22	27	The Cross-Chapter Box 3 Comparison of NDCs and current policies with the 2030 GHG emissions from long-term temperature pathways is very similar to the IPCC SR 1.5C Ch.4 Cross-Chapter Box 11. It should also discuss how the gap could be reduced with more ambitious NDCs, possibly providing some assessment framework.	Rejected. The purpose of this Box is to provide a place for a handshake between Ch3 and 4. It is not to discuss how to reduce the gap (which is the purpose of the rest of Ch4)	bertoldi paolo	European Commission	Italy
1921	20	6	20	20	This is a very nice and concise introduction, which could even have been used in the main part of the chapter.	Thanks	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71411	20	6	20	20	This is a very nice and concise introduction, which could even have been used in the main part of the chapter.	Thanks	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
85163	20	16	20	16	Please add "and enhancing": "All signatory countries committed to communicating and enhancing the NDCs (...)" . The ratcheting-up mechanism of national plans is a central pillar of the Paris Agreement architecture. Hence, please add as well "Each further NDC should be more ambitious than the previous one, known as the principle of 'progression'."	[Accepted] Sentence has been revised as suggested.	Jens Tambke	Umweltbundesamt	Germany
9053	20	21	20	22	The fonts for the title, figure caption, axes, and labels need to be black and higher resolution. As it is, it is hard to read.	[Editorial] Figure quality will be improved.	Singfoong Cheah	Independent consultant, formerly more than 10 years with the National Renewable Energy Laboratory, USA	United States of America
67515	20	21	20	22	If distinction between the pathways incl. and excl. conditional NDCs is available, that would be informative for what cap binding by 2030.	[Rejected] The pathways shown in the figure build upon the Illustrative Pathways which only include one representative pathway on NDCs. Also, unfortunately pathways do not always assess both conditional and unconditional NDCs. Finally, the strong overlap between the two would make the figure less readable.	Taran Fiehn	Statistics Norway, Research Dep.	Norway
55197	20	21	21	45	The figure in Cross-Chapter Box 3 uses some pathways that have a 50% chance of success and others that have a 67% chance of success -- but the difference is buried in the legend (page 21, lines 7-8). This needs to be an apples-to-apples comparison.	[Accepted] The figure builds upon the climate assessment of pathways conducted in chapter 3 that very clearly describes the rationale and process of the categorization. Due to space constraints this cannot be reiterated here, but a cross-reference to the relevant section has been added.	Government of United States of America	U.S. Department of State	United States of America
55199	20	21	21	45	The Cross-Chapter Box 3 figure could better characterize how national plans contribute to uncertainty.	[Rejected] The cross-chapter box combines information from chapters 3 and 4. Uncertainties are characterized more explicitly in the assessments of those chapters, but for space constraints cannot be reiterated here.	Government of United States of America	U.S. Department of State	United States of America
47329	20	22	20	24	cross-chapter box3, figure 1 needs to be more illustrated because all contents are not readable	[Editorial] Figure quality will be improved.	Khaled Mohamed Madkour	Ain Shams University, Cairo, Egypt	Egypt
1927	20	23			A promising figure, which can be further developed to show the gaps more clearly. While it is great to have the long-term and historical parts, currently these are not really used in the text of the box. There is also an issue with the scaling, which makes the required emission reductions seem much less dramatic here than in chapter 3.	Noted. The figure has been revised.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71413	20	23			A promising figure, which can be further developed to show the gaps more clearly. While it is great to have the long-term and historical parts, currently these are not really used in the text of the box. There is also an issue with the scaling, which makes the required emission reductions seem much less dramatic here than in chapter 3.	Noted. The figure has been revised.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
67517	21	9	20	27	Yes, NDCs are useful for "national adaptation planning", but why haven't you also a subsection on "planning for climate policy risk", for which NDCs are also pivotal both for governments and corporations. Should symmetrically address these two types of risk.	Noted. Discussion of risks associated with policy implementation can be found in 4.4.3.	Taran Fiehn	Statistics Norway, Research Dep.	Norway
16285	21	21	22	8	Considering the purpose of creating Cross-Chapter Boxes and the significance of the contents in those Boxes, "other gap indicators" part is redundant and doesn't seem to be as important as other contents in the Box. It might be shortened or succinctly re-written to the length of "Emission Gap" part reflecting the relative importance of two.	[Rejected] There is a growing literature that looks at "gap indicators" other than emissions. These are equally or more important than the emissions gap indicator as they are more directly related to the underlying structural change in the system while emissions are the result of this structural change.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
385	21	22	21	32	Emission gaps projected for 2030 should be placed in greater context here with regard to the mitigation pathways necessary to achieve the temperature goals of the Paris Agreement.	Unclear what this comment is aiming at.	Michael Kennish	Rutgers University	United States of America
1925	21	23	21	23	This is a strange formulation "acting immediately". Does it mean peaking in 2020 and least-cost thereafter? Please define.	[Rejected] The sentence precisely states what immediately means here, i.e. starting mitigation after 2020.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71415	21	23	21	23	This is a strange formulation "acting immediately". Does it mean peaking in 2020 and least-cost thereafter? Please define.	[Rejected] The sentence precisely states what immediately means here, i.e. starting mitigation after 2020.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
10583	21	25	21	26	Again this sentence is identical to the sentence on page 12 lines 18 - 19. You will have to choose!	[Noted] This box combines information from multiple chapters and therefore restates some of the findings from those.	Philippe Waldteufel	CNRS	France
55201	21	26	21	32	This distinction between the 'emissions gap' and the 'implementation gap' is critical material that will get repeated and cited again and again. Triple check it for clarity and accuracy.	[Noted] Results are carefully checked.	Government of United States of America	U.S. Department of State	United States of America
1923	21	27	21	30	The ranges for unconditional and conditional seem to have been inadvertently swapped	[Rejected] The reported ranges are correct. As expected the emissions gap is reported to be large for unconditional NDCs (which are less ambitious and yield a larger gap) than for conditional NDCs (which are more ambitious and therefore yield a smaller gap).	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71417	21	27	21	30	The ranges for unconditional and conditional seem to have been inadvertently swapped	[Rejected] The reported ranges are correct. As expected the emissions gap is reported to be large for unconditional NDCs (which are less ambitious and yield a larger gap) than for conditional NDCs (which are more ambitious and therefore yield a smaller gap).	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
47377	21	33	22	8	Regarding other "gap" indicators, the Climate Transparency report series present a set of policy gap indicators. https://www.climate-transparency.org/wp-content/uploads/2020/11/Climate-Transparency-Report-2020.pdf A few other studies (incl. Kriegler et al. 2018 cited in this chapter) looked at whether historically observed successful sector-level policies are collectively strong enough to reach 2C or 1.5C consistent emission pathways by 2030 if they're rolled out globally. Fekete, H., Kuramochi, T., Roelfsema, M., den Elzen, M., Forsell, N., Hoehne, N., et al. (2021). A review of successful climate change mitigation policies in major emitting economies and the potential of global replication. Renew. Sustain. Energy Rev. 137, 110602. doi:10.1016/j.rser.2020.110602.	Noted	Takeshi Kuramochi	NewClimate Institute	Germany
55203	21	34	21	38	What about indicators for AFOLU? Measurement of methane emissions from livestock? Carbon sequestration from agroforestry? Nitrogen emissions from croplands? Shifting diets? Reduced food loss and waste? As in other parts of this chapter, land does not seem to get the attention it needs to have.	[Rejected] The paragraph summarizes the literature on alternative "gap indicators", but is not proposing a set of new indicators.	Government of United States of America	U.S. Department of State	United States of America
52069	21	36	21	37	Deployment of low-carbon energy sources and lowering fossil fuel level of production and investments to bridge the gap between NDCs and emissions	[Noted] The comment appears to be consistent with the the SOD.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
55205	22	1	22	5	Are there analogues to this information about energy for the land sector (AFOLU)? If so, include them here. If none exist, say that.	[Rejected] The paragraph summarizes the literature on alternative "gap indicators", but is not proposing a set of new indicators. We can unfortunately not list all indicators that have not been proposed.	Government of United States of America	U.S. Department of State	United States of America
55207	22	6	22	8	This text talks about the emissions gap for one sector. Isn't an equally large or larger issue the links among sectors -- so it's hard to say what the emissions gap is for one sector because the need for any particular sector to contribute depends on what other sectors do and how they affect each other. There isn't a single solution.	[Rejected] The paragraph talks about the link between the global long-term temperature goals set out by the Paris Agreement and total (not sectoral) emissions. To make this clearer, the term "economy-wide" has been inserted prior to "emissions gap" in line 8.	Government of United States of America	U.S. Department of State	United States of America
47357	22	9	22	27	The entire adaptation section in the Cross-Chapter Box 3 seems a bit out of place, especially that the box title indicates that the box is about GHG emission mitigation.	Noted. The discussion has been moved to a specific Box.	Takeshi Kuramochi	NewClimate Institute	Germany
71419	22	9	22	27	It needs to be mentioned here that the Paris Agreement encourages countries to prepare Adaptation Communications. Including an adaptation component in the NDC is only one possible way of doing this (where for mitigation, it is compulsory for each Party to prepare, communicate and maintain a nationally determined contribution towards the global mitigation goal).	Noted. However, the discussion is focused on the adaptation gap.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
18133	22	21	22	30	These lines say that there is an adaptation gap requiring institutional capacity, planning and investment and that adaptation costs are approx. USD 400 billion - I think this is a really important point, worth including in the Executive Summary - I didn't see it mentioned there	Rejected. The discussion on the adaptation gap complements the discussion on the emissions gap, which is the core purpose of the cross-chapter box. High level messages on adaptation gap are more relevant in dedicated chapters of IPCC Working Group II.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
55209	22	22	22	27	This is another point where the need to connect SDGs to mitigation and adaptation is apparent. Adding something along the lines of "Unless LDCs receive support in their efforts to achieve resilience to present-day climate change impacts, their ability to achieve low-emission development will be further called into question."	Taken into account. SDG are addressed in several places across chapter 4, the Adaptation gap is has been made into a separate box in the FGD. We have not include a specific sentence on LDCs, only, for finance see chapter 15	Government of United States of America	U.S. Department of State	United States of America
20607	22	24	22	26	on what basis is this statement made? developed countries never committed to cover all of developing countries' adaptation needs	[Accepted] Statement was adjusted.	Government of France	Ministère de la Transition écologique et solidaire	France
55211	22	26	22	26	If mitigation is not successful, adaption will be a moving target. So mitigation does indeed have higher priority.	Not sure what the comment is about.	Government of United States of America	U.S. Department of State	United States of America
8249	22	29	28	39	It would be interesting to further elaborate on the role of NGOs and how they could adopt their operations to mitigate emissions	Noted. NGOs included in the broad category of "non-governmental stakeholders"	Frida Zahlander	DanChurchAid	Denmark

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
20609	22	30	22	32	Please consider mentioning environmental NGOs as well	Noted. NGOs included in the broad category of "non-governmental stakeholders"	Government of France	Ministère de la Transition écologique et solidaire	France
387	22	40	22	46	The contributions of non-state actors and subnational actors to mitigation actions that will be important in achieving Paris climate goals are limited. Their databases on mitigation actions are not substantial. In addition, the limited data that have been compiled and analyzed from these actors leaves considerable uncertainty with respect to reduction of GHG emissions. There should be greater discussion on page 23 of how these deficiencies will impact near-term and medium-term emission reduction goals.	Noted. Uncertainties regarding the assessment of emission reductions associated with non-state and subnational actors discussed at length in FGD, and reflected in the confidence statement associated with this estimate.	Michael Kennish	Rutgers University	United States of America
55213	22	43	22	44	Given the various business-focused transparency initiatives, if the conclusion here is that they are not amounting to much, then say that. Somehow the relationship between this statement and those initiatives needs to be addressed.	Noted. Yet as noted in the text, the academic literature assessing progress by non-state initiatives remains limited.	Government of United States of America	U.S. Department of State	United States of America
9889	22		23		<ul style="list-style-type: none"> The decision adopting the Paris Agreement stresses the importance of "stronger and more ambitious climate action" by non-government and subnational stakeholders, "including civil society, the private sector, financial institutions, cities and other subnational authorities, local communities and indigenous peoples" Non-state actors, e.g., companies and civil society, and subnational actors, e.g. cities and regions, have emerged to undertake a range of largely voluntary carbon mitigation actions (both as individual non-state actors (NSA in the following) and through national and international cooperative initiatives (ICIs). 	Not clear what this comment is about. This is text from the SOD.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
84841	23	4	23	10	While there is limited literature on subnational emissions target, there is some both grey and peer-reviewed that could be mentioned here. I think Kevin Andersen als published some studies of cities fair shares in sweden and perhaps the UK. There is also grey literature from: Deadline 2020 for C40 (https://www.c40.org/other/deadline_2020), Tyndall - Manchester Carbon Budget. Additionally, Meinshausen et al. (including me), published in a grey literature report a subnational framework directly derived from one of our publication referred to in this SOD (www.nature.com/nclimate/journal/v7n11/full/nclimate3186.html) to assess Australia's subnational equity targets: https://www.climatechange.vic.gov.au/_data/assets/pdf_file/0016/421702/Greenhouse-Gas-Emissions-Budgets-for-Victoria.pdf . I understand that this literature may fall outside the IPCC scope. In any case the AR6 can mention that equity metrics can apply to subnational constituents, as opposed to companies, but that literature is limited at the moment. Of course equity should then not only understood as linking ambition across sovereign entities but also in relation to their national governments that may share responsibility and capability to act over some emissions jointly.	Noted. However, the focus of section 4.2.3 is on estimating the mitigation potential of non-state and non-governmental mitigation action.	Yann Robiou du Pont	Climate Analytics	France
55215	23	11	23	20	The text requires some context for these estimates. For example, compare these estimates to Griscom et al.'s 2017 PNAS global estimate of 11.2 Gt/yr for Natural Climate Solutions. Griscom et al. estimated 30% mitigation was needed to achieve a 2°C goal. So these commitments don't seem anywhere near sufficient.	Accepted. This sentence has been removed.	Government of United States of America	U.S. Department of State	United States of America
71421	23	17	23	28	The caveat "do not lead to weaker mitigation by others" understates how strong this additionality assumption is. This should be stated more explicitly. The assumption would essentially require each actor to somehow 'ring fence' any mitigation they achieve to prevent it from counting towards national targets, or require governments to compensate for NSA outcomes by tightening their own targets an equivalent amount. Perhaps if discussing these issues more openly in the chapter would in turn allow the limited evidence qualifier to be strengthening (i.e. stronger evidence for a more modest statement).	Accepted. Discussion of additionality assumption expanded.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
1929	23	21	23	28	In light of all the caveats and the limited literature basically driven by fey authors, I wonder if the table and figure provide good representation for an IPCC report	Noted. Mitigation action by non-state actors is part of the mandate of Chapter 4. We believe that the section presents an accurate picture of the evidence available to date on this matter.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71423	23	21	23	28	comment deleted	Noted	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
16287	23	21	26	31	In page 23, authors indicate that the potential emission reductions from international cooperative initiatives have been assessed and synthesized in several studies, citing "Hsu et al. 2020; Lui et al. 2020". However, why does Table 4.2 only cite Hsu et al. 2020 as its source? I got curious about this because in FOD, the same table contained 27 sub-national and non-state actions without indicating which paper it referred. In the current table 4.2, only 19 cases are reported, reducing the emission reduction potential from 39 Gt to 20 Gt in 2030. The gap between two estimates are too large, so please double check the coverage of ICIs cases and their reduction potential reported in Table 4.2 and Fig. 4.1 in subsection 4.2.3 and properly cite.	Accepted. From the FOD to the FGD, we refined our criteria for selecting ICIs for inclusion. For example, the FOD had some initiatives that were no longer operational (i.e., Compact of Mayors). The original 39 Gt was based on simply aggregating all of the estimated impact of the initiatives included in Table 4.2, whereas the revised Table 4.2 drawn from Hsu et al. (2020) takes into account overlaps and is a closer representation of estimated reduction potential.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
5113	23	24	23	28	Could you specify the topic of current/target/potential membership? I did not fully understand what is meant by it.	Accepted. Added the following sentence to p. 23, after line 24: "Current membership reflects the number of non-state or subnational actors that are presently committed to a particular initiative; while targeted or potential membership represents a membership goal (e.g., increasing from 100 to 200 members) that an initiative may seek to achieve (Kuramochi et al., 2020)."	Lina Hollender	n/a	Germany
49703	24	1	26	31	Interesting overview of initiatives. It would be good to link it closer to the UNFCCC initiatives under the Marrakech Partnership for Global Climate Action. The UNFCCC Climate Action Pathways document illustrates many goals by every sector for the 2030 and 2050 timeframes, some of them also contain very specific mitigation goals. You can find the documents here: https://unfccc.int/news/un-climate-action-pathways-map-route-from-covid-19-recovery-to-resilient-net-zero-economy	Noted.Thank you for this comment. Many of the initiatives included in this section are part of the Marrakech Partnership for Global Climate Action. We have included a specific reference to the Marrakech Partnership on p. 22: "The Marrakech Partnership for Global Action, launched in the 2016 UNFCCC Conference of Parties by two "high-level champions," further formalized the contributions of non-government and subnational actors taking action through seven thematic areas (e.g., energy, human settlements, industry, land-use, etc.) and one cross-cutting area (resilience)."	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
79443	24	1	26	31	Suggest to link it closer to the UNFCCC initiatives under the Marrakech Partnership for Global Climate Action. The UNFCCC Climate Action Pathways document illustrates many goals by every sector for the 2030 and 2050 timeframes, some of them also contain very specific mitigation goals. You can find the documents here: https://unfccc.int/news/un-climate-action-pathways-map-route-from-covid-19-recovery-to-resilient-net-zero-economy	Noted.Thank you for this comment. Many of the initiatives included in this section are part of the Marrakech Partnership for Global Climate Action. We have included a specific reference to the Marrakech Partnership on p. 22: "The Marrakech Partnership for Global Action, launched in the 2016 UNFCCC Conference of Parties by two "high-level champions," further formalized the contributions of non-government and subnational actors taking action through seven thematic areas (e.g., energy, human settlements, industry, land-use, etc.) and one cross-cutting area (resilience)."	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
51615	24	29	24	29	Table 4.2 The "Collaborative Climate Action Across the Air Transport World (CAATW)" initiative does not deserve to be cited in this table because the stabilisation of net carbon emissions from 2020 is achieved through carbon offsetting (CORSIA). See page 10-65, lines 32-33: "By its nature CORSIA does not lead to a reduction in the emissions by aviation as it deals mostly in approved offsets"	Noted. Many of the individuals that participate in initiatives are not transparent about how they plan to reach their goals and may also rely on offsets. We have added some text on this point to the chapter.	eric lombard	Stay Grounded	France

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
76427	24	29	25	30	Table 4.2 - There are no nuclear energy options listed in the Sector columns. This looks to be a significant oversight for an energy source with about the most successful track record in emissions reductions to date. At least one major global partnership has an appropriate programme. In 2018, the NICE Future initiative successfully launched at the ninth Clean Energy Ministerial. Operating on a Global scale the NICE Future initiative aims to initiate a dialogue on the role that clean and reliable nuclear energy can play in bolstering economic growth, energy security and access, and environmental stewardship—with a focus on innovative applications for advanced nuclear systems to enable coordinated and integrated clean energy systems of the future. 1.If one nation, Germany acted like a responsible nation in addressing climate change and replaced its 241TWh of coal burning, 85 TWh of methane burning and its 58TWh of biomass burning with nuclear energy that would save 0.45GT of carbon dioxide emissions each year 2.If Belgium ensured its existing nuclear power plants remained operational and it increased its use of nuclear energy to 60% of its grid that would ensure that 0.03GT of CO2/year was not emitted. 3.The EU needs to build new nuclear power plants and rehabilitate the old units at a far lower cost than renewable if serious inroads into carbon reductions is to be made. 4.Africa cannot afford 300GW of renewables with all the grid expansion and fossil fuel backup. It is not a plausible option for a low carbon future. A far lower cost option on these delicate grids is the construction of small nuclear power plants subject to cooling water resources being available. 5.No sensible assessment of the materials sustainability of deploying 1,5TW of additional wind and solar has been made. Nuclear power plants would use about 5 -10% of the non-renewable materials that wind and solar would utilise. Those plants would last for at least 80 years.	Rejected. Table 4.2 lists only initiatives by non-state actors. The NICE partnership mentioned by the comment is at government level.	Robert Parker	Nuclear for Climate Australia	Australia
8165	24	29	26	30	Table 4.2: Please revise table. Depending on NDC and policy, there are noticeable differences between "no policy", "current policy", and "NDC", and the reduction potentials should not be grouped or summed up.	Rejected. This is outside the scope of this particular part of the chapter, which is about sub-national actors.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
74165	24	29	26	30	Table 4.2 only mentions renewables and fails to mention efforts to deploy additional nuclear generation. See for example the recent decision of China to increase its nuclear generation between now and 2025 to 70 GWE. https://www.globalconstructionreview.com/news/china-approves-10bn-plan-build-four-nuclear-reactors/ Similar efforts are underway in India which expects a substantial increase in nuclear generation. https://www.bloomberg.com/news/articles/2021-01-19/india-debuts-largest-domestic-nuclear-reactor-with-more-planned	Rejected. Table 4.2 lists only initiatives by non-state actors. The NICE partnership mentioned by the comment is at government level.	Jeffrey Merrifield	Pillsbury Law Firm	United States of America
61681	24	29	26	31	Table 4.2 lists only one of the European Technology & Innovation Platforms, namely that for photovoltaics. It would be prudent for table 4.2 to include all of the ETIP, including the Sustainable Nuclear Energy Technology Platform (SNETP) described at https://snetp.eu/ .	Rejected. We have only included studies covered by the peer-reviewed literature, the former was but the latter are not.	Rauli Partanen	Think Atom	Finland
65721	24	29	26	31	Table 4.2 lists only one of the European Technology & Innovation Platforms (ETIPs), namely that for photovoltaics. In fairness, table 4.2 should include all of the ETIPs, including the Sustainable Nuclear Energy Technology Platform (SNETP) described at https://snetp.eu/ .	Rejected. We have only included studies covered by the peer-reviewed literature, the former was but the latter are not.	Eero Hirvijoki	Aalto University	Finland
70003	25	29	26	30	Table 4.2, line "Forestry". This estimation of emission reduction potential is over-optimistic and should be revised. The table mentions the goals of the New York declaration in the column "targets". Recent NYDF Assessment Report "NYDF Assessment Partners. 2019. Protecting and Restoring Forests" (https://forestdeclaration.org/images/uploads/resource/2019NYDFReport.pdf) estimates that only 18% of 2020 goal has been reached.	Accepted. Added to this sentence, "although the Initiative acknowledges that insufficient progress has to-date been made towards this goal".	Markku Kamminen	University of Helsinki	Finland
309	25		25		Table 4.2 second to last row of the table: IPCC has adopted the term short-lived climate forcers (SLCF) instead of short-lived climate pollutants (SLCP)	Accepted.	Sandro Fuzzi	ISAC CNR	Italy
84475	26	30	26	31	Updated information is available in Chapter 8 (page 7 lines 26-33) that indicates the new savings potential to have reached 2.3 GtCO ₂ -eq annually by 2030 and 4.2 GtCO ₂ -eq annually for 2050 for this sample of cities.	Accepted. Reference to Chapter 8 added	Siir KILKIS	The Scientific and Technological Research Council of Turkey	Turkey
8167	26	31	26	31	Please explain "LCTP".	Accepted. Spelled out in footnote.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
55217	27	1	27	5	In Figure 4.1, the panel on the right lists forestry as a category. What about LULUCF generally? Is this a knowledge/research gap? If so, say that.	Noted. The underlying paper chose the label "forestry" as shortcut for the broader category of LULUCF. We would therefore keep the current label.	Government of United States of America	U.S. Department of State	United States of America
66781	27	4	27	4	It would be helpful if discussion of this figure, and more generally, estimates in this section, included discussion of the potential for double counting. This is also true for Table 4.2. In particular, inclusion of city and regional initiatives may double counting various sectoral initiatives. The text should ideally address this issue carefully as it has substantial implications for the true potential of NSA led efforts.	Accepted. Discussion of potential for overlaps expanded in FGD ("Care is to be taken not to depict these efforts as additional to action within national NDCs, unless this is clearly established (Broekhoff et al. 2015). There are potential overlaps between individual NSA and ICL, and across ICLs – Karamochi et al. (2020) propose partial and conservative partial effect methods to avoid double counting when comparing ambition, a matter that merits further attention. As the diversity of actions increased, the potential to count the same reductions multiple times increases.") and reflected in confidence statement attached with NSA mitigation estimates.	Navroz Dubash	Centre for Policy Research	India
24927	27	5	27	5	In the table above fig 4, "forestry" is in the range 3.8-8." (which are already big numbers!). How is that Fig 4 (right) suggests up to 12 GtCO ₂ /y?	Noted. Table value of 3.8 to 8 GtCO ₂ is a summary of various studies. Figure 4 provides the results from one study. The figure suggests around 5 GtCO ₂ (not 12), which is within the range of values in the table	Giacomo Grassi	Joint Research Centre, European Commission	Italy
389	28	4	28	9	Businesses can significantly contribute to global mitigation efforts by reducing GHG emissions and other actions. However, there are no legally binding commitments to do so. While they have been encouraged to pledge reduction of their emissions, these efforts are not mandated by government policies.	Noted. We mention already in the chapter that these efforts are not binding and are often voluntary.	Michael Kennish	Rutgers University	United States of America
5031	28	5	28	5	the authors write "For example, the SBTi (Science-Based Targets Initiative) encourages companies to pledge to reduce..." suggest to delete "to pledge" as follows "For example, the SBTi (Science-Based Targets Initiative) encourages companies to pledge to reduce..."	Accepted	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
84477	28	13	28	14	An additional reference that may be useful is a new report that synthesizes net-zero emission targets that is used in Box 8.1 (Chapter 8, page 54). This would also complement subnational policies in the next sentence.	Accepted. Cross reference to Chapter 8 introduced.	Siir KILKIS	The Scientific and Technological Research Council of Turkey	Turkey
55219	28	18	28	18	Remove "very"	Accepted	Government of United States of America	U.S. Department of State	United States of America
70005	28	18	28	21	Based on the previous comment on Table 4.2. This text is over-optimistic. Revise it.	Noted. See response to comment No.70003. Sentence modified.	Markku Kamminen	University of Helsinki	Finland
391	28	21	28	23	There needs to be a discussion of deforestation rates projected over the short- and mid-term. How will changes in these rates affect the total carbon emission pool as well as temperature goals? For example, deforestation is increasing at an alarming rate in Brazil and other places. Projections must be made to determine how these changes will affect mitigation strategies and development pathways.	Noted. This is not addressed in our chapter, and is instead in the chapter on Land use change/forestry. Here we are only reporting and synthesizing data on what sub-national actors report in terms of emissions reductions for the sector.	Michael Kennish	Rutgers University	United States of America
55221	28	24	28	25	This statement should be elevated to the SPM.	Noted	Government of United States of America	U.S. Department of State	United States of America
25059	28	24	28	32	The following should be updated "The member companies of the GCCA (CSI) have become better prepared for future legislation on managing GHG emissions and developed management competence to respond to climate change compared to non-member companies in the cement sector (Busch et al. 2008)." Indeed, GCCA members have released a Climate Ambition Statement which is worth highlighting here https://gccassociation.org/climate-ambition/#:~:text=%E2%80%9CThe%202050%20Climate%20Ambition%20represents,carbon%20neutral%20basis%20by%202050.	Accepted. Material updated.	Claude Lorea	GCCA	Belgium

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
64273	28	24	28	32	In the energy sector, some voluntary initiatives are also emerging to stop methane emissions associated with oil and gas supply chains. The Oil and Gas Methane Partnership (OGMP) is a voluntary initiative lead by the Climate and Clean Air Coalition, which has recently published a comprehensive framework for methane detection, measurement and reporting (https://www.ccacoalition.org/en/resources/oil-and-gas-methane-partnership-ogmp-20-framework). This framework defines several levels and a path to a Gold Standard requiring direct measurements and credible abatement targets to progressively reduce methane emissions.	Accepted. Material added.	Christian Lelong	Kayros	United Kingdom (of Great Britain and Northern Ireland)
3471	28	32	28	32	It is suggested to add the following phrase: "Accordingly, the cement industry has developed some Roadmaps to reach the net carbon neutrality by 2050 (Sanjuán et al. 2020)" => Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. <i>Energies</i> 2020, 13, 3452. https://doi.org/10.3390/en13133452	Accepted. Reference added	Miguel Angel Sanjuán	IECA	Spain
10361	28	32	28	32	It is suggested to add the following phrase: "Accordingly, the cement industry has developed some Roadmaps to reach the net carbon neutrality by 2050 (Sanjuán et al. 2020)" => Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. <i>Energies</i> 2020, 13, 3452. https://doi.org/10.3390/en13133452	Accepted. Reference added	Aniceto Zaragoza	Oficemen	Spain
11517	28	32	28	32	It is suggested to add the following phrase: "Accordingly, the cement industry has developed some Roadmaps to reach the net carbon neutrality by 2050 (Sanjuán et al. 2020)" => Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. <i>Energies</i> 2020, 13, 3452. https://doi.org/10.3390/en13133452	Accepted. Reference added	PEDRO MORA PERIS	UNIVERSITY	Spain
55223	28	37	28	39	The final sentence in this paragraph seems tacked on. Consider deleting it.	Accepted. Sentence removed.	Government of United States of America	U.S. Department of State	United States of America
83081	28	37	28	39	Even as a social scientist who works with discourse analysis I find the meaning of this sentence hard to grasp. In which ways are these storylines (in documents!) relevant for mitigation practice?	Accepted. Sentence removed.	Geden Oliver	German Institute for International and Security Affairs	Germany
48427	28	40	28	40	Elaboration on the economic implications on national mitigation pathways, ideally those grounded by the AR6 scenario database, is expected, because the Chapter 3 (section 3.6) and the previous IPCC assessment reports have focused on this topic.	Noted. Economic implications of mitigation pathways discussed in section 4.2.6.	Ken Oshiro	Kyoto University	Japan
83567	28	40	29	7	A recent article on net-zero targets might provide further evidence for the assessment in this paragraph: Rogelj, Geden, Cowie & Reisinger, <i>Nature</i> , 2021.	Accepted. Reference added, in Box 4.2.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
55225	28	45			Unclear what "mid-term mitigation strategies" refers to. If authors mean NDCs, say NDCs. But the sentence is also confusing because of the different use of "long-term" vs. "mid-term" in the Paris Agreement vs. in this report. Authors clarify this later in the text but it would be helpful to clarify here. Suggest using the phrase "mid-century" where it is accurate to do so in order to avoid this confusion.	Accepted. Terminology clarified.	Government of United States of America	U.S. Department of State	United States of America
55227	29	5			Authors could just say "up to 2050" or "up to mid-century" to avoid the confusion of referring to 2050 as mid-term here while the 2050 strategies are known as "long-term strategies".	Accepted. Terminology clarified.	Government of United States of America	U.S. Department of State	United States of America
83083	29	5	29	7	Maybe better to avoid the "neutrality" concept here and say "aim at net zero GHG or CO2 emissions", to indicate early on that there's an important difference (see also my more general "net zero" comment on the entire chapter)	Accepted "net zero GHG or CO2 emissions" will be used.	Geden Oliver	German Institute for International and Security Affairs	Germany
14957	29	6	29	6	This is not true as framework like UNEP or the Climate Action Tracker actually perform these analyses. Please revise!	Noted. However, additional assumptions about emissions by parties that have not submitted mid-century low emission strategies must be made to draw global implications.	Government of Saint Kitts and Nevis	Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements	Saint Kitts and Nevis
72725	29	6	29	6	There is literature that looks at how estimates can be made for the warming level associated with specific national targets. See, for example, the Climate Action Tracker and Paris Equity Check.	Rejected. We cite published papers, not online tools (as the peer review status of the latter is unclear, and web-based information can disappear). Substantively, direct links between an individual actor's mitigation efforts in the near-term and global temperature goals in the long-term cannot be inferred; making direct links requires clear distinctions of spatial and temporal scales and explicit treatment of ethical judgements made	Matthew Gidden	Climate Analytics	Germany
14959	29	9			While the issue highlighted in Box 4.1 is scientifically correct, the messaging resulting from the way the box is written is very problematic as the lay reader could misunderstand the core message to be that ambitious mitigation efforts of individual countries do not really matter, cannot be used infer global temperature implications and therefore will not get us to meeting the Paris agreement. The necessity of clearly and transparently outlining equity as well as other countries' mitigation assumptions underlying these kinds of analyses should be highlighted in a more positive way. The box should be framed around the uncertainties associated with such projections, including the assumptions that need to be made, without implying that any target could lead to any pathway, which is not really helpful.	Accepted. Box rephrased to indicate that ambitious mitigation efforts matter.	Government of Saint Kitts and Nevis	Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements	Saint Kitts and Nevis
60331	29	9	29	30	There is a huge demand from actors to understand how their actions link to a global temperature goal, this is probably the reason for this box. But the text in the box is quite defensive. It could be formulated more positively e.g. in line 14: "As a result, individual country emission pathways in the near- to mid-term CAN be linked to a long-term temperature ONLY WITH additional assumptions specifying (i) the GHG emissions and removals of other countries up the 17 mid-term; and (ii) the GHG emissions and removals of all countries beyond the near- and mid-term.". The next sentence "In fact, a given emission pathway in the near- to mid-term at the national level could be tied to any long-term temperature level" is misleading because it is only in theory possible, many long temperature levels are clearly out of reach. The current text could be interpreted that we can solve the problem after 2030, which we can clearly show from the literature that we cannot. "The assumptions made about mitigation efforts in other countries as well as about emissions beyond 2030 or 2050 are not always explicit." could be made positive by saying "should be made explicit."	Accepted.	Niklas Höhne	NewClimate Institute	Germany
66783	29	9	29	30	No explicit suggestion here, but I just had to say how delighted I am to see this box, which lends important transparency to the slew of 2 and 1.5 degree compatible national pathways, which, as the box makes clear, really depend on all sorts of assumptions, often implicit.	Thanks	Navroz Dubash	Centre for Policy Research	India
83085	29	9	29	30	This is a great and much needed box. Is there really no literature you could refer to, where this issue is being analysed in a more detailed way?	Noted. At least indirect literature cited in Box. No direct literature found.	Geden Oliver	German Institute for International and Security Affairs	Germany
67519	29	12	29	13	strictly speaking, the words "the sum of" makes this sentence less precise and can be dropped. (Indeed, the whole sentence can be deleted as the next sentence has the same content and is better.)	Accepted. Sentence deleted.	Taran Fæhn	Statistics Norway, Research Dep.	Norway
83571	29	12	29	13	This statement can be made more general so that it applies more broadly to the targets in the Paris Agreement. Article 2 of the Paris Agreement doesn't refer to 2100 in particular. This statement could thus be changed to: "Global average temperature at a given point of time in the future will depend on the combined effect of all countries' GHG emissions until then."	Accepted. Point made in second sentence instead of first.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
83569	29	13	29	13	For accuracy, this should refer to cumulative "CO2" emissions.	Accepted	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
83573	29	14	29	14	This statement is slightly inaccurate. Warming is not a direct function of any single actor's emissions, but it is definitely to some degree linked to it. This can be corrected by writing: "Any single country's or any individual actor's mitigation efforts only contribute indirectly to the resulting global warming." The rest of the paragraph then follows nicely.	Rejected. The slight inaccuracy in the statement is corrected, but not in the way suggested by reviewer, since "contributes indirectly" softens the (quantitative) point made in the box.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
72727	29	17	29	20	This statement is overly simplistic, unhelpful and should be thoroughly revised. With this a the current core statement emerging from Box 4.1, the box actually becomes quite dangerous as it misses the point of highlighting the need to clearly outline the equity and emission reduction assumptions for individual countries when providing these types of analyses.	Accepted. Statement deleted.	Matthew Gidden	Climate Analytics	Germany
78121	29	17	29	20	This statement is overly simplistic, unhelpful and should be thoroughly revised. With this a the current core statement emerging from Box 4.1, the box actually becomes quite dangerous as it misses the point of highlighting the need to clearly outline the equity and emission reduction assumptions for individual countries when providing these types of analyses.	Accepted. Statement deleted.	Charlotte Plinke	Climate Analytics	Germany
83575	29	17	29	20	This is inaccurate. First, global warming is not only assessed in 2100. For warming in 2100, the assumptions for the second half of the century indeed affect the temperature outcome, but that does not have to be the case if global emissions would decline rapidly and peak warming is achieved over the course of the 21st century.	Accepted. Statement deleted.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
83577	29	17	29	20	While true in theory, this statement can be perceived as misleading because while it is true that one can in theory assume anything - just like one can draw pathways freehand on a sheet of paper - the plausibility of assumptions will determine whether one can actually reach "any" temperature target. What this statement allows a reader to take away is that if the US continues to increase emissions until the end of the century, this can still be consistent with limiting warming to 1.5°C because one can assume technically impossible emissions removals by other countries. I thus think this statement makes a too generalizing assertion.	Accepted. Statement deleted.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
55229	29	24	29	30	Is there any more accessible way to talk about these routes?	Noted. Discussion of "routes" deleted.	Government of United States of America	U.S. Department of State	United States of America
52071	29	25	29	28	A uniform carbon price trajectory and to have a net zero by 2050 model to reach 1.5 is ambitious but it is beyond UNFCCC and PA which focus on avoiding global warming and it also might not be aligned with national circumstances	Noted. Discussion of "routes" deleted.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
85761	29	32	29	36	Please correct: The Paris Agreement does not define the term 'long-term' as 2050. Parties have considered a range of dates in developing their long-term strategy.	Noted. Correct that the Paris Agreement does not define long-term as 2050; in this IPCC report, 2050 is the point defining the boundary between mitigation in long-term (assessed in chapter 3) and near- to medium-term (in this chapter). Also note that decision 1/CP.21, paragraph 35 "Invites Parties to communicate, by 2020, to the secretariat mid-century, long-term low greenhouse gas emission development strategies in accordance with Article 4, paragraph 19, of the Agreement". Mid-century is 2050.	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
83579	29	32	36	7	A recent article on net-zero targets might provide further evidence for the assessment in this paragraph: Rogelj, Geden, Cowie & Reisinger, Nature, 2021.	Noted. Reference introduced in Box 4.2.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
55231	29	34			The clarification beginning "note that by long-term ..." should be provided in the previous section (it is helpful but comes too late)	Partially accepted, in that introductory paragraph of section 4.2.4. now refers to mid-century.	Government of United States of America	U.S. Department of State	United States of America
78403	29	34	29	34	End of mid-term and start of long-term.....	Accepted.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
1933	29	37	29	41	There is something missing here about the implications of reference years and net zero GHGs or carbon. Would also be good to specifically link this to chapter 3 and the scientific assessments of what is consistent with the 2 and 1.5C goals.	Accepted. Sentence modified to incorporate suggestions.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71425	29	37	29	41	There is something missing here about the implications of reference years and net zero GHGs or carbon. Would also be good to specifically link this to chapter 3 and the scientific assessments of what is consistent with the 2 and 1.5C goals.	Accepted. Sentence modified to incorporate suggestions.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
83087	29	37	29	41	Several issues here: most submissions are on 80% so far, but only because many EU countries submitted their plans before the EU decided on new target of "net zero GHG emissions" by 2050 (before it was 80-95%). The claim that net zero strategies have been increasing after SR1.5 is incorrect or misleading since the example given is a misinterpretation of what happened in Germany, caused by a poor official German government translation (German documents always called 95% - the upper level of the 80-95% range - "weitgehende Treibhausgasneutralität", which then got wrongly translated into "extensive" while "weitgehend" in fact means "almost" - the assumption being 95% conventional mitigation plus ~5% LULUCF sink, see Geden/Scheiml 2020 https://www.swp-berlin.org/1018449/2020RPO8). There have been net zero strategies in other countries before, but not in the form of official long-term strategies under the PA (and they turned out not to be credible, with Costa Rica's "carbon-neutral by 2021 claim" being the most prominent case)	Noted. German example deleted.	Geden Oliver	German Institute for International and Security Affairs	Germany
76429	29	39	29	41	Germany has no path to achieving GHG neutrality by 2050 iff ever. It is increasing the use of gas imports from Russia and is winding back its only reliable low carbon generators, namely its nuclear power plants.	Noted. No literature provided to back this up.	Robert Parker	Nuclear for Climate Australia	Australia
1931	30	1			Should specify that these are UNFCCC submissions. Support linking to the UNFCCC website rather than including the table here as it is prone to outdated, noting that the link in line 3 of page 30 is not working.	Partially accepted. Table kept, but specifying that those are UNFCCC submissions.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
63579	30	1			For above table 4.3, (Canada, Date Submitted- Dec 11, 2020, net zero greenhouse gas emissions by 2050). On November 19, 2020, Canada proposed a Net -Zero Emissions Accountability Act, that will formalize Canada's target to achieve net-zero emissions by the year 2050. https://www.canada.ca/en/environment-climate-change/news/2020/11/government-of-canada-charts-course-for-clean-growth-by-introducing-bill-to-legislate-net-zero-emissions-by-2050.html ; https://www.canada.ca/en/environment-climate-change/news/2020/11/government-of-canada-charts-course-for-clean-growth-by-introducing-bill-to-legislate-net-zero-emissions-by-2050.html ;	Rejected. UNFCCC official website only indicates Canada's 17.11.2016 submission (https://unfccc.int/process/the-paris-agreement/long-term-strategies). Canada's net zero objective is listed in Table 4.6.	Government of Canada	Environment and Climate Change Canada	Canada
71427	30	1			Should specify that these are UNFCCC submissions. Support linking to the UNFCCC website rather than including the table here as it is prone to outdated, noting that the link in line 3 of page 30 is not working.	Partially accepted. Table kept, but specifying that those are UNFCCC submissions.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
393	30	1	30	3	As shown in Table 4.3, the GHG emission development strategies for most countries target 80% emission reduction in 2050 compared to 1990, 2000, or 2005 levels. In addition, most countries reporting net zero GHG or GHG neutrality targets are doing so for 2050. These step reductions will be challenging to achieve. There should be a discussion in Section 4.2.4.2 of the probability of achieving the short- and medium-term temperature goals in light of the limitations of steep GHG reductions necessary to meet temperature goals of the Paris Agreement.	Noted. Pathways and obstacles to accelerated mitigation are discussed in section 4.2.5 onward. There is no basis to establish probabilities, on the other hand.	Michael Kennish	Rutgers University	United States of America
5115	30	1	31	1	Can't all the GHG reduction targets be referred to a common reference point (e.g. emissions in 1990)? You could add a separate column for this. Otherwise it's a bit like comparing apples and oranges	Rejected. Table 4.3 reports official submissions to the UNFCCC, as they are written by governments.	Lina Hollender	n/a	Germany
16289	30	1	31	1	After Dec. 11, 2020, 6 more countries have submitted their LEDS. Please update the table.	Accepted. Table 4.3 updated.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16291	30	1	31	1	For those that had submitted the LEDS several years ago(USA,2016 - Ukraine, 2018), we should note that the LT targets summarized in Table 4.3 are no longer valid; current information in the last column is just misleading. It should be indicated somehow that most of them are EU members (so they have EU-wide 2050 Net Zero goal) or already taking policy or legislative actions toward carbon neutrality by 2050.	Noted. However, Table 4.3 reflects official LEDS submission to the UNFCCC.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16293	30	1	31	1	Please double check whether South Africa set the 2050 Net Zero goal. It doesn't seem to be the case in my read. In LEDS, South Africa clearly state their vision statement: "South Africa follows a low-carbon growth trajectory while making a fair contribution to the global effort to limit the average temperature increase, while ensuring ...". In other part of the LEDS, it states "This Strategy is a living document, the beginning of our journey towards ultimately reaching a net zero economy by 2050."	Checked.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
83089	30	1	31	1	Table 4.3 needs some updates (you know that already) but - if you keep it in this detailed format - maybe also cross-checking from experts from the respective countries. The entry for Germany is problematic, there was never a net-zero pledge, (although it may sound like it, because of a misleading official translation of what the 95% target means (German documents always called 95% - the upper level of the 80-95% range - "weitgehende Treibhausgasneutralität", which then got wrongly translated into "extensive" while "weitgehend" in fact means "almost" - the assumption being 95% conventional mitigation plus ~5% LULUCF sink, see Geden/Schmitt 2020 https://www.swp-berlin.org/10.18449/2020RP08). In case you opt for a summary (which would be probably better, since it would diminish the potential for factual errors), it would be good to reflect on the differences between the official long-term strategies and official government announcements. Quite often, the announcements are more ambitious than the submitted strategies, and not only when there was a change in government after a strategy had been submitted (e.g., in Austria, where the new government claims to pursue a "climate neutrality by 2040" target but then delivers a net zero GHG by 2050 strategy)	Noted. However, 95% mitigation plus 5% sinks makes this goal close to net zero CO2. Kept as in Table 4.5 (in FGD numbering)	Geden Oliver	German Institute for International and Security Affairs	Germany
55233	30	3			In Table 4.3, Benin has a target: avoidance of at least 12 MtCO2e of emissions and sequestration of at least 163 MtCO2e by 2030.	Noted. Benin entry completed.	Government of United States of America	U.S. Department of State	United States of America
55235	30	3			In Table 4.3, Norway also reflects its target in quantitative terms: "In quantitative terms, the target is to achieve emission reductions of the order of 80-95% from the level in the reference year 1990. In its political platform, the Government has agreed to strengthen the target to emission reductions of the order of 90-95% and to propose that the Parliament amends the Climate Change Act accordingly to reflect this."	Accepted. Entry modified.	Government of United States of America	U.S. Department of State	United States of America
55237	30	3			In Table 4.3, while South Africa's long-term strategy mentions net zero, it is not clear that the country is adopting this as a GHG reduction target. The specific language on net zero is: "this Strategy is a living document, the beginning of our journey towards ultimately reaching a net zero carbon economy by 2050." Elsewhere in the same document, it says: "In the absence of an agreed quantitative articulation of the vision, the Peak, Plateau, Decline Emissions Trajectory Range, as reflected in the NCCRP and NDP, is used as the benchmark against which the performance of SALEDS will be measured. The Peak, Plateau, Decline Emissions Trajectory Range does not achieve net-zero emissions. While the ECIU data set interprets this as a net-zero target, the ClimateWatch data set does not (https://www.climatewatchdata.org/net-zero-tracker). It may be appropriate to include a caveat."	Noted. Kept as stated in document.	Government of United States of America	U.S. Department of State	United States of America
16927	30	3	30	3	Spanish Long Term Decarbonization Objective is Climate Neutrality by 2050 (https://www.miteco.gob.es/prensa/ultimas-noticias/el-gobierno-aprueba-la-estrategia-de-descarbonizaci%C3%A3n-a-largo-plazo-que-marca-la-senda-para-alcanzar-la-neutralidad-clim%C3%A1tica-a-2050/cm:30-516141)	Accepted. Included in Tables 4.5 and 4.6.	Government of Spain	Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica	Spain
20611	30		30		For France: The updated strategy, aiming at GHG neutrality in 2050 should be submitted to the UNFCCC secretariat by the time of the end of the review	Noted.	Government of France	Ministère de la Transition écologique et solidaire	France
1935	31	2			Suggest to reconsider the heading to reflect that this is an account of countries that have formally declared net zero targets, and potentially reverse the order of 4.2.4.2 and 4.2.4.1	Partially accepted. Text revised to reflect the purpose of subsection.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
63581	31	2			On December 11, 2020 Canada released a Strengthened Climate Plan titled "A Healthy Environment and a Healthy Economy" which includes 64 new measures to support targets of net-zero by 2050. https://www.canada.ca/en/environment-climate-change/news/2020/12/a-healthy-environment-and-a-healthy-economy.html : https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/healthy-environment-healthy-economy.html	Partially accepted. Official submission to UNFCCC kept in Table 4.5, while additional plan listed in Table 4.6.	Government of Canada	Environment and Climate Change Canada	Canada
71429	31	2			Suggest to reconsider the heading to reflect that this is an account of countries that have formally declared net zero targets, and potentially reverse the order of 4.2.4.2 and 4.2.4.1	Partially accepted. Text revised to reflect the purpose of subsection.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
18135	31	3	31	23	Could include insights from CAS 2020 as there will be more recent announcements	Noted	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
1937	31	3	31	3	Are some of these not net zero GHG?	Accepted. Text revised.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71431	31	3	31	3	Are some of these not net zero GHG? A footnote should be added to explain the achievement in the case of Suriname and Bhutan. Presumably achievement in these cases largely denotes the presence of a large LULUCF sink. Has their achievement been assessed scientifically (e.g. is it robust to determine that the removals are anthropogenic?)	Accepted. Text revised.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
55239	31	4			"mitigation strategies" suggests something more complex than an emissions target; many countries have pledged net-zero emissions but do not have a strategy; therefore this may be an overstatement. If authors are just referring to net zero targets (as in Table 4.4), suggest replacing "mitigation strategies" with "net zero targets".	Accepted. Text revised.	Government of United States of America	U.S. Department of State	United States of America
83091	31	4	31	7	The ECIU is not a scientifically credible source and should not be used as the basis for assessment. It doesn't give much information and contains several factual errors	Noted. List double checked.	Geden Oliver	German Institute for International and Security Affairs	Germany
76431	31	7	31	10	France will need to ensure it maintains and expands its nuclear energy fleet if it is to meet its target. Great care must be exercised to ensure methane burning is eliminated as a backup to renewables.	Noted. Not a comment, however.	Robert Parker	Nuclear for Climate Australia	Australia
72729	31	7	31	7	Does Suriname include natural sinks in its NDC? Net zero CO2 would be achieved in anthropogenic sinks balance emissions, so natural sinks should not be included.	Accepted. Text revised.	Matthew Gidden	Climate Analytics	Germany
78123	31	7	31	7	Suriname includes natural sinks in its NDC, so this is not strictly true - Suriname hasn't achieved anthropogenic carbon neutrality. Please revise.	Accepted. Text revised.	Charlotte Plinke	Climate Analytics	Germany
20613	31	7	31	9	This updated strategy should be communicated to the UNFCCC secretariat by the end of the review	Noted.	Government of France	Ministère de la Transition écologique et solidaire	France
83093	31	7	31	9	The French "bas-carbone" strategy may sound like it aims at "carbon neutrality" (net zero CO2) but it in fact aims at "net zero GHGs" (not to be called "climate neutrality" in the IPCC report, see Glossary). A similar issue arises with Finland's 2035 net zero target (which is presented as "carbon neutrality" in English documents, which appears to be a misleading translation stemming from the original Finnish wording, because the strategy is actually about net zero GHGs, as you can see in their long-term strategy). These two examples (mentioned also in Rogelj et al. 2021, in Nature 591, "Three ways to improve net zero emissions targets") show that careful treatment of announcements is due	Accepted. Text revised.	Geden Oliver	German Institute for International and Security Affairs	Germany
72731	31	11	31	13	This implies the UK's net zero goal is less set in stone than it is - it's written in law.	Noted. However, the comment does not make the sentence invalid (in reporting what the UK CCC states).	Matthew Gidden	Climate Analytics	Germany
78125	31	11	31	13	This implies the UK's net zero goal is less set in stone than it is - it's written in law. Please revise.	Noted. However, the comment does not make the sentence invalid (in reporting what the UK CCC states).	Charlotte Plinke	Climate Analytics	Germany
45861	31	13	31	16	Please revise. Germany plans a 55% reduction of GHG-emissions until 2030 and strives for GHG-neutrality by 2050. There is no third step and no plan for a single technology as carbon sink.	Noted. Corrigenda	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
83097	31	13	31	16	This claim is incorrect. You are citing a high-quality analysis of what Germany should do, not what the government decided to do (official target is 55% by 2030)	Noted. Corrigenda	Geden Oliver	German Institute for International and Security Affairs	Germany
16295	31	18	31	19	The sentence "... China and Korea have not yet submitted their long-term strategies to UNFCCC, but they have announced ... net zero GHG emission by 2050 ..." (UN 2020a,b) should be revised, reflecting Korea's official LEDS submission to UNFCCC, which states Korea's net zero emission goal by 2050.	Accepted. Republic of Korea's official LEDS submission to the UNFCCC reflected in Table 4.5.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
55241	31	25			There is another data source on net zero: https://www.climatewatchdata.org/net-zero-tracker	Noted	Government of United States of America	U.S. Department of State	United States of America

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63583	31	25			On November 19, 2021 Canada announced the Canadian Net-Zero Emissions Accountability Act (Currently In Policy Document)- Target Year - 2050. https://www.canada.ca/en/environment-climate-change/news/2020/11/government-of-canada-charts-course-for-clean-growth-by-introducing-bill-to-legislate-net-zero-emissions-by-2050.html	Accepted.	Government of Canada	Environment and Climate Change Canada	Canada
16297	31	25	32	1	The last row "Korea/2050/Proposed Legislation/Speeches and Statements by the President" should be revised to "Korea/2050/In Policy Document/2050 Carbon Neutral Strategy of the Republic of Korea"	Corrigenda	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16299	31	25	32	1	List of nations with net zero target and related information in Table 4.4 are highly time-dependent, so please cross-check those information using several different sources when updating the table.	Accepted	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
83095	31	25	32	1	This table should be replaced with text, because it contains many factual errors (which is unavoidable, at this level of detail, also because governments are not always clear about what exactly they aim for, and sometimes there's conflicting information about what is going on in non-Western countries, and sometimes there's heavy spin on what is going on there, when some want to show country x as a bright example for country y, whereas experts from country x would point to problems with such interpretations about what's going on in their country - Norway is a prime example) and these announcements/plans are obviously "moving targets". Some examples for errors and potential misunderstandings: While the Austrian government's coalition agreement claims net zero by 2040, the same government sent a long-term strategy to the UNFCCC 11 months after it was formed and there it is saying 2050 (as per your own table 4.3) - how to decide here which one counts? Plus, under new EU law, there will be an overarching, union-wide 2050 target but nobody can say in advance what it would mean for individual countries (some would need to be net-zero before 2050). Germany did not claim to go for net zero GHGs by 2050 in its original Climate Action Plan (see my comment above). This would be highly confusing, but probably broadly cited, because no credible table exists. Referring to ECU would be highly problematic, since it is not a scientifically credible source and should not be used as the basis for assessment, not even for a first glance (see my comment above). If chapter 4 were to retain this table, it would need to clarify what these net zero targets refer to, which is equally important than their legal/political status (see my general comment on net zero on the entire chapter): For example: EU is net-zero GHG, China is net zero CO2, New Zealand net-zero long-lived GHGs (CO2 and N2O, but not CH4)	Partially accepted. Table kept but revised.	Geden Oliver	German Institute for International and Security Affairs	Germany
55243	32	1			See U.S. comment on Table 4.3 regarding South Africa and different interpretations about whether it has a net zero target	Accepted. Table revised.	Government of United States of America	U.S. Department of State	United States of America
16929	32	1	32	1	Spanish Long Term Decarbonization Objective is published in Policy Document (https://www.miteco.gob.es/prensa/ultimas-noticias/el-gobierno-aprueba-la-estrategia-de-descarbonizaci%C3%B3n-a-largo-plazo-que-marca-la-senda-para-alcanzar-la-neutralidad-clim%C3%A1tica-a-2050/tcm:30-516141) and targeted by proposed legislation (https://www.miteco.gob.es/ministerio/proyecto-de-ley-de-cambio-climatico-y-transicion-energetica.aspx)	Accepted. Table revised.	Government of Spain	Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica	Spain
67521	32	1	32	1	As a matter of fact, Norway has no net zero target by 2050, and definitely not in the Climate Act, as claimed in Table 4.4. As correctly referred to in Table 4.3, above, the formulation in the Climate Act is "low-emission society by 2050", at present defined as 80-95% reduction from 1990. It is under updating these days to 90-95%. A curiosity is that the Norwegian Parliament passed a decision in 2015 of "climate neutrality by 2030", which apparently renders the target in 2050 in the Climate Act less stringent! Only little is said about the 2030 neutrality target and its interpretations, but international offsets of some kinds will likely be involved.	Accepted. Table revised.	Taran Fiehn	Statistics Norway, Research Dep.	Norway
1939	32	2			This information in this section and section 4.2.5 complements the top down assessments in chapter 3 really well and it would be interesting to have a cross chapter box exploring this further - bring about strengthened messaging	Noted. Chapters 3 and 4 are already connecting through Cross-Chapter Box 6. Further connection is at SPM level.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71433	32	2			This information in this section and section 4.2.5 complements the top down assessments in chapter 3 really well and it would be interesting to have a cross chapter box exploring this further - bring about strengthened messaging. For example 3.5.3 and 4.2.5 both consider the issue of how to strengthen short-term mitigation, with long-term targets in mind.	Noted. Chapters 3 and 4 are already connecting through Cross-Chapter Box 6. Further connection is at SPM level.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
48405	32	2	32	7	I suggest including recent trends of national scenario assessment. For example, in case of Japan, while the current texts mention only the study conducted in 2008, recently the multi-model exercises have been conducted in terms of the 2050 goal (Oshiro et al. 2019, Sugiyama et al. 2021). * Oshiro et al. (2019) https://doi.org/10.1007/s10584-019-02490-x Sugiyama et al. (2021) https://doi.org/10.1007/s11625-021-00913-2	Rejected. This paragraph is about early developments of mid-century mitigation pathway analysis.	Ken Oshiro	Kyoto University	Japan
76433	32	2	32	7	Regarding JAPAN and its GHG reductions, while fossil fuel use is expected to decline, it remains high, at 76% of TPES and more than half of power generation in 2030. The envisioned energy mix for 2030 is coherent with the goal to reduce GHG emissions by 26% by 2030 compared to 2013 levels, and assumes that nuclear energy restarts as planned. However, in light of the newly announced ambition to become carbon-neutral by 2050, there is a need to raise the zero-emission power source ratio already by 2030. The upcoming revision of the SEP in 2021 is a logical starting point for this. The government should develop scenarios how to close an eventual gap in electricity generation if restarts of nuclear plants are delayed. Uncertainty regarding these dimensions risks suppressing the necessary investments in energy infrastructure. Japan's 5th Strategic Energy Plan of 2018 presented nuclear power as "an important base-load power source contributing to the stability of the long-term energy supply-and-demand structure". Under the plan, nuclear power is expected to achieve a 20-22% share of the country's electricity mix by 2030. According to the government, this goal is achievable once about 30 of the existing fleet of 33 remaining operable nuclear reactors return to service and have an average capacity factor of 80%.	Noted	Robert Parker	Nuclear for Climate Australia	Australia
37541	32	8	32	11	"In the developing countries, China, India, South Africa assessed their national emission pathways." This statement is with heading "Mid-century low emission strategies at the national level in the academic literature", giving a wrong impression. India has not communicated LTS yet to the UNFCCC.	Noted. However, title does not mention LEDS. And makes it clear it discusses academic analysis of mid-century mitigation pathways.	Government of India	Ministry of Environment, Forests and Climate Change	India
72733	32	15			Please add: "while being consistent with limiting warming to 1.5°C."	Accepted.	Matthew Gidden	Climate Analytics	Germany
78127	32	15			Please add: "while being consistent with limiting warming to 1.5°C."	Accepted.	Charlotte Plinke	Climate Analytics	Germany
48407	33	1	34	1	While this part is written based on the comparison with net zero emission target, those with the NDC and Mid century strategies will also be expected.	Unclear what the comment aims at.	Ken Oshiro	Kyoto University	Japan
55245	33	4	33	4	"emission" should be "emissions"	Accepted	Government of United States of America	U.S. Department of State	United States of America
29853	34	1	34	1	Figure 4.2 - Please consider to provide an explanation to why historical GHG emissions are lower than historical CO2 energy emissions for Sweden, as this is not intuitive.	Noted. Historical GHG emissions removed from Figure 4.2. Carbon sinks added to some historical GHG emissions explain why GHG are lower than CO2 emission for some countries.	Government of Norway	Norwegian Environment Agency	Norway
48397	34	1	34	1	In Figure 4.2, more detailed categorization of national scenarios are expected. Currently there are only two categories, namely with or without mitigation, but the submitted national mitigation scenarios can be classified into NDC, Mid-century strategy and Enhanced mitigation, according to the meta-scenario sheet submission template.	Rejected. That would add too much information to Figure 4.2.	Ken Oshiro	Kyoto University	Japan
48409	34	1	34	1	In Figure 4.2, adding the plot on NDC around 2030 and mid century strategy by 2050 will be helpful. As Figure 4.2 of the FOD included these plots.	Rejected. That would add too much information to Figure 4.2.	Ken Oshiro	Kyoto University	Japan
48411	34	1	34	1	I am a bit confused with the definition of Figure 4.2. If all green and yellow lines indicate energy CO2 only, the points of historical GHG (Kyoto gases) emissions should be removed. But emission pathways of France looks that there are both energy CO2 and Kyoto gas emission pathways. If so, the label of lines in the legend should be modified.	Accepted. Historical GHG removed. Entry for France removed.	Ken Oshiro	Kyoto University	Japan
80559	34	1	34	2	In Brasil and the UK subgraphs, some of the CO2 energy with mitigation lines cease abruptly around year 2030. The caption does not discuss these cases.	Accepted. The lines are plotted using the data from the actual researches.	Olga Savchuk	Instituto Superior Tecnico	Portugal

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84437	34	1	34	2	The data points for Sweden seems to have been mixed up regarding GHG and CO2 energy. Please double-check, it does not make sense.	Noted. Entry for Sweden deleted.	Mattias Lantz	Uppsala university	Sweden
72735	34	2			There would be value in including other analysis for comparison, e.g. the Climate Action Tracker country analysis.	Rejected. That would add too much information to Figure 4.2.	Matthew Gidden	Climate Analytics	Germany
78129	34	2			There would be value in including other analysis for comparison, e.g. the Climate Action Tracker country analysis.	Rejected. That would add too much information to Figure 4.2.	Charlotte Plinke	Climate Analytics	Germany
74819	34		34		Consider the facts that between July 2019 and June 2020, the total electricity generation into the national grid was 11,301 GigaWatt hours (GWh) consisting of 47% geothermal, 33% hydro, 8% thermal, with the remaining 1% being a combination of wind, biomass and solar, making total renewables to be 92% of the total generation. Again according to the Least Cost Power Development Plan (LCPDP) 2017-2037 plan, if all the planned power plants come on board, the country's electricity generating capacity will increase to 7,200 megawatts (MW) in 2030 and over 9,900 MW by 2037. By then, demand will range from 7,000 MW to 9,000MW, depending on the growth of industries (NDC GOK december 2020). Therefore the Kenya emission trajectories in the figure is not representative and should	Noted. Data for Kenya revised.	Government of Kenya	Kenya Meteorological Service	Kenya
55247	35	4	35	16	A little bit hedge-podge. Make sure to put the main point clearly in topic sentence.	Noted.	Government of United States of America	U.S. Department of State	United States of America
14961	35	4	35	6	This chapter uses definitions of "1.5°C scenarios" that are not consistent with chapter 3 definitions. This is a major concern. It should be clear when referring to definitions set out in national documents that these are not the interpretations of the IPCC, but rather the interpretations of specific countries/ documents. While net zero CO2 in 2050 is a global benchmark for a 1.5°C compatible pathway, this does not necessarily apply at the national level. Please revise here and throughout the chapter.	Noted. It is made clear that the 1.5C scenarios as as described by the authors of the studies (see Box 4.2).	Government of Saint Kitts and Nevis	Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements	Saint Kitts and Nevis
72737	35	4	35	6	Please check for consistency in the definitions used for 1.5°C scenarios between this chapter and chapter 3.	Noted. It is made clear that the 1.5C scenarios as as described by the authors of the studies (see Box 4.2).	Matthew Gidden	Climate Analytics	Germany
78131	35	4	35	6	Please make sure to use definitions of "1.5°C scenarios" that are consistent with chapter 3 definitions. It should be clear when referring to definitions set out in national documents that these are not the interpretations of the IPCC, but rather the interpretations of specific countries / documents. While net zero CO2 in 2050 is a global benchmark for a 1.5°C compatible pathway, this does not necessarily apply at the national level. Please revise here and throughout the chapter.	Noted. It is made clear that the 1.5C scenarios as as described by the authors of the studies (see Box 4.2).	Charlotte Plinke	Climate Analytics	Germany
83099	35	4	35	6	Are the reductions numbers given referring to global pathways or to certain country groups? And which gases (GHG) would be more ambitious than CO2 only?	Accepted. Text revised.	Geden Oliver	German Institute for International and Security Affairs	Germany
18137	35	4	37	4	Check and clarify these figures, in terms of emissions units and dates	Accepted. Text revised.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
15227	35	5	35	6	In the sentence "1.5°C scenarios (typically assumed to imply net zero emissions in 2040)", the time point for net zero emission (in 2040) is inconsistent with the statement in Chapter 3 (around 2050), please check and revise. The statement of page 5 (lines 17-19) of Chapter 3 reads "In terms of CO2 emissions, a warming limit of 1.5°C (50% probability) with no low (< 0.1°C) temporary overshoot of the limit is associated with 13-25 GtCO2 in 2030 and net zero CO2 emissions around 2056 (2045-2070) (medium confidence)."	Accepted. Text revised.	Government of China	China Meteorological Administration	China
78405	35	6	35	6	Need to specify net zero CO2 or GHG always	Accepted. Text clarified.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
55249	35	12	35	12	Replace "drastic" with "dramatic"	Noted	Government of United States of America	U.S. Department of State	United States of America
45863	35	12	35	13	With regards to the evaluation of the adequacy of country NDCs, the authors should choose a uniform approach rather than singling out individual countries.	Rejected. Japan, China, Germany mentioned, and further countrise in following, on LEADS. We cannot review the literature without providing examples.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
45865	35	14	35	16	Please revise. No specific technology is decided on for the transport sector in Germany.	Accepted. Description will be more clear.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
72739	35	17	35	25	This subsection 4.2.3.4 would benefit from a discussion o the role of LULUCF or carbon dioxide removal.	Noted.	Matthew Gidden	Climate Analytics	Germany
78133	35	17	35	25	This subsection has no discussion of LULUCF or carbon dioxide removal, which is surely important when discussing net zero targets. Please elaborate throughout section 4.2.3.4.	Noted.	Charlotte Plinke	Climate Analytics	Germany
55251	35	22	35	22	Replace "underlines" with "notes"	Accepted	Government of United States of America	U.S. Department of State	United States of America
72741	35	22	35	22	IAMs show that ASIA CO2 emissions including LULUCF go to zero around 2050--2075. Please clarify	Rejected. This section mainly mentions around 2050.	Matthew Gidden	Climate Analytics	Germany
48413	35	32	36	1	In Table 4.5, multi-model studies for single region should also be covered. For example, JMIP (Japan Model Intercomparison Project) can be listed as an multi-model national analysis, where five energy system and integrated assessment models assessed the mitigation pathways in Japan by 2050.	Accepted	Ken Oshiro	Kyoto University	Japan
66957	35	33	35	34	COMMIT, 2019 could be replaced by: Fragkos, Panagiotis, van Soest, Heleen, Schaeffer, Roberto, Reedman, Luke, Koberle, Alex, Macaluso, Nick, Evangelopoulou, Stavroula, De Vita, Alessia, Sha, Fu, Qimin, Chai, Kejun, Jiang, Mathur, Ritu, Shekhar, Swapnil, Boer, Rizaldi, Dewi, Retno G., Herran, Diego S., Oshiro, Ken, Fujimori, Shimichiro, Park, Chan, Safonov, George, and Iyer, Gokul C. Energy System Transitions and Low-Emission Pathways in Australia, Brazil, Canada, China, EU-28, India, Indonesia, Japan, Republic of Korea, Russia, and United States. United States: N. p., 2021. Web. doi:10.1016/j.energy.2020.119385.	Accepted	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
62079	36	1	36	1	Please check Rogelj et al. 2017, this seems not a CD-LINKS publications. I would cite: CD-LINKS studies that present global national emissions pathways for 1.5C and 2C. I would cite: Roelfsema, M., van Soest, H. L., Harmsen, M., van Vuuren, D. P., Bertrams, C., den Elzen, M., ... & Luderer, G. (2020). Taking stock of national climate policies to evaluate implementation of the Paris Agreement. Nature Communications, 11(1), 1-12.	Accepted	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
11123	36	7	36	7	I very much liked the entire section that starts here. If there were more time to iterate, I would love it if the analytic framework it presents could be the starting points for much of chapters 13 - 16.	Thanks	Anthony Patt	ETH Zürich	Switzerland
78407	36	7	47	28	There is a very substantial overlap between this material and the sectoral chapters (and some other material). Is it necessary or could there be more cross-reference. At least needs checked for consistency.	Accepted. Cross-references to other chapters included.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
83117	36	7	47	29	I wonder why the AFOLU sector is missing here, in terms of conventional mitigation (agricultural non-CO2 emissions, which are not all SLFCs, and avoided emissions from land-use change) and removals (through afforestation, peatland restoration etc.). LULUCF is an important element of NDCs (https://cbmjournals.biomedcentral.com/articles/10.1186/s13021-016-0068-3). In case you'd want to keep methane with other SLFCs, you could also create a CDR section covering land-based removals and emerging considerations on technological CDR (the latter being part of almost all modelling that leads to national net-zero GHG targets - as mentioned in 4.2.5.5), some of which is already referenced throughout section 4.2.5. It is also an emerging policy issue in OECD countries, see Schenuit et al. 2021 (https://www.frontiersin.org/articles/10.3389/fclim.2021.638805/full)	Noted. Emission reductions in AFOLU sector less often included in mitigation scenarios reviewed in preparing 4.2.5. Detailed discussion provided in Chapter 7.	Geden Oliver	German Institute for International and Security Affairs	Germany
72743	36	12	36	13	Is there a reference for this? The use of "adequately" seems like a judgement on the literature, rather than a scientific assessment. Please revise!	Noted. There are no references for this statement as it is intended to be a summary sentence based on the findings throughout this chapter. If references are to be added, it'd require adding nearly all of the references in the demand subsections and subsequent sections on systems analysis and non-CO2 GHGs.	Matthew Gidden	Climate Analytics	Germany

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
78135	36	12	36	13	Is there a reference for this? The use of "adequately" seems like a judgement on the literature, rather than a scientific assessment. Please revise!	Noted. There are no references for this statement as it is intended to be a summary sentence based on the findings throughout this chapter. If references are to be added, it'd require adding nearly all of the references in the demand subsections and subsequent sections on systems analysis and non-CO2 GHGs.	Charlotte Plinke	Climate Analytics	Germany
395	36	14	37	23	It may be overly optimistic to predict that global energy-related carbon emissions will fall by more than 70% during the next 30 years. Cutting industry CO2 emissions by 65-90% from the 2020 level by 2050 and generating 70-95% of electricity from low-carbon sources will be extremely challenging. Although the GHG reduction targets and pathways in Table 4.3 (80% reduction in 2050 from 1990 and 2005 renewable electricity scenarios) are deemed technically feasible and are considered consistent with Paris Agreement temperature goals below and 1.5°C and 2°C, the probability of achieving them may be low over the next 30 years. Highly accelerated mitigation pathways and plans should be implemented immediately to achieve these temperature goals, including aggressive measures of complete substitution of fossil fuels with renewables, generation of electricity using low carbon fuels, reduction of energy demands through greater efficiency and conservation, carbon capture and storage, and application of new technologies. However, these aggressive goals are not consistent in the short-term with operations of many industrial and domestic energy supply systems. Section 4.2.5.1 should consider in more detail the probability of achieving the Paris Agreement temperature goals considering the required steep trajectories of cuts in carbon use by industry/business and domestic sectors over the next 30 years.	Noted. This is a comment for CH3.	Michael Kennish	Rutgers University	United States of America
61683	36	15	37	1	"Research has shown that targets and pathways considered consistent with well below 2C or 1.5C (see Box 4.1) (including 80% reduction in 2050 from 1990, and 100% renewable electricity scenarios) are technically feasible, although significant increases in adoption of carbon capture and sequestration (CCS) and other carbon sinks, renewable energy, electrification, and other new and transformative technologies in demand sectors will be needed as well as increased end use energy efficiency." The paragraph contradicts itself, and for some reason, nuclear is omitted even though it is our second largest source of low-carbon energy. To make it consistent, replace the two occurrences of "renewable" with "low-carbon". On a broader note, there is no need to specifically use "renewable energy" here as it is much less scientifically precise compared to "low-carbon", and can be misleading from the target, which is emissions reduction as efficiently as possible.	Accepted. The original emphasis on renewables was due to the focus of Figure 4.3 on renewable electricity generation, and not intended to exclude nuclear. We have changed renewables to low carbon here.	Rauli Partanen	Think Atom	Finland
65723	36	15	37	1	The paragraph likely has a misprint: "Research has shown that targets and pathways considered consistent with well below 2C or 1.5C (see Box 4.1) (including 80% reduction in 2050 from 1990, and 100% renewable electricity scenarios) are technically feasible, although significant increases in adoption of carbon capture and sequestration (CCS) and other carbon sinks, renewable energy, electrification, and other new and transformative technologies in demand sectors will be needed as well as increased end use energy efficiency." Replace the two occurrences of "renewable" with "low-carbon".	Accepted. The original emphasis on renewables was due to the focus of Figure 4.3 on renewable electricity generation, and not intended to exclude nuclear. We have changed renewables to low carbon here.	Eero Hirvijoki	Aalto University	Finland
78137	36	15	37	3	CCS receives a very prominent place in this list - however it is unclear what exactly this refers to (carbon removal/CCS with power generation?). This is much too vague, please revise and reorder.	Noted and partially accepted. We have revised CCS to include CCS and CDR. This was intentionally general because it encompasses multiple forms of CCS, including power and industrial applications; bioenergy with CCS, as discussed later in more details in 4.2.5.5.	Charlotte Plinke	Climate Analytics	Germany
5257	36	16	37	2	It is false to state that scenarios 100%Renewable are technically feasible. The report published in february 2021 by IAE and RTE clearly established that such scenarios can be contemplated but are submitted to strict and cumulative conditions, technically not resolved, subject to economic evaluation but obviously very costly, and submitted to public acceptance. It is clear that the scenario 100% renewable cannot be the objective of a responsible politic line. The present wording has to be modified. In addition, why does the author remain quiet about another tool to be used to accelerate mitigation in several countries well before 2050: Poland, China, India, UK, Japan, Turkey, several countries in EU, etc. Please, complete the § by adding this information.	Q. Do we have references to backup claim that 100% ren scenarios are feasible? (the statement lacks references). At least papers cited in 4.5.2.3. Need to review 2021 report? Changed text to "low carbon fuel" to include role for nuclear.	Michel SIMON	Retraité/ Pdt d'association	France
83119	36	20	36	24	You should add here the already cited and high-quality Görtz et al. 2020 study on net zero GHG pathways for Germany (https://www.agora-energievwende.de/en/publications/towards-a-climate-neutral-germany-executive-summary/), showing also high deployment rates for industrial CCS, and BECCS & DACCS	Unclear what part of the text this section refers to.	Geden Oliver	German Institute for International and Security Affairs	Germany
47365	36		48		Section 4.2.5 "What is to be done to accelerate mitigation": The section presents technical potential of options and country good practices among others. In relation to this, the recently-published article (Fekete et al., 2021) might provide useful knowledge here. The article conducted a comprehensive review of sector-level policies in key major emitting economies, identified successful policies and quantified their impact over a period up to 10 years. Fekete, H., Kuramochi, T., Roelfsema, M., den Elzen, M., Forsell, N., Hoehne, N., et al. (2021). A review of successful climate change mitigation policies in major emitting economies and the potential of global replication. <i>Renew. Sustain. Energy Rev.</i> 137, 110602. doi:10.1016/j.rser.2020.110602.	Noted. Thank you for sharing this reference. Since this section specifically focuses on near to mid-term scenarios, we think the literature's focus on existing successes in policies may be outside our scope and may be better suited for another section of the report.	Takeshi Kuramochi	NewClimate Institute	Germany
55253	37	1	37	3	Carbon dioxide removal (CDR) should be included in this list.	Accepted	Government of United States of America	U.S. Department of State	United States of America
72745	37	1	37	3	For carbon removal? Why is CCS first in the list? This is too vague and could be interpreted as CCS with power generation.	Accepted. Listing reordered	Matthew Gidden	Climate Analytics	Germany
76435	37	1	37	5	Nuclear enedrgy has notbeen included as one of the obvious measures to reduce emissions. This needs to be included and an oversight.	Accepted. We have changed renewable energy to low carbon energy	Robert Parker	Nuclear for Climate Australia	Australia
55255	37	3	37	3	"will be needed" should read "would be needed"	Accepted. We have made this change.	Government of United States of America	U.S. Department of State	United States of America
55257	37	3	38	13	CDR should be mentioned along with CCS under this bullet or preferably a discussion provided for CDR under its own bullet.	Accepted. We have added CDR along with CCS.	Government of United States of America	U.S. Department of State	United States of America
3475	37	5	37	5	It is suggested to add a new paragraph: "In Europe, standardization of ternary cements with a low content of Portland cement clinker, i.e. low-carbon cements, has been performed. Furthermore, breakthrough initiatives are being implemented to reach the net carbon neutrality by 2050 (Sanjuán et al. 2020b). In particular, blast-furnace cements provide a high reduction of carbon dioxide emissions in comparison with common Portland cements (Sanjuán et al. 20219)." ==> References A2 & A3. Reference A2: Sanjuán, M.Á.; Andrade, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake by Mortars and Concretes Made with Portuguese Cements. <i>Appl. Sci.</i> 2020k, 10, 646. https://www.mdpi.com/2076-3417/10/2/646 Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. Reference A3: Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. <i>Energies</i> 2019, 12, 2346. https://www.mdpi.com/1996-1073/12/12/2346	Noted. However this is too detailed for this subsection on broader pathways and this may be a better fit for the industry chapter.	Miguel Angel Sanjuán	IECA	Spain

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
10365	37	5	37	5	It is suggested to add a new paragraph: "In Europe, standardization of ternary cements with a low content of Portland cement clinker, i.e. low-carbon cements, has been performed. Furthermore, breakthrough initiatives are being implemented to reach the net carbon neutrality by 2050 (Sanjuán et al. 2020b). In particular, blast-furnace cements provide a high reduction of carbon dioxide emissions in comparison with common Portland cements (Sanjuán et al. 20219)." ==> References A2 & A3. Reference A2: Sanjuán, M.Á.; Andrade, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake by Mortars and Concretes Made with Portuguese Cements. Appl. Sci. 2020b, 10, 646. https://www.mdpi.com/2076-3417/10/2/646 Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. Reference A3: Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. Energies 2019, 12, 2346. https://www.mdpi.com/1996-1073/12/12/2346	Noted. However this is too detailed for this subsection on broader pathways and this may be a better fit for the industry chapter.	Aniceto Zaragoza	Oficemen	Spain
11521	37	5	37	5	It is suggested to add a new paragraph: "In Europe, standardization of ternary cements with a low content of Portland cement clinker, i.e. low-carbon cements, has been performed. Furthermore, breakthrough initiatives are being implemented to reach the net carbon neutrality by 2050 (Sanjuán et al. 2020b). In particular, blast-furnace cements provide a high reduction of carbon dioxide emissions in comparison with common Portland cements (Sanjuán et al. 20219)." ==> References A2 & A3. Reference A2: Sanjuán, M.Á.; Andrade, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake by Mortars and Concretes Made with Portuguese Cements. Appl. Sci. 2020b, 10, 646. https://www.mdpi.com/2076-3417/10/2/646 Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. Reference A3: Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. Energies 2019, 12, 2346. https://www.mdpi.com/1996-1073/12/12/2346	Noted. However this is too detailed for this subsection on broader pathways and this may be a better fit for the industry chapter.	PEDRO MORA PERIS	UNIVERSITY	Spain
55259	37	5	37	5	At the end of the first paragraph stating that "a range of other policy measures that incorporate questions of equity for both international and national policy", this point could be expanded by drawing upon citations in the section beginning on page 91 and noting the need to consider political as well as technological realities.	Accepted. We have added citations from page 91.	Government of United States of America	U.S. Department of State	United States of America
37531	37	6	37	6	"In China, India, Japan and other Southeast Asian countries". China, India and Japan are not SEA countries. Please correct accordingly.	Accepted. We have made the correction.	Government of India	Ministry of Environment, Forests and Climate Change	India
61111	37	6	37	6	"In China, India, Japan and other Southeast Asian countries". China, India and Japan are not SEA countries. Please correct accordingly.	Accepted. We have made the correction.	LOKESH CHANDRA DUBE	TERI School of Advanced Studies	India
37487	37	6	37	8	"In China, India, Japan and other Southeast Asian countries, key drivers for more aggressive action related to climate change, have stemmed also out of regional concerns over health and air quality related to air pollutants". This is true for the transport sector in India, but not necessarily for all sectors such as renewables where aggressive targets have been set for other reasons being energy security and climate concerns.	Noted. We discussed climate drivers for mitigation pathways in the first paragraph of this section.	Government of India	Ministry of Environment, Forests and Climate Change	India
311	37	8	37	8	IPCC has adopted the term short-lived climate forcers (SLCF) instead of short-lived climate pollutants (SLCP)	Accepted. We have made the correction.	Sandro Fuzzi	ISAC CNR	Italy
73035	37	11			Before the final comma, add a citation. And then add: "rapid decarbonization of all fossil fuels entering the U.S. economy (Edwards & Cox 2020)" (See details in one of the comments above).	Accepted. We have added the reference.	Larry Edwards	Larry Edwards Environmental Consulting	United States of America
61685	37	11	37	13	"In North America, a few pathway studies have focused on power [...] demand-side reductions in Canada (Hammond et al. 2020; Vaillancourt et al. 2017; Jayadev et al. 2020; Hodson et al. 2018; Victor et al. 2018; Bahn and Vaillancourt 2020)." This statement is incorrect. The paper addressing Canada (Vaillancourt et al. 2017, https://doi.org/10.1016/j.apenergy.2017.03.104) estimates a 3-fold increase in electricity production, a 7-10-fold increase in nuclear power, and that 90% of electricity generation comes from the combination of nuclear and hydro by 2050. The 3-fold increase in electricity production enables the electrification of, e.g., the heating sector. The "[...] demand-side reductions in Canada" should be replaced with "[...] promotion of nuclear energy and hydropower in Canada".	Partially Accepted. We have added electrification as a strategy in describing Canada. However, we note that in Vaillancourt, energy efficiency is one of three key strategies considered so there is demand-side reductions and our statement remains correct. There are no specific new references on the promotion of nuclear energy or hydropower in Canada so this has not been added.	Rauli Partanen	Think Atom	Finland
65725	37	11	37	13	"In North America, a few pathway studies have focused on power [...] demand-side reductions in Canada (Hammond et al. 2020; Vaillancourt et al. 2017; Jayadev et al. 2020; Hodson et al. 2018; Victor et al. 2018; Bahn and Vaillancourt 2020)." This statement is incorrect. The paper addressing Canada (Vaillancourt et al. 2017, https://doi.org/10.1016/j.apenergy.2017.03.104) estimates a 3-fold increase in electricity production, a 7- to 10-fold increase in nuclear power, and that 90% of electricity generation comes from the combination of nuclear and hydro by 2050. It is this 3-fold increase in the electricity production that enables the electrification of, e.g., the heating sector. The "[...] demand-side reductions in Canada" should be replaced with "[...] promotion of nuclear energy and hydropower in Canada".	Partially Accepted. We have added electrification as a strategy in describing Canada. However, we note that in Vaillancourt, energy efficiency is one of three key strategies considered so there is demand-side reductions and our statement remains correct. There are no specific new references on the promotion of nuclear energy or hydropower in Canada so this has not been added.	Eero Hirvijoki	Aalto University	Finland
5033	37	13	37	13	The authors write "In Latin America, much of the existing pathways emphasise.....", I suggest to write "In Latin America, many (or most) of the existing pathways emphasise....."	Accepted.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
47695	37	13	37	16	There is an article under review which compares the mitigation strategies of Brazil across a number of Integrated Assessment Models. The study is interesting because in places the mitigation efforts of Brazil within a global context. The strategies of biomass production, consumption, export and afforestation, as well as local energy demand measures are consistently assessed. Unsurprisingly, the study shows that models generally disagree with each other. One important aspect the DO agree on, however, is the importance of the land sector. Specifically, the importance of pasture intensification, and the provision of negative emissions either via BECCS or Afforestation. Furthermore, the study highlights the importance of Brazil in global mitigation efforts, either by providing large volumes of CDR, or providing bioenergy for use in other regions. Koberle et al. (under review), Can global models provide insights into regional mitigation strategies? A diagnostic model comparison study of bioenergy in Brazil, Climatic Change	Noted. Point about the importance of bioenergy and carbon capture in Brazil already made.	Vassilis Daioglou	Utrecht University	Netherlands
78139	37	14			What does power sector refer to? Same below (line 18) - what does "electricity" refer to?	Accepted. We have changed it to thermal power generation.	Charlotte Plinke	Climate Analytics	Germany
72747	37	14	37	14	"Power sector" is rather vague	Accepted. We have changed it to thermal power generation.	Matthew Gidden	Climate Analytics	Germany
31161	37	16	37	17	The UK is no longer part of the EU, so although it was a member when the climate neutrality goal was agreed in the European Council (and so EU-28 is correct in that case), it is no longer subject to this agreement. As a result, it is best to refer to the climate neutrality goal as either the EU-27's or simply the European Union's goal.	Accepted. We have changed it to just the EU.	Brendan Moore	University of East Anglia	United Kingdom (of Great Britain and Northern Ireland)
83101	37	16	37	17	There's no EU-28 anymore (although the modelling is often still on EU-28), please just cut the number. And interesting issue here: the IPCC report will want to avoid the "climate neutrality" terminology while many actors use it as a shortcut for "net zero GHG emissions" (as is the case in the EU. Maybe better to go with the net zero version, since it says what the EU does want to achieve	Accepted. We have changed it to just the EU.	Geden Oliver	German Institute for International and Security Affairs	Germany
52073	37	16	37	18	The European Union-28's 2050 climate neutrality goal that is explored by pathways that emphasize complete substitution of fossil fuels with electricity, low carbon fuels, particularly renewables, demand reductions through efficiency and conservation, and novel fuels and end-use technologies is discriminated plan against fossil fuels and it focuses on the sources not the emissions, plus, it ignores the land use and agriculture which are part of GHG emissions	Accepted. We have changed it to just the EU.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia

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61687	37	16	37	18	"[...] low carbon fuels, particularly renewables; [...]", the European Commission 2050 strategy "Clean Planet for All" (https://ec.europa.eu/clima/policies/strategies/2050_en) also confirmed that nuclear will be the backbone of 2050 carbon-free Europe. Further, nuclear can provide clean hydrogen/fuels more cost-effectively than wind/solar, according to recent research Kayfeci et al. 2019, https://doi.org/10.1016/B978-0-12-814853-2.00003-5 ; LucidCatalyst, 2021, https://www.lucidcatalyst.com/hydrogen-report). It would be prudent to rephrase the statement into "[...] low-carbon fuels; [...]" for "low-carbon" includes "renewable" but also leaves other options open in a technology neutral way.	Noted, but as shown in Figure 4-2, there is significant emphasis on renewables within EU so we believe it is worth noting.	Rauli Partanen	Think Atom	Finland
27643	37	16	37	20	Consider the UK exit of the EU. The same comment applies for all analysis presented for EU-28 in this chapter.	Accepted. We have changed it to just the EU.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
83103	37	16	37	20	For the EU, not that many studies exist that look at pathways for economy-wide net-zero GHG (which is more ambitious than net zero CO2). The two studies you are citing (Capros et al. and Duscha et al) both show the need for carbon dioxide removal to counterbalance residual emissions (see also ch2.7), on the order of 5-10% of 1990 emissions, be it by afforestation/LULUCF only (Duscha et al.) or by both ecosystem-based CDR and technological CDR (BECCS & DACCS). CDR is also part of the official EU Commission pathways that lead to net zero by 2050 (https://ec.europa.eu/clima/sites/default/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf) Given the assumed volumes, it would be good to mention CDR here. CDR also play a significant role in CO2 only pathways towards net zero in industrialized countries, see Schreyer et al. 2020 (https://iopscience.iop.org/article/10.1088/1748-9326/abb852) or in net zero GHG energy system pathways (see Pye et al. 2021: https://www.tandfonline.com/doi/full/10.1080/14693062.2020.1824891)	Accepted. We have revised the text and added the new reference.	Geden Oliver	German Institute for International and Security Affairs	Germany
5259	37	18	37	18	"Yes, EU 28's are targeting carbon neutrality by 2050, and replacement of fossil fuels by electricity. The present forget to mention that this objective relies partially on wind and solar energies, and essentially on nuclear. Even if the Greens does not like it, physical laws are stubborn! The pathway to carbon neutrality includes necessarily nuclear energy."	Noted, but as shown in Figure 4-2, there is significant emphasis on renewables within EU so we believe it is worth noting.	Michel SIMON	Retraité/ Pdt d'association	France
65727	37	18	37	18	"[...] low carbon fuels, particularly renewables; [...]", Rephrase as "[...] low-carbon fuels; [...]", Term "low-carbon" already includes "renewable" and literature points out that hydrogen production for synthetic fuels with nuclear is cheaper than with solar or wind (Kayfeci et al. 2019, https://doi.org/10.1016/B978-0-12-814853-2.00003-5 ; LucidCatalyst, 2021, https://www.lucidcatalyst.com/hydrogen-report). It would seem odd to promote only one clean technology in this light.	Noted. Renewables are worth noting here because it is projected to meet 70% of primary energy consumption in Capros et al. 2019 and 100% of power generation in Zappa et al. 2019, whereas the projections for hydrogen production for synthetic fuels is on a smaller scale.	Eero Hirvijoki	Aalto University	Finland
20195	37	21	37	23	For Africa, key development goals and drivers of climate action include not only expanding energy access but also mitigating air pollution and death rates due to heavy reliance on traditional biomass use in households: - Van de Ven, D. J., Sampedro, J., Johnson, F. X., Bailis, R., Forouli, A., Nikas, A., ... & Doukas, H. (2019). Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa. Environmental Research Letters, 14(9), 094001. - Forouli, A., Nikas, A., Van de Ven, D. J., Sampedro, J., & Doukas, H. (2020). A multiple-uncertainty analysis framework for integrated assessment modelling of several sustainable development goals. Environmental Modelling & Software, 131, 104795.	Accepted and added.	Nikas Alexandros	National Technical University of Athens	Greece
47999	37	21	37	23	Recent literature suggests that bioenergy can also be a very promising mitigation option for Africa's sustainable development. We proposed to include additional text on this, as follows: "[...] Africa's future pathways will be shaped by its goal of increasing energy access. Existing literature so far has focused on cleaner expansion of power supply alongside end-use efficiency improvements, as well as on the potential of expansion of biofuels and modern bioenergy for transport, electricity and cooking as a means of addressing energy access, food security and economic development in a sustainable way". Below we present extracts from existing literature to back these claims. The authors of this chapter are invited to carefully consider them: "Most of the ethanol could compete with gasoline at a crude oil price below USD 90 per barrel, close to midcase projections by the US Energy Information Administration for 2030 (EIA, 2018); the electricity would cost around USD 0.062 per kilowatt-hour (kWh). These twin technology vectors, applied to all land suited to sugarcane cultivation, could further expand energy production to some 129 billion litres of ethanol manufacture and 159 TWh of electricity generation per annum. With crude oil prices towards the middle of a prospective range of USD 50 to USD 100 per barrel, most of the ethanol thus produced would be cost-competitive on an energy-equivalent basis. The electricity could be generated for as little as USD 0.054 per kWh." (IRENA (2019), Sugarcane bioenergy in southern Africa: Economic potential for sustainable scale-up, International Renewable Energy Agency, Abu Dhabi) "By using its current molasses for ethanol production, Swaziland could increase electricity generation by 40% using bagasse and replace 60% of cooking fuel or 30% of liquid fossil fuel. Sugarcane expansion over 1% of the pastureland in Angola, Mozambique, and Zambia could replace greater than 70% of cooking fuel. Bioelectricity generation from modest sugarcane expansion could be increased by 10% in Malawi, Mozambique, and Zambia and by 20% in Angola." (Souza SP Horta Nogueira LA, Watson HK, Lynd LR, Elmissiry M and Cortez LAB (2016) Potential of Sugarcane in Modern Energy Development in Southern Africa. Front. Energy Res. 4:39. doi: 10.3389/fenrg.2016.00039) "... simulations show that over 210 000 households could be served with electricity and other 31 000 with modern cooking fuels under the scenarios examined. Less dependence on traditional biomass may also spare wooded environments from deforestation. However, harnessing modern energy from sugarcane does not come without challenges. Economic pitfalls	Accepted.	Marcelo moreira	UNICAMP - Agroicone	Brazil

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
50919	37	21	37	23	Recent literature suggests that bioenergy can also be a very promising mitigation option for Africa's sustainable development. We proposed to include additional text on this, as follows: "[...] Africa's future pathways will be shaped by its goal of increasing energy access. Existing literature so far has focused on cleaner expansion of power supply alongside end-use efficiency improvements, as well as on the potential of expansion of biofuels and modern bioenergy for transport, electricity and cooking as a means of addressing energy access, food security and economic development in a sustainable way". Below we present extracts from existing literature to back these claims. The authors of this chapter are invited to carefully consider them: "Most of the ethanol could compete with gasoline at a crude oil price below USD 90 per barrel, close to midcase projections by the US Energy Information Administration for 2030 (EIA, 2018); the electricity would cost around USD 0.062 per kilowatt-hour (kWh). These twin technology vectors, applied to all land suited to sugarcane cultivation, could further expand energy production to some 129 billion litres of ethanol manufacture and 159 TWh of electricity generation per annum. With crude oil prices towards the middle of a prospective range of USD 50 to USD 100 per barrel, most of the ethanol thus produced would be cost-competitive on an energy-equivalent basis. The electricity could be generated for as little as USD 0.054 per kWh." (IRENA (2019), Sugarcane bioenergy in southern Africa: Economic potential for sustainable scale-up, International Renewable Energy Agency, Abu Dhabi) "By using its current molasses for ethanol production, Swaziland could increase electricity generation by 40% using bagasse and replace 60% of cooking fuel or 30% of liquid fossil fuel. Sugarcane expansion over 1% of the pastureland in Angola, Mozambique, and Zambia could replace greater than 70% of cooking fuel. Bioelectricity generation from modest sugarcane expansion could be increased by 10% in Malawi, Mozambique, and Zambia and by 20% in Angola." (Souza SP, Horta Nogueira LA, Watson HK, Lynd LR, Elmissiry M and Cortez LAB (2016) Potential of Sugarcane in Modern Energy Development in Southern Africa. Front. Energy Res. 4:39. doi: 10.3389/fenrg.2016.00039) "... simulations show that over 210 000 households could be served with electricity and other 31 000 with modern cooking fuels under the scenarios examined. Less dependence on traditional biomass may also spare wooded environments from deforestation. However, harnessing modern energy from sugarcane does not come without challenges. Economic pitfalls	Accepted. We have added short text to capture these points.	Government of Brazil	Ministry of Foreign Affairs of Brazil	Brazil
78141	37	24	37	26	Please specify the literature that this section builds on. Is only national/regional literature included? Also, please improve this sentence as it is not clear what to derive from "including some pathways..."	Accepted. We have clarified this is only national (or regional in the case of the EU) pathways literature	Charlotte Plinke	Climate Analytics	Germany
48415	37	24	38	13	While the current paragraph 4.2.5.2 is written based on the published literatures, the scenarios included in AR6 database should also be considered to elaborate these characteristics. At least, key indicators in the scenarios which are relevant to these characteristics, such as energy demand per GDP, electrification rate, and share of CCS, should be summarized like Figure 4.3.	Noted. Table 4.3, relies on the database of scenarios assembled for AR6. However, the national scenario part of the database does not provide an exhaustive coverage of existing models and scenarios, and its analysis must thus be supplemented by direct analysis of underlying papers.	Ken Oshiro	Kyoto University	Japan
61689	37	24	38	13	The list of "characteristics of accelerated mitigation pathways" dismisses nuclear energy, even though in IPCC 2018 SPM four main scenarios see nuclear increasing 2-6 fold by 2050 and 1.5-2 fold by 2030. Literature also points out that nuclear energy is a viable pathway to accelerated mitigation (see e.g., Brooks, 2012, https://doi.org/10.1016/j.enpol.2011.11.041 ; Qvist and Brook, 2015, https://doi.org/10.1371/journal.pone.0124074 ; Apergis et al. 2010, https://doi.org/10.1016/j.ecolecon.2010.06.014 ; Menyah and Wolde-Rufael, 2010, https://doi.org/10.1016/j.enpol.2010.01.024 ; Baek, 2015, https://doi.org/10.1016/j.apenergy.2015.01.074 ; Horvath and Rachlew, 2016, https://doi.org/10.1007/s13280-015-0732-y). Correct the list of "characteristics of accelerated mitigation pathways" accordingly.	Accepted. We have changed non-fossil to nuclear to further emphasize its role.	Rauli Partanen	Think Atom	Finland
65729	37	24	38	13	The list of "characteristics of accelerated mitigation pathways" now dismisses nuclear energy. Literature, however, compellingly points out that nuclear energy is a viable pathway to accelerated mitigation (see e.g., Brooks, 2012, https://doi.org/10.1016/j.enpol.2011.11.041 ; Qvist and Brook, 2015, https://doi.org/10.1371/journal.pone.0124074 ; Apergis et al. 2010, https://doi.org/10.1016/j.ecolecon.2010.06.014 ; Menyah and Wolde-Rufael, 2010, https://doi.org/10.1016/j.enpol.2010.01.024 ; Baek, 2015, https://doi.org/10.1016/j.apenergy.2015.01.074 ; Horvath and Rachlew, 2016, https://doi.org/10.1007/s13280-015-0732-y ; and many more). Correct the list of "characteristics of accelerated mitigation pathways" accordingly.	Accepted. We have changed non-fossil to nuclear to further emphasize its role.	Eero Hirvijoki	Aalto University	Finland
52075	37	24	38	23	The authors undermine the fossil fuels in the listed characteristics of accelerated mitigation pathways. It should be included	Rejected. Accelerated mitigation pathways analyzed in this section are about getting away from fossil-fuels, or developing carbon capture and storage.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
72749	37	25	37	26	Is this only based on national / regional literature? It would be good to specify that. Please check consistency with definitions in chapter 3 and elsewhere in this report.	Accepted. Yes, this is only based on national/regional literature and we have specified it here.	Matthew Gidden	Climate Analytics	Germany
55	37	27	37	37	"Energy efficiency, conservation, and reducing energy use in all energy demand sectors (buildings, transport, and industry are included in nearly all literature that addresses future demand growth". Comment: There are 35 papers that follow that statement. But there is not a single paper or discussion in relation to the challenge / evidence of large energy rebound, which serves to limit the effectiveness of those demand-sided interventions. Example 'large rebound' papers : 1. Saunders HD. Recent Evidence for Large Rebound: Elucidating the Drivers and their Implications for Climate Change Models. Energy J. 2015;36(1):23-48. ; 2. Stern, D.I., 2020. How large is the economy-wide rebound effect?. Energy Policy, 147, p.111870.; 3. Brockway P. E., Sorrell S.R., Semieniuk G., Heun M.K., Court V. (2021) Energy efficiency and economy-wide rebound effects: a review of the evidence and its implications, Renewable and Sustainable Energy Reviews. In review.	Noted. Rebound effects are discussed in FGD Chapter 9 (buildings), section 9.9.2.	Paul Brockway	University of Leeds	United Kingdom (of Great Britain and Northern Ireland)
3975	37	27	37	37	"Energy efficiency, conservation, and reducing energy use in all energy demand sectors (buildings, transport, and industry are included in nearly all literature that addresses future demand growth". Comment: There are 35 papers that follow that statement. But there is not a single paper or discussion in relation to the challenge / evidence of large energy rebound, which serves to limit the effectiveness of those demand-sided interventions. Example 'large rebound' papers : 1. Saunders HD. Recent Evidence for Large Rebound: Elucidating the Drivers and their Implications for Climate Change Models. Energy J. 2015;36(1):23-48. ; 2. Stern, D.I., 2020. How large is the economy-wide rebound effect?. Energy Policy, 147, p.111870.; 3. Brockway P. E., Sorrell S.R., Semieniuk G., Heun M.K., Court V. (2021) Energy efficiency and economy-wide rebound effects: a review of the evidence and its implications, Renewable and Sustainable Energy Reviews. Available at: https://doi.org/10.1016/j.rser.2021.110781	Noted. Rebound effects are discussed in FGD Chapter 9 (buildings), section 9.9.2.	Paul Brockway	University of Leeds	United Kingdom (of Great Britain and Northern Ireland)
49705	37	38	37	39	This bullet point should also include electrification of transport, or? Currently it just reads as fuel-cell vehicles (which only focuses on trucks) and it misses to include the transition from internal combustion engines to electric-powered transportation.	Accepted. We have changed to electrification of transport.	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
72751	37	38	37	39	What about electric vehicles?	Accepted. We have changed to electrification of transport.	Matthew Gidden	Climate Analytics	Germany
79445	37	38	37	39	This bullet point should also include electrification of transport. Currently it just reads as fuel-cell vehicles (which only focuses on trucks) and it misses to include the transition from internal combustion engines to electric-powered transportation.	Accepted. We have changed to electrification of transport.	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
55261	37	38	37	40	Why is "fuel cell" the only item mentioned for transportation. What happened to electric vehicles running off of an RE grid?	Accepted. We have changed to electrification of transport.	Government of United States of America	U.S. Department of State	United States of America
78143	37	44			What is a renewable fuel?	Accepted. We have changed to renewable energy.	Charlotte Plinke	Climate Analytics	Germany
72753	37	44	37	44	Please clarify what a renewable fuel would be	Accepted. We have changed to renewable energy.	Matthew Gidden	Climate Analytics	Germany

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
52057	37	44	37	45	The discussion excludes fossil fuels from the lower CO2 fuels even with the existence of CCUS and DAC technologies. It should be mentioned that these alternatives provide additional options for lower emissions.	Noted, but CCS is not included here because it is described separately in the following bullet.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
61691	37	44	37	45	"Lower CO2 emissions fuels, particularly renewable, non-fossil, and some biofuels, are seen as necessary in all pathways" This should be rephrased into "Lower CO2 emissions fuels are seen necessary in all pathways" to be more inclusive and scientifically correct. Literature cited in chapter 3 of the current draft points that synthetic fuels produced with hydrogen from nuclear energy are cheaper than those produced with hydrogen from solar or wind (Kayfeei et al. 2019, https://doi.org/10.1016/B978-0-12-814853-2.00003-5). See also (LucidCatalyst, 2021, https://www.lucidcatalyst.com/hydrogen-report).	Noted but no changes. There is a much larger body of literature on renewable, non-fossil/nuclear and biofuels, as cited throughout this chapter so these are worth calling out.	Rauli Partanen	Think Atom	Finland
65731	37	44	37	45	"Lower CO2 emissions fuels, particularly renewable, non-fossil, and some biofuels, are seen as necessary in all pathways" Rephrase into "Lower CO2 emissions fuels are seen necessary in all pathways". Literature cited in chapter 3 of the current draft points that synthetic fuels produced with hydrogen from nuclear energy are cheaper than those produced with hydrogen from solar or wind (Kayfeei et al. 2019, https://doi.org/10.1016/B978-0-12-814853-2.00003-5). See also (LucidCatalyst, 2021, https://www.lucidcatalyst.com/hydrogen-report).	Noted but no changes. There is a much larger body of literature on renewable, non-fossil/nuclear and biofuels, as cited throughout this chapter so these are worth calling out.	Eero Hirvijoki	Aalto University	Finland
76437	37	44	37	45	Nuclear energy needs to be included as one of the Lower CO2 emissions fuels	Accepted. We have changed non-fossil to nuclear.	Robert Parker	Nuclear for Climate Australia	Australia
5261	37	44	38	2	On line 44, please add "or nuclear". Since, as already stated nuclear will have a heavier contribution than wind and solar. Only 2 or 3 countries are considering a 100% renewable scenario. These countries (Costa Rica, Ireland,... Are relying on hydrothermal resources. Apart these exceptions, and to the best of my knowledge, no country has set a target of 100 wind and solar electricity, sur to constraints on necessary monitoring of production level, frequency and voltage.	Accepted. We have changed non-fossil to nuclear.	Michel SIMON	Retraité/ Pdt d'association	France
61693	37	45	38	2	"Some countries have set targets of up to 100% renewable electricity, [...]. The countries should be listed here instead of using the vague "some". As such, this is not optimal climate policy, as target for "100% low-carbon electricity" would ensure a better outcome in all important ways, so not sure why this suboptimal policy is brought out here as an example? Especially as countries which already have very low carbon electricity have done it with hydro/geothermal (geographically limited, such as Norway, Island), with a combination of hydro and nuclear (Sweden, Switzerland) or with mostly nuclear (France). Perhaps these achievements should be mentioned here, as well as stated targets, which are still speculative?"	Noted. Country examples are provided in section 4.2.5.2 and Box 4.3.	Rauli Partanen	Think Atom	Finland
65733	37	45	38	2	"Some countries have set targets of up to 100% renewable electricity, [...]. Avoid using vague expressions such as "some". Provide the list of countries explicitly. If the list is prohibitively long, state how many countries.	Noted. Country examples are provided in section 4.2.5.2 and Box 4.3.	Eero Hirvijoki	Aalto University	Finland
80327	37	45	38	2	Brazil has an Energy Policy for Biofuels ("RenovaBio"), which is in the beginning of its implementation, but under a vision of growth, it would be an opportunity to establish criteria for the promotion of the policy as well as the expansion of the discussion to a global level.	Noted. Discussion of specific policy instruments is more directly the task of Chapter 13.	JUAN DIAZ	Association	United States of America
76439	38	1	38	2	This is quite a bizarre sentence. The main instrument of low emissions in France is nuclear energy. Burning biofuels is not low carbon.	Noted. This is one of the cited strategies from the analysis in the cited references.	Robert Parker	Nuclear for Climate Australia	Australia
76441	38	3	38	13	CCS is a technically challenging technology with very high energy intensity and does not have a universal application especially to small emitters.	Partially accepted. Technical and economic challenges with CCS have been added.	Robert Parker	Nuclear for Climate Australia	Australia
78145	38	3	38	13	Please improve this paragraph. CCS for CDR or for power/industry? What is the difference in CCS scale considered necessary? Why are only some limitations elaborated in section 3 below?	Noted. CCS applications, their differences in scale are discussed further in section 4.2.5.4.	Charlotte Plinke	Climate Analytics	Germany
83105	38	3	38	13	Please add Schreyer et al. 2020 https://iopscience.iop.org/article/10.1088/1748-9326/abb852	Accepted. We have added this reference.	Geden Oliver	German Institute for International and Security Affairs	Germany
72755	38	3	38	3	Please specify if CCS is referred to as CCS for CDR or for power/industry	Accepted. CDR has been added along with CCS so it includes both.	Matthew Gidden	Climate Analytics	Germany
83107	38	7	38	10	Unclear what the underlying logic is here - "negative emissions" on the project or sector level, or economy-wide in a country? If it is project or sector-level net negative within country-wide net-zero then it would be good to say that explicitly, and maybe avoid confusion of carbon dioxide removal (as a practice) and net negative emissions (as a pathway feature). On the "including CCS" there's some clarification needed. Does this simply refer to CDR methods that include CCS? If so, then better say so explicitly, or/and include BECCS & DACCS as examples	Accepted. We have revised it to clarify it is economy-wide in a country.	Geden Oliver	German Institute for International and Security Affairs	Germany
64275	38	14	38	23	Ambitious targets for methane mitigation require appropriate tools to establish a baseline for global emission rates and measure their evolution over time. Eliminating large methane sources from the energy sector is now possible thanks to remote sensing technologies, and monitoring satellites have identified mitigation opportunities in the fossil fuel industry equivalent to 1-2 Gt of CO2. As natural gas is used in a large number of countries as a transition fuel to accelerate the phase-out of coal, reducing the methane intensity of natural gas production and transport systems is particularly important. Blowdowns performed ahead of pipeline maintenance are an example of highly environmentally harmful practices which could easily be avoided. In an ESA paper, 46 methane super-emissions detected by satellites are indeed reported along two major Russian pipelines (https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Monitoring_methane_emissions_from_gas_pipelines).	Noted. Methane mitigation was not included in the scenarios reviewed in this subsection, but methane is addressed in subsection 4.2.5.12 on short lived climate forcers.	Christian Lelong	Kayros	United Kingdom (of Great Britain and Northern Ireland)
61695	38	17	38	18	"These include, broadly, decarbonising electricity supply to produce net zero CO2, including through renewable energy, [...]. There is no reason to decrease the scientific accuracy and relevancy of the statement by adding the "including through renewable energy". Either rephrase into "[...] including through nuclear and renewable energy and CCS, [...]" or leave the phrase "including through renewable energy" out completely. If the target is a low-carbon energy system, one should stick with "low-carbon" to maintain technological neutrality.	Accepted. Renewable energy has been changed to low carbon energy.	Rauli Partanen	Think Atom	Finland
65735	38	17	38	18	"These include, broadly, decarbonising electricity supply to produce net zero CO2, including through renewable energy, [...]. Either rephrase into "[...] including through nuclear and renewable energy, [...]" or leave the phrase "including through renewable energy" out completely. If the target is a low-carbon energy system, one should stick with "low-carbon" and not promote one technology over others.	Accepted. Renewable energy has been changed to low carbon energy.	Eero Hirvijoki	Aalto University	Finland
55263	38	17	38	22	Nuclear power needs to be in this list.	Accepted. Renewable energy has been changed to low carbon energy so it is inclusive of nuclear.	Government of United States of America	U.S. Department of State	United States of America
5263	38	18	38	18	Once mor, the author has forgotten "nuclear" after renewable.. Or state "low carbon electricity production."	Accepted. Renewable energy has been changed to low carbon energy so it is inclusive of nuclear.	Michel SIMON	Retraité/ Pdt d'association	France
78005	38	18	38	18	Suggested edit: sentence to: "These include, broadly, decarbonizing electricity supply to produce net zero or negative CO2 ... than today;" Rationale: Baiman suggested edits for Chapter 4: Mitigation and development pathways in the near- to mid-term.	Noted. Reference to net zero CO2 removed from sentence	Ron Baiman	Benedictine University	United States of America
76443	38	18	38	45	Low carbon nuclear energy needs to be included throughout this section in tools for specific policies and measures.	Accepted. Renewable energy has been changed to low carbon energy so it is inclusive of nuclear.	Robert Parker	Nuclear for Climate Australia	Australia
16301	38	20			"vehicles; 4) dramatically lower use ..." -> delete "4)"	Accepted.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
313	38	22	38	22	methane is defined in WGI as one of the short-lived climate forcers.	Accepted. Revised to "methane and other short-lived climate forcers."	Sandro Fuzzi	ISAC CNR	Italy
18853	38	24	38	24	We are missing the references that nuclear is complement to RES for low-carbon electricity production (according to studies published by NEA/IEA).	Noted. These references are provided in section 4.2.5.6.	Tomáš Martanović	Ministry of Industry and Trade	Czech Republic
52077	38	24	39	24	excluding natural gas and clean fossil fuel technologies e.g. CCUS and DAC from the decarbonization electricity generation Net Zero models	Noted. CCS use in the power sector are discussed in section 4.2.5.5. This section focuses only on renewable energy.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
48417	38	24	39	31	Ideally, these elaborations on country energy trends should be grounded by scenario data included in AR6 scenario database, not only by the single model literatures.	Noted. National scenario database provides partial overview of the literature. Analysis of scenario literature beyond scenario database is thus necessary.	Ken Oshiro	Kyoto University	Japan

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
5265	38	24	39	32	The whole chapter 4.2.5.3, has to be reconfigured., many statements seems incorrect, incomplete or not substantiated. The author takes his dreams for reality. The report must keep in linbe with the official target and pathways, and not publish data which are not qualified. Remember that still now, the major part of the increase of energy consumption is covered by coal. Strong development of renewable has not reduced the coal production in Germany : renewables have essentially been the substitute to lack of production by nuclear reactor shutdown for political reasons, and Germany remains by far the greatest GHG emitter in the EU. China makes big efforts to reduce coal, but confirms that it will continue to use at least up to 2030, the decrease coming later. The major effort is made by connecting 6 to 8 nuclear reactor per year to the grid, the contribution of wind and solar being not negligible, bur remaining quite modest. On line 40, the EU policy and target is NOT to have 100% renewable energy by 2050.(I don't know where the authir has caught this idea!) Some papers have been published promoting some dreaming scenario, generally by accist groups like Greenpeace or Negawatt. They have not been worked out at official level for a very simple reason: they lead to a cost of electricity which is not affordable. On line 1 page 39, this reference is not relevant! Remember that official target is to keep 50% of electricity produced by nuclear. I don't know the referred syudy of M. Kralowski, but this is a fantasy, and I think thar IPCC should keep with official objectives! Page 39, mines 4 to 6. remeber that the grids operator have already alerted on the fact that stability of network is set at risk is the share of renewable boes beyond 40%. For Japan, the author should remember that Hydrogen is not a source o energy, but just an energy vector. And considering China, the time horizon is not mentioned, but 59% of total energy (no electricity) produced by renewables in the foreseeable future is just an unreasonable figure! Unless the author want to demonstrate that the 1.5°C pathway is not feasible! The WHOLE chapter have to be rewritten with official figures, realistic targets and pathways and reasonable data. Or deleted.	Rejected. Mitigation pathways with higher share of renewables, some of which 100% renewables, exist in the scientific literature and require assessment, all the more so that energy mixes in the future are part of ongoing public debates. On specific points, the statement about the EU does not say that the EU objective is 100% renewables. It merely states that some authors find the EU mitigation objective feasible with renewables. For the case of France, there is an ongoing debate over future energy mix. Finally, challenges for high renewables scenarios are discussed later in the section.	Michel SIMON	Retraité/ Pdt d'association	France
16303	38	24	47	29	The titles of subsections 4.2.5.3 ~ 4.2.5.14 are not consistent in their form (sentence or phrase).	Noted. Titles revised to improve readability, not necessarily uniformity across subsections.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
55265	38	25	38	26	It is important to stress that solar and wind are ready for large scale deployment right now, in stark contrast to all of the other mitigation options. Costs per KWh delivered to the grid, as well as storage costs are still going down, and they are already on par with, or cheaper than, fossil electricity. It does not always make sense to continue to invest in stranded assets.	Noted. Added text to the effect that renewables are more mature than many of the other mitigation options.	Government of United States of America	U.S. Department of State	United States of America
20615	38	25	38	29	Add some text at the end of the paragraph: "Some studies are being led in order to assess the different options ("100% renewables" or "renewables and other low carbon energy sources") to reach a fully decarbonized electricity production, while taking into account their technical feasibility, their impact on the economy and on security of electricity supply." (https://www.rte-france.com/actualites/rte-aie-publient-etude-forte-part-energies-renouvelables-horizon-2050-et-les-differents-scenarios-proposes: https://assets.rte-france.com/prod/public/2021-01/Bilan%20Previsionnel%202050-consultation-complet.pdf)	Partially accepted. First half of sentence included.	Government of France	Ministère de la Transition écologique et solidaire	France
37033	38	25	38	29	Renewable energy option may be suitable for countries which have lesser population density	Noted. Comments 37033, 35, 37, 39, 41, 43 and 45 all sentences of same comment. Specific country listing deleted from first paragraph of section (now 4.2.5.2). Note that this section is dedicated to renewables, while section 4.2.5.5. focuses on nuclear, and 4.2.5.11 on demand.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37035	38	25	38	29	with large available waste land and good solar radiation.	Noted. Comments 37033, 35, 37, 39, 41, 43 and 45 all sentences of same comment. Specific country listing deleted from first paragraph of section (now 4.2.5.2). Note that this section is dedicated to renewables, while section 4.2.5.5. focuses on nuclear, and 4.2.5.11 on demand.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37037	38	25	38	29	For large densely populated and developing countries like India, complete reliance for 100% green energy based	Noted. Comments 37033, 35, 37, 39, 41, 43 and 45 all sentences of same comment. Specific country listing deleted from first paragraph of section (now 4.2.5.2). Note that this section is dedicated to renewables, while section 4.2.5.5. focuses on nuclear, and 4.2.5.11 on demand.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37039	38	25	38	29	on renewables alone is not feasible since solar and wind are intermittent with poor capacity factor	Noted. Comments 37033, 35, 37, 39, 41, 43 and 45 all sentences of same comment. Specific country listing deleted from first paragraph of section (now 4.2.5.2). Note that this section is dedicated to renewables, while section 4.2.5.5. focuses on nuclear, and 4.2.5.11 on demand.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37041	38	25	38	29	and can not provide the base load even with their fullest potential harnessed.	Noted. Comments 37033, 35, 37, 39, 41, 43 and 45 all sentences of same comment. Specific country listing deleted from first paragraph of section (now 4.2.5.2). Note that this section is dedicated to renewables, while section 4.2.5.5. focuses on nuclear, and 4.2.5.11 on demand.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37043	38	25	38	29	The growing population with increasing GDP would require several fold increase in energy demand in near future.	Noted. Comments 37033, 35, 37, 39, 41, 43 and 45 all sentences of same comment. Specific country listing deleted from first paragraph of section (now 4.2.5.2). Note that this section is dedicated to renewables, while section 4.2.5.5. focuses on nuclear, and 4.2.5.11 on demand.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37045	38	25	38	29	Nuclear has to play major role in energy mix.	Noted. Comments 37033, 35, 37, 39, 41, 43 and 45 all sentences of same comment. Specific country listing deleted from first paragraph of section (now 4.2.5.2). Note that this section is dedicated to renewables, while section 4.2.5.5. focuses on nuclear, and 4.2.5.11 on demand.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
61697	38	25	38	29	"Power generation could decarbonise much faster with scaled up deployment of renewable energy and storage that are both relatively mature, available, and decreasing in costs" is misleading and hypothetical. First, storage is not readily available anywhere near the needed scale. Secondly, there is no guarantee of the continuation of cost reductions, nor is there guarantee that we can increase the necessary minerals-production flows cost-effectively, environmentally sustainably and fast enough to make for example large scale batteries widely available. Therefore, replace "renewable energy and storage" with "low-carbon energy", which is more accurate and includes the nuclear projects that are already proven to be able to decarbonize national power generation at speeds necessary.	Rejected. All available literature anticipates cost reduction of renewables and storage. We added text that models scenarios are continuously outpaced by real developments in renewables.	Rauli Partanen	Think Atom	Finland
65737	38	25	38	29	"Power generation could decarbonise much faster with scaled up deployment of renewable energy and storage that are both relatively mature, available, and decreasing in costs". This is misleading and hypothetical. First of all, storage is not readily available. Secondly, there is no guarantee of the continuation of cost reductions. Therefore, replace "renewable energy and storage" with "low-carbon energy".	Rejected. All available literature anticipates cost reduction of renewables and storage. We added text that models scenarios are continuously outpaced by real developments in renewables.	Eero Hirvijoki	Aalto University	Finland
37533	38	27	38	29	"Higher penetration of renewable energy in the power sector is a common theme in the EU scenarios (EU has more zero emission electricity, phasing out coal in Germany, Ireland), U.S., China, and India, but also in resource-rich countries such as Brazil." It should be re-written as "Higher... but also in resource-constrained countries like India".	Noted. Reference to resource rich/constrained regions deleted.	Government of India	Ministry of Environment, Forests and Climate Change	India
50285	38	28	38	29	Several other countries in the EU also have committed to or plan a coal phase out, see figure on page 15 of https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0564&from=EN	Noted. Reference to coal phaseout deleted.	Matthias Weitzel	European Commission, Joint Research Centre	Spain
84439	38	30	38	39	Several of the studies that claim 100% renewable energy systems have been responded to by other authors that show difficulties with this goal. For instance the articles by Jacobson et al. Are very ambitious in scope, but as responses to earlier attempts show, there are a number of difficulties in covering such plans for many different regions and nations. The behaviour of the main author by taking the response by Clack et al. (2017) (https://www.pnas.org/content/114/26/6722) to court should also be a warning sign that these ambitious articles may be problematic in several ways. Bias Others have also reacted to issues with these plans, although not in academic literature: https://passiividentiteetti.wordpress.com/2016/01/02/part-1-why-does-mark-jacobson-hate-finland/ https://passiividentiteetti.wordpress.com/2016/01/03/part-2-he-also-hates-ethiopia/	Accepted. More nuanced discussion included pointing to challenges in implementation.	Matias Lantz	Uppsala university	Sweden
27645	38	36	38	38	Delete "100% renewable adoption for electricity generation by 2050 is found to be feasible for 143 countries with only a 9% average increase in economic costs (considering all social costs) if annual electricity demand can be reduced by 57%", or elaborate on whether developing countries are included in the analysis, if issues related to energy access are also incorporated, as well as the assumptions made in regard to the availability of the necessary financial resources.	Partially accepted. Text revised and nuanced, not deleted.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
61699	38	36	38	38	"100% renewable adoption for electricity generation by 2050 is found to be feasible for 143 countries with only a 9% average increase in economic costs (considering all social costs) if annual electricity demand can be reduced by 57% (Jacobson et al. 2017, 2019)". Electrification needs to increase significantly, so assuming a 57% REDUCTION in electricity demand is not something we should look forward to. The paper/model is also questionable, as the paper (Zappa et al., 2019, https://doi.org/10.1016/j.apenergy.2018.08.109) instead shows that the cost of 100% renewable electricity system would be 30% more expensive. Furthermore, Jacobson's models of 100% renewable energy scenarios have been widely rebutted (see, e.g., Clack et al., 2017, https://doi.org/10.1073/pnas.1610381114). A technology neutral approach is, by definition, more efficient than a technologically limited approach, and therefore IPCC should not promote such approaches (especially since they are also disputed).	Accepted. More nuanced discussion included.	Rauli Partanen	Think Atom	Finland
65739	38	36	38	38	"100% renewable adoption for electricity generation by 2050 is found to be feasible for 143 countries with only a 9% average increase in economic costs (considering all social costs) if annual electricity demand can be reduced by 57% (Jacobson et al. 2017, 2019)". This is highly questionable. The paper (Zappa et al., 2019, https://doi.org/10.1016/j.apenergy.2018.08.109) instead shows that the cost of 100% renewable electricity system would be 30% more expensive. Furthermore, Jacobson's visions of 100% renewable energy scenarios have been widely rebutted (see, e.g., Clack et al., 2017, https://doi.org/10.1073/pnas.1610381114 ; Bistline and Blanford, 2016, https://doi.org/10.1073/pnas.1603072113). Revise and remove the associated references to Jacobson and co. The IPCC should rely only on non-disputed research.	Accepted. More nuanced discussion included.	Eero Hirvijoki	Aalto University	Finland
61703	38	38	38	39	page.38 line.38-page.38 line.39. "Studies for countries and regions with high shares of renewable energy include:" Why would IPCC promote suboptimal pathways that only include "renewable energy sources", given that they are riskier, higher cost, slower, have a higher environmental and material footprint, and are not technology neutral and frankly come out as advertising for renewables industry? This kind of promotion is scientifically questionable and inaccurate, seems heavily biased and seriously degrades the credibility and independence of IPCC and through that, the whole climate change mitigation urgency.	Rejected. Mitigation pathways with large shares of renewables exist in the literature and in policy debates. The Section does not promote those relative to other mitigation options.	Rauli Partanen	Think Atom	Finland
72757	38	38	38	39	Please extend the list below to cover also most vulnerable regions	Noted. We do not have specific literature on the most vulnerable regions to add.	Matthew Gidden	Climate Analytics	Germany
16931	38	39	38	39	Spain has set the objective of 100% renewable electricity in 2050 (https://www.miteco.gob.es/prensa/ultimas-noticias/el-gobierno-aprueba-la-estrategia-de-descarbonizaci%C3%B3n-a-largo-plazo-que-marca-la-senda-para-alcanzar-la-neutralidad-clim%C3%A1tica-a-2050/cm:30-516141)	Accepted. Spain's climate neutrality LEDS is acknowledged in Section 4.2.4.1.	Government of Spain	Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica	Spain
83109	38	40	38	40	It's either a climate neutrality target or a net zero GHG target - the latter term is the clearer one	Accepted. We have changed it to net zero GHG target.	Geden Oliver	German Institute for International and Security Affairs	Germany
47697	38	40	38	45	It is important to note that meeting EU renewable energy targets, particularly though the increased use of bioenergy, will likely require the region to increase its imports of bioenergy. Thus affecting energy security but, more importantly, leading to potential sustainability issues if the bioenergy is produced in areas with weak environmental standards. Mandley, S. J., Daioglou, V., Junginger, H. M., van Vuuren, D. P., & Wicke, B. (2020). EU bioenergy development to 2050. Renewable and sustainable energy reviews, 127, 109858. Daioglou, V., Muratori, M., Lamers, P., Fujimori, S., Kitous, A., Köberle, A. C., ... & van Vuuren, D. P. (2020). Implications of climate change mitigation strategies on international bioenergy trade. Climatic Change, 163(3), 1639-1658	Accepted. This note about imports has been added to the Bioenergy discussion section.	Vassilis Daioglou	Utrecht University	Netherlands
61701	38	40	38	45	The EU roadmap 2050 has a significant portion of both electricity and final energy generated from nuclear (European Commission https://doi.org/10.2833/10759 and https://doi.org/10.2834/02074). Therefore the statement that "The EU 2050 net climate neutrality goal can be met with 100% renewable power generation" is both irrelevant and misleading, and promoting a pathway that is suboptimal for climate mitigation. Even if something "can be done" in a model, doesn't mean that it should be done or promoted as something that should be done, especially by the technologically neutral IPCC. This appears biased and as advertising for the wind and solar industry, decreasing the credibility of climate science. Also, (Zappa et al., 2019) explicitly points out that the "costs [of 100%RE] would be 530e billion per year, 30% more than a system with nuclear or CCS". It would hence also be much more unlikely and risky pathway politically.	Noted. This section is about high-renewables scenarios. It points out that 100% renewables scenario can support the EU net zero target, but not that it has to.	Rauli Partanen	Think Atom	Finland
65741	38	40	38	45	The EU roadmap 2050 has a significant portion of both electricity and final energy generated from nuclear (European Commission https://doi.org/10.2833/10759 and https://doi.org/10.2834/02074). Therefore the statement that "The EU 2050 net climate neutrality goal can be met with 100% renewable power generation" is both irrelevant and misleading. The statement should read that "EU 2050 net climate neutrality goal can be met with 100% low-carbon power generation" and contain the appropriate citations to the aforementioned official EU plans. Furthermore the mentioned reference (Zappa et al., 2019) explicitly points out that the "costs [of 100%RE] would be 530e billion per year, 30% more than a system with nuclear or CCS".	Noted. This section is about high-renewables scenarios. It points out that 100% renewables scenario can support the EU net zero target, but not that it has to.	Eero Hirvijoki	Aalto University	Finland
84441	38	40	38	45	The referral to a 100% renewable power generation scenario for the EU 2050 net climate neutrality goal is a bit at odds with reality, and should be complemented with comments about present challenges. I am not aware of relevant studies, but the fact that several countries are also having programmes for nuclear power, others see an increasing reliance on fossil gas (Nordstream), this section can be improved and more nuanced.	Noted. This section is about high-renewables scenarios. It points out that 100% renewables scenario can support the EU net zero target, but not that it has to.	Mattias Lantz	Uppsala university	Sweden
84443	38	43	38	45	"A 1.5C pathway for the EU includes 85% renewable generation, with battery, pumped hydro, and chemical storage for variable renewables (Capros et al. 2019)." The Capros 2019 article also includes about 15% nuclear power, so it is reasonable to mention it in a similar manner in sec 4.2.5.6.	Noted. Section on nuclear power has been expanded.	Mattias Lantz	Uppsala university	Sweden
20617	39	1	39	3	A more recent study with updated data on energy prices tells a bit different story. The extra cost would be only 4% in average, and less than 9% in 95% of all 315 assessed scenarios. Shirzadeh B., Parrier Q., Quirion P. How Sensitive are Optimal Fully Renewable Power Systems to Technology Cost Uncertainty?. The Energy Journal (2020). https://doi.org/10.5547/01956574.43.1.bsh	Accepted. Reference added.	Government of France	Ministère de la Transition écologique et solidaire	France
24671	39	1	39	3	Given that France currently has one of the most decarbonised power systems in Europe, we would question the validity of such a statement given that the goal is to reduce CO2 emissions rather than promote one technology over another	Rejected. The present section is about renewables. The debate on future energy supply is ongoing in France at time of writing. And comment is policy prescriptive.	Ann Jessica Johnson	FORATOM (European Atomic Forum)	Belgium
61705	39	1	39	3	France currently has a very low-carbon electricity mix with nuclear at 71% share. Why would one even propose France to shift from an already low-carbon electricity mix into a higher-risk, higher cost, higher environmental and material-impact and very likely higher emissions mix? France should use its resources in decarbonizing the non-electric sectors of its society, not spending time and resources in dismantling and rebuilding something that is already near optimal.	Rejected. The present section is about renewables. The debate on future energy supply is ongoing in France at time of writing. And comment is policy prescriptive.	Rauli Partanen	Think Atom	Finland
65743	39	1	39	3	France currently has a practically carbon-neutral electricity mix with nuclear accounting for 71% and fossil sources only for 8% of the power sector, respectively. Further, as mentioned also on page 41, line 36, the French government has committed to 50% of nuclear share by 2035. Therefore, the statement that "In France, for example, 100% renewable generation could include 62% from wind, 26% from solar PV, and 12% from ocean, but would require additional imports or curtailed demand to address variability issues (Krnkowski et al. 2016)" is both misleading and irrelevant. Either remove it or replace it with a more relevant estimate.	Rejected. The present section is about renewables. The debate on future energy supply is ongoing in France at time of writing.	Eero Hirvijoki	Aalto University	Finland

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
72915	39	1	39	3	The bullet point on France is misleading, because France is largely embedded in the Continental European grid. Most scenarios include a large share of offshore wind for example, coming from several wind regimes. Such advanced modelling is developed for example by Brown in T. Brown, D. Schlachterberger, A. Kies, S. Schramm, M. Greiner, Synergies of sector coupling and transmission reinforcement in a cost-optimised, highly renewable European energy system, (already quoted in JAR6 SOD). Energy, Volume 160, 2018, Pages 720-739, ISSN 0360-5442, https://doi.org/10.1016/j.energy.2018.06.222 .	Accepted. Reference added	Antoine BONDUELLE	EE-Consultant	France
72917	39	1	39	3	Shirzadeh et al. Show that cost are not increasing in a full 100% RE electric grid: Shirzadeh B., Perrier Q., Quirion P. How Sensitive are Optimal Fully Renewable Power Systems to Technology Cost Uncertainty?. The Energy Journal 2020. https://doi.org/10.5547/01956574.43.1.bshi	Accepted. We have added this reference and note about incremental costs being minimal.	Antoine BONDUELLE	EE-Consultant	France
76599	39	1	39	3	Regarding 100% renewable generation in France, see also Perrier, Q., Quirion, P. and Shirzadeh, B. 2020: How Sensitive are Optimal Fully Renewable Power Systems to Technology Cost Uncertainty?. The Energy Journal, 43, https://doi.org/10.5547/01956574.43.1.bshi According to this publication, 100% renewable can be met in 2050 in France without requiring additional imports and for a cost similar to the current mix.	Accepted. We have added this reference and note about incremental costs being minimal, and qualify the statement about imports being true in some studies but not all.	Charlotte MIJEON	Réseau "Sortir du nucléaire" (organization affiliated to the French Climate Action Network)	France
76445	39	1	39	32	With respect to France, that nation has already achieved amongst the World's lowest emissions intensities with <60 gr CO2/kWh achieved with nuclear energy - why would it change to less effective, more expensive and higher risk renewables? Nuclear energy needs to be used as a viable tool in all nations attempts to get to zero carbon	Rejected. The present section is about renewables. The debate on future energy supply is ongoing in France at time of writing. And comment is policy prescriptive.	Robert Parker	Nuclear for Climate Australia	Australia
5117	39	4	39	6	There are numerous studies on Germany's energy transition, many of them more up to date than Schmid and Knopf (2012). You might want to have a look at Agora Energiewende or even McKinsey publications	Accepted. Newer studies added.	Lina Hollender	n/a	Germany
45867	39	4	39	6	Please revise. Old quote, not accurate anymore.	Accepted. Newer studies added.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
83111	39	4	39	6	The Schmidt/Knopf 2012 study is a little outdated, given that we are already in 2021	Accepted. Newer studies added.	Geden Oliver	German Institute for International and Security Affairs	Germany
48099	39	14	39	17	"For the U.S., accelerated mitigation pathways include up to 40% power generation from solar PV and wind by 2050." Several papers on transitioning the U.S. to 100% renewables by 2050 have been published. These include (1) Jacobson, M.Z., M.A. Delucchi, G. Bazouin, Z.A.F. Bauer, C.C. Heavey, E. Fisher, S. B. Morris, D.J.Y. Piekutowski, T.A. Vencill, T.W. Yeskoo, 100% clean and renewable wind, water, sunlight (WWS) all-sector energy roadmaps for the 50 United States, Energy and Environmental Sciences, 8, 2093-2117, doi:10.1039/C5EE01283J, 2015; (2) Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, and B.A. Frew, A low-cost solution to the grid reliability problem with 100% penetration of intermittent wind, water, and solar for all purposes, Proc. Nat. Acad. Sci., 112 (49), 15,060-15,065 doi: 10.1073/pnas.1510028112, 2015; (3) Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, and B.V. Mathiesen, Matching demand with supply at low cost among 139 countries within 20 world regions with 100% intermittent wind, water, and sunlight (WWS) for all purposes, Renewable Energy, 123, 236-248, 2018; (4) Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, S.J. Coughlin, C. Hay, I.P. Manogaran, Y. Shu, and A.-K. von Krauß, Impacts of Green New Deal energy plans on grid stability, costs, jobs, health, and climate in 143 countries, One Earth, 1, 449-463, doi:10.1016/j.oneear.2019.12.003, 2019	Accepted. References added.	Mark Jacobson	Stanford University	United States of America
78239	39	15	39	15	Correct usage - Use of "Renewable generation and nuclear" like done in present case should be replicated in the entire report. At several instances, renewable appears to be subsuming nuclear while the sentence reads entirely opposite.	Accepted. Changed to Low Carbon instead of only Renewable in many previous instances where nuclear could be applicable.	Reetesh Chaurasia	Department of Atomic Energy, Government of India	India
55267	39	15	39	16	This means keeping existing nuclear power alive. New and better nuclear technology will take a few decades. Too late!	Noted.	Government of United States of America	U.S. Department of State	United States of America
55269	39	15	39	17	Nuclear today provides 20-25% of U.S. power. Does this mean that the U.S. will expand to 50% nuclear? It takes at least 20 years to get a new nuclear plant approved and built -- at best.	Noted.	Government of United States of America	U.S. Department of State	United States of America
72759	39	18	39	21	What about the research by Koerberle et al 2020: https://link.springer.com/article/10.1007/s10584-020-02856-6 ?	Accepted. Reference added.	Matthew Gidden	Climate Analytics	Germany
78147	39	18	39	21	What about the research by Koerberle et al 2020: https://link.springer.com/article/10.1007/s10584-020-02856-6 ?	Accepted. Reference added.	Charlotte Plinke	Climate Analytics	Germany
5035	39	22	39	22	the authors write "potential also exist for solar." I suggest correcting as follows "potential also exists for solar..."	Accepted. We have made this correction.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
62081	39	22	39	24	I would also refer to Ricardo Delgado, Thomas B. Wild, Ricardo Arguello, Leon Clarke, German Romero, Options for Colombia's mid-century deep decarbonization strategy, Energy Strategy Reviews, Volume 32, 2020.	Accepted. Reference added.	Michel den Elzen	PBL Netherlands Environmental Assessment Agency	Netherlands
47375	39	25	39	27	On Japan's need for power generation from hydrogen in 2050, I don't think it is balanced to just emphasise this particular technological option. There are quite a few papers published in recent months, including those in the following special issue in Sustainability Science (see link below). These papers should provide more broader picture on the role of renewables in Japan. https://link.springer.com/journal/11625/topicalCollection/AC_9ad334d69d8118185398263fbc22961	Accepted. Reference added.	Takeshi Kuramochi	NewClimate Institute	Germany
50007	39	25	39	27	The recently completed model intercomparison EMF 35 Japan Model Intercomparison Project might be useful in discussing mitigation in Japan. As expected, renewables will expand (Shiraki et al., 2021, https://doi.org/10.1007/s11625-021-00917-y). Excluding scenarios with large nuclear and biomass shares, the median VRE share will be about 52% under 80% emissions reduction scenarios.	Accepted. Reference added.	Masahiro Sugiyama	University of Tokyo	Japan
64153	39	25	39	27	The insight described here (role of hydrogen in 2050 emissions reduction goal in Japan) is not relevant to the section (decarbonisation of electricity through renewable energy). Relevant insights are provided by Shiraki et al. (2021 Sustainability Sci), Oshino et al. (2018 Carbon Manag), Silva Herran et al. (2019, Climate Policy).	Accepted. First reference added and link to hydrogen deleted.	Diego Silva Herran	National Institute for Environmental Studies	Japan
47439	39	28	39	31	It is crucial that the "1.5°C pathways" presented here are specified, clarified, and put in context with the Chapter 3 classification. What do they entail? Please revise!	Partially accepted. Discussion of country examples put in a box to illustrate diversity of mitigation pathways. Details of each scenario difficult to provide due to space constraints.	Government of Saint Lucia	Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Development	Saint Lucia
72761	39	28	39	31	It is crucial that the "1.5degC pathways" presented here are specified and clarified. What do they entail? Please revise	Partially accepted. Discussion of country examples put in a box to illustrate diversity of mitigation pathways. Details of each scenario difficult to provide due to space constraints.	Matthew Gidden	Climate Analytics	Germany
78149	39	28	39	31	It is crucial that the "1.5C pathways" presented here are specified and clarified. What do they entail?	Partially accepted. Discussion of country examples put in a box to illustrate diversity of mitigation pathways. Details of each scenario difficult to provide due to space constraints.	Charlotte Plinke	Climate Analytics	Germany
5267	40	1	40	1	Cannot use the figure 4.3, un readable	Editorial. Figure 4.3 revised.	Michel SIMON	Retraité/ Pdt d'association	France
47331	40	1	40	1	figure 4.3 needs to be more illustrated because all contents are not readable	Editorial. Figure 4.3 revised.	Khaled Mohamed Madkour	Ain Shams University, Cairo, Egypt	Egypt
9879	40	1	40	2	"Large-scale BECCS may push planetary boundaries for freshwater use, exacerbate land-system change, significantly alter biosphere integrity and biogeochemical 1 flows". It would be interesting to put some data from the literature to add the weight of this statement.	Noted. This comment is about page 41, lines 1 and 2. Space does not allow to expand more. See Chapter 7.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
61707	40	2	40	5	Why is "historically increasing shares of renewable electricity" promoted in Figure 4.3? Renewable electricity is not the goal (and can be counterproductive), low-carbon electricity is. Replace Figure 4.3 with one that shows increasing shares of low-carbon electricity to be scientifically more accurate and relevant from climate mitigation point of view. Also, given the many national grid-decarbonizations happened before the often-selected 1990, be sure to include years prior to that as well, the nuclear energy programs from 1970s to 1990s are very relevant for planning future decarbonization projects. The quality of the graph is poor, making it impossible to read, so hopefully resolution can be increased.	Rejected. The subsection is about renewable energy. Section 4.2.5.5 is about nuclear.	Rauli Partanen	Think Atom	Finland
76447	40	6	40	24	Bioenergy is not a sustainable source of low carbon energy. All biological materials contains essential element from the environment. It is not sustainable in the long term to be expelling these into the atmosphere - it will severely degrade the environment.	Rejected. Discussion of limitations associated with biomass energy is conducted in third paragraph of this section.	Robert Parker	Nuclear for Climate Australia	Australia
61709	40	8	40	14	"Domestic biomass alone can help Germany meet its 95% CO2 reduction by 2050 goal [...]" (Mikova et al 2019). The statement is subject to misinterpretation. In the given reference, all renewable technologies in Germany are assumed to have low-medium level (1-50%) of penetration. Rephrase. Also, bioenergy emissions are counted towards LULUCF-emissions, so scaling them up from current levels in many countries will be limited, as the annual carbon sinks start to shrink for example in forests. Expanding bioenergy crops has potentially detrimental effects on soil carbon accumulation as well as for biodiversity and ecosystem viability. Promoting strongly expanding bioenergy use from current levels is not sustainable from an environmental point of view. See https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review	Rejected. Discussion of limitations associated with biomass energy is conducted in third paragraph of this section.	Rauli Partanen	Think Atom	Finland
85155	40	10	40	11	Please formulate in a more balanced way: "Some studies suggest that BECCS in the power sector could be cost-effective for supply-side mitigation." Please add: "Whereas evidence taking into account associated side effects and impacts from planting, transporting and capturing to storage, including cost implications e.g. for the necessary transport infrastructure, is scarce." References: https://www.nature.com/articles/s41558-017-0045-1 https://www.chathamhouse.org/2020/01/net-zero-and-beyond-what-role-bioenergy-carbon-capture-and-storage?utm_medium=email&utm_source=Chatham%20house	Noted. Limitations of BECCS are discussed in last paragraph of this section.	Jens Tambke	Umweltbundesamt	Germany
45869	40	12	40	14	Please revise. "Biomass alone" sounds not accurate. Also, Germany strives for GHG-neutrality by 2050.	Noted. Text consistent with reference. Our understanding from the German LEDS is that it aims at reducing GHG emissions by 80%-95% by 2050, and achieve neutrality.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
24929	40	12	40	17	what do you mean with "northwest EU countries"? Germany is not west. In general, here and elsewhere there is much (too much) focus on EU countries, and Germany in particular. I understand that is probably where the literature is, but any effort to rebalance this would be appreciated. "Domestic biomass alone can help Germany meet its 95% CO2 reduction by 2050 goal". Which biomass? specifying this is important, given the very heated debate around woody biomass in EU and US. As you are certainly aware, 60% of renewable energy in EU comes from woody biomass (half of which secondary residues - Camia et al. 2021: https://ec.europa.eu/jrc/en/publication/eu-scientific-and-technical-research-reports/use-woody-biomass-energy-production-eu), but any further increases of this contribution would likely have negative overall climate impacts through reduced forest sinks.	Accepted. Text revised.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
72763	40	12	40	17	The language used in this paragraph implies these changes are "needed", rather than that they are used as part of certain projections. Please reword	Accepted. Paragraph revised.	Matthew Gidden	Climate Analytics	Germany
83113	40	12	40	17	EU countries don't have CO2 reduction targets but GHG reduction targets. Furthermore, the cited modelling studies sometimes refer to earlier targets that are outdated now. This does not make the results invalid, but the paragraph should avoid creating confusion what the EU targets is (its net zero GHGs by 2050, as decided by EU Heads of State and Government, & soon to be enshrined in EU Climate Law)	Accepted. We have reviewed and revised language throughout this subsection.	Geden Oliver	German Institute for International and Security Affairs	Germany
65745	40	13	40	14	"Domestic biomass alone can help Germany meet its 95% CO2 reduction by 2050 goal [...]" (Mikova et al 2019). The statement is subject to misinterpretation. In the given reference, all renewable technologies in Germany are assumed to have low-medium level (1-50%) of penetration. Revise.	Rejected. This does not seem to contradict the finding from the paper that domestic biomass can help Germany meet its target.	Eero Hirvijoki	Aalto University	Finland
80329	40	15	40	17	Opening up possibilities about eventual biomass production with disposal of the grains, or even an equivalence of energy production through biomass and biofuels.	Noted	JUAN DIAZ	Association	United States of America
55271	40	18	40	21	This is a statement that is worthy of the SPM.	Noted.	Government of United States of America	U.S. Department of State	United States of America
55273	40	18	40	21	Add. for clarity and reinforcement, that renewable generation and efficiency/conservation are preferable by far.	Noted. The scenario analysis shows the technology potential but do not specify preferences.	Government of United States of America	U.S. Department of State	United States of America
18139	40	18	41	2	Recommend adding a strength of evidence, confidence level here	Noted. Choice made not to add confidence statement at all level-4 subheadings.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
83115	40	18	41	2	Here you should refer to and draw on the extensive analysis on BECCS in chapter 7. Unclear why you mainly draw on literature concerned with global pathways here, since they might assume unrealistically high volumes from BECCS (given that BECCS usually worked as proxy for technological CDR in global IAMs). All the literature cited refers to global IAM modelling of BECCS, while BECCS is hardly being discussed in UN climate policy (Fridahl 2017, https://www.sciencedirect.com/science/article/abs/pii/S0301421517300605) it might be wise to add emerging bottom up perspectives as well since this literature takes national circumstances much better into account, including the critical issue of which feedstock to use (e.g., residues in which industries (not only power sector, but also biorefineries or pulp and paper). Such literature mainly exists for countries where BECCS is seriously discussed in climate policy circles (see Schenutt et al. 2021, https://www.frontiersin.org/articles/10.3389/fclim.2021.638805/full), like the US (e.g., Sanchez et al. 2018, https://www.pnas.org/content/115/19/4875.short), UK (e.g., Zhang et al. 2020, https://pubs.rsc.org/~/content/articlehtml/2020/se/c9se00609e) or Sweden (e.g., Klement et al. 2021, https://www.frontiersin.org/articles/10.3389/fclim.2021.615578/full)	Noted. We added reference to Chapter 7.	Geden Oliver	German Institute for International and Security Affairs	Germany
72765	40	22	40	24	Vassilis Diaoglou's work on bioenergy payback periods should be cited here. These problems are relevant for bioenergy, too.	Accepted. Citation added.	Matthew Gidden	Climate Analytics	Germany
27647	40		40		Figure 4.3 is not readable. The axis legends are not clear.	Accepted. Figure edited.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
9877	41	2	41	24	It is said that 'accelerated mitigation pathways encompass both rapid deployment of new technologies such as CCS or electric vehicles'. Suggestion : the contribution of current CCS on global mitigation scenarios, although is not yet significant, need to be reported to make an accelerated mitigation pathways based on CCS.	Noted.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
47441	41	3			This section should start with context on CCS in the changing landscape of cheap RE and batteries. Some citations are very old. If the aim is to show what national studies suggest, this should be made clear and the context provided by global studies should be added (e.g. CCS + coal / gas not cost effective for power generation) Please thoroughly revise this section!	Partially accepted. The broader context of CCS is laid out elsewhere, in chapter 6. We have clarified the context for the national studies.	Government of Saint Lucia	Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Development	Saint Lucia

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
72767	41	3			This section should start with context on CCS in the changing landscape of cheap RE and batteries. Some citations are very old. If the aim is to show what national studies suggest, this should be made clear and the context provided by global studies should be added (e.g. CCS + coal / gas not cost effective for power generation). Please thoroughly revise this section	Partially accepted. The broader context of CCS is laid out elsewhere, in chapter 6. We have clarified the context for the national studies.	Matthew Gidden	Climate Analytics	Germany
78151	41	3	41		This section should start with context on CCS in the changing landscape of cheap RE and batteries. Some citations are very old. If the aim is to show what national studies suggest, this should be made clear and the context provided by global studies should be added (e.g. CCS + coal / gas not cost effective for power generation). Please thoroughly revise this section! Minor comments in addition, which dimension of feasibility is evaluated for Brazil? What is the scale of CCS needed in Japan, and is "needed" the adequate formulation or is it only that they are used as part of certain projections? This section deserves more attention by the authors, and would benefit from additional literature review.	Partially accepted. The broader context of CCS is laid out elsewhere, in chapter 6. We have clarified the context for the national studies.	Charlotte Plinke	Climate Analytics	Germany
52079	41	3	41	16	The CCS technology is now considered viable option and its feasibility should be considered by the authors in all the chapter	Taken into account. The feasibility of all technologies is assessed across the Working Group III report. Chapter 6 includes assessment of technologies associated with energy systems. Our focus here is on assessing national pathway studies. Another review comment (48101) questions feasibility	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
5269	41	3	41	24	I suggest to develop a very important point, which is mentioned in the title: if the CCS technology is about to be mastered, the social acceptance is not clear (What do we do with the captured CO2? The solution to fill natural reservoir is an option, but who will accept to have such a reservoir in the neighborhood?) and the cost of CCS is for now a real handicap to his development.	Accepted. The limitations of CCS has been added.	Michel SIMON	Retraité/ Pdt d'association	France
76449	41	3	41	24	CCS is a high risk option that is expensive and technically challenging. Nuclear energy needs to be expanded rapidly to replace fossil fuel use and avoid commitments to CCS	Noted. Reviewer states a view, without providing substantiation or literature	Robert Parker	Nuclear for Climate Australia	Australia
20619	41	3	41	4	About the title of the subsection: CCS deployment is not only conditioned on the economic feasibility but also to the possibility of ensuring the durability of storage, and to societal preference (acceptability)	Accepted. The limitations of CCS has been added.	Government of France	Ministère de la Transition écologique et solidaire	France
47199	41	3	41	4	It is not a scientific statement you are expected to find in an IPCC report	Accepted. We have revised the text to note this is finding from some analyses, not a scientific statement.	Stuart Minchin	The Pacific Community	Australia
48101	41	3	41	4	"CCS may be needed to mitigate emissions from the remaining fossil fuels that cannot be decarbonised, but the economic feasibility of deployment is not yet clear." The issue is not only the economic feasibility but whether CCS (or DAC) even works to the extent promoters have claimed AND whether it represents an opportunity cost because replacing coal with renewables not only reduces more CO2 than using the same renewables to power CCS, but replacing coal with renewables also eliminates air pollution and mining, which CCS does not. So CCS is an opportunity cost, as quantified with data here: Jacobson, M.Z., The health and climate impacts of carbon capture and direct air capture, Energy and Environmental Sciences, 12, 3567-3574, doi:10.1039/C9EE02709B, 2019.	Accepted. The limitations of CCS has been added.	Mark Jacobson	Stanford University	United States of America
52055	41	5	41	24	CCS is presented as a viable option. However, there is no mention of incorporating CCS with fossil fuels (only biofuels). CCS with Fossil Fuels should be rephrased as an alternative and should be included in the SPM.	Noted. China's examples are focused specifically on fossil fuels. Japan's example also mentions fossil fuels.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
55275	41	8	41	22	This section has many occurrences of words like "necessary" and variants of "need". Most of these statements are in the passive voice and cite only one reference. Does the entire author team really stand by all of these statements enough to allow the passive voice? For example, at lines 12-13, "China would need 100% CCS in the remaining 12% of power generation from coal and gas power and 250 GW of BECCS (Jiang et al., 2018)." Consider rephrasing to: "An analysis concluded that China would need 100% CCS in the remaining 12% of power generation from coal and gas power and 250 GW of BECCS (Jiang et al., 2018)." This kind of change should be made throughout this section. Attribute the claims and model estimates to the authors and studies.	Accepted. We have made language revisions throughout to indicate that these are findings from specific analyses, studies, not policy recommendations.	Government of United States of America	U.S. Department of State	United States of America
8869	41	17	41	19	Kato and Kurosawa (2021, Sustainability Science) also discusses the importance of CCS through NETS/CDR (BECCS and DACCS) to achieve net-zero emissions for Japan.	Accepted. We have added this reference	Etsushi Kato	Institute of Applied Energy	Japan
50009	41	17	41	19	The magnitude of CCS varies greatly by model, and this has to do with hydrogen import to some extent (Sugiyama et al., 2021, https://doi.org/10.1007/s11625-021-00913-2 ; Ju et al., 2021, https://doi.org/10.1007/s11625-021-00905-2).	Noted. The specifics of CCS modeling is outside the scope of this specific section.	Masahiro Sugiyama	University of Tokyo	Japan
20621	41	20	41	20	The affirmative aspect of the sentence "In parts of the EU, after 2030, CCS also becomes profitable with expected rising CO2 prices (Schiffer 2015)" needs to be nuanced. Today nothing guarantees profitability for the horizon 2030. There still needs to be investment in R&D in the field and the technology must be sufficiently efficient from an environmental point of view.	Accepted. We have revised the language.	Government of France	Ministère de la Transition écologique et solidaire	France
85157	41	20	41	21	Please add: "(...) although evidence on cost-effectiveness is scarce and uncertain." REFERENCE: EU COM: https://ec.europa.eu/energy/topics/oil-gas-and-coal/carbon-capture-and-storage_en	Accepted. We have added this point and associated reference.	Jens Tambke	Umweltbundesamt	Germany
78007	41	24	41	25	Suggested edit: Between these lines add the following paragraph: "In the US legislation has been passed (Section 45Q of the US Tax Code passed in 2018) that provides a tax credit for Direct Air Capture (DAC). The legislation was specifically designed to stimulate the rapid scaling up of currently available carbon negative fossil fuel based electric power generation technology that supports accelerated economic development and carbon removal, using existing fossil fuel and power generation infrastructure, during the transition to a fully Renewable Energy and Materials Economy (REME) (Chichilnisky and Bal 2019, p. 304-70) (Eisenberger 2020) (Baiman 2021)." Rationale: See references below. I25 References: Chichilnisky, Graciela and Peter Bal. 2019. Reversing Climate Change. Singapore: World Scientific Publishing Co. Pte. Ltd. Eisenberger, Peter. 2020. Renewable energy and materials economy. Submitted to Physics and Society, Dec. 29. Accessed at: https://arxiv.org/pdf/2012.14976.pdf Baiman, Ron. 2021. In Support of a Renewable Energy and Materials Economy (REME): A Global Green New Deal (GGND) that Includes Arctic Sea-Ice Climate Triage and Carbon Cycle C1+I25imate Restoration. Submitted to the Review of Radical Political Economics. Accessed at: https://www.epgonline.org/post/arctic-sea-ice-traige-carbon-cycle-restoration-and-a-renewable-energy-and-materials-economy	Noted. This specific instance is beyond the general scope of this section.	Ron Baiman	Benedictine University	United States of America
37047	41	25	41	26	No mention about India. India has a three-stage nuclear program with an ultimate	Accepted, included in 4.2.5.6	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37049	41	25	41	26	objective of utilizing its vast thorium reserves which has significantly large potential for clean energy source.	Rejected. The reviewer does not provide literature, we look but could not find literature to support this statement	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37051	41	25	41	26	With low carbon emission as compared to solar and wind, with high capacity factor	Partially accepted. Taken into account. The role of nuclear power is assessed in chapter 6. The role of nuclear power more generally is assessed in chapter 6	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37053	41	25	41	26	and base load stability, nuclear energy is one of the most suitable means of decarbonisation.	Partially accepted. Taken into account. The role of nuclear power is assessed in chapter 6. The role of nuclear power more generally is assessed in chapter 6	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
55277	41	25	41	26	What does the word strategic mean? Nuclear has also proven to be very expensive. To get companies to engage, the state has taken on the important big risks, not the companies or the banks. In addition, there is a strategic vulnerability in armed conflict situations.	Accepted. We have deleted the word "strategic."	Government of United States of America	U.S. Department of State	United States of America

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82613	41	25	41	26	The bolded text “Nuclear power is considered strategic for some countries, while others plan to reach their mitigation targets without additional nuclear power.” is a weak encapsulation of the role that nuclear is expected to play under the scenarios presented and discussed especially when compared to how other technologies are presented. Figure 3.16 shows nuclear energy growing in most scenarios presented, and to high levels (greater than 15% tpe) in 160. In fact there are several countries where preserving/increasing nuclear energy is expected to make major contributions to their mitigation targets.	Accepted. We have replaced "strategic" with "complementary to renewable power" and added more references and examples of analyses that find increasing role and potential for nuclear.	Jonathan Cobb	World Nuclear Association	United Kingdom (of Great Britain and Northern Ireland)
76451	41	25	41	42	The role of nuclear energy in a low carbon future is central to success. This section needs to highlight this message. Moves in France to wind nuclear back to 50% are not based on sensible science but are merely political. Hopefully this policy will die a natural death.	Noted. We have added more references and examples of analyses that find increasing role and potential for nuclear.	Robert Parker	Nuclear for Climate Australia	Australia
61711	41	25	42	2	Section 4.2.5.6 should include also the analysis of Canada (Vaillancourt et al., 2017, https://doi.org/10.1016/j.apenergy.2017.03.104) which reports a 7-10-fold increase in nuclear energy by 2050 and in Fig 9 shows that 90% of electricity generation is nuclear+hydro in 2050.	Accepted. We have added this reference.	Rauli Partanen	Think Atom	Finland
61715	41	25	42	2	Section 4.2.5.6 should include also the analysis of South-Korea (Hong and Brook, 2018, https://doi.org/10.1016/j.enpol.2017.10.012 ; Hong et al., 2014, https://doi.org/10.1016/j.enpol.2014.05.054 ; Cho and Yim, 2020, https://doi.org/10.1002/er.5109) which show the benefits of retaining and even increasing the role of nuclear in the energy mix as both a source of cheap electricity and an enabler for larger penetration of variable renewables via the load-following capabilities of the Korean APR-1400 and APR-1000 reactor types.	Accepted. We have added these references.	Rauli Partanen	Think Atom	Finland
61717	41	25	42	2	Section 4.2.5.6 should include also the analysis of mitigation scenarios for Australia (Hong et al., 2014, https://doi.org/10.1016/j.apenergy.2014.09.062) which show that the optimal scenario embraces nuclear and brings the power sector life-cycle emission below the level of 27g CO2-eq/kWh. This would satisfy emissions reduction targets as well as have the least aggregate negative environmental and economic impacts from all considered scenarios.	Noted. Due to space and length constraints, we have focused only on the largest emitters and nuclear power users but cannot add additional examples.	Rauli Partanen	Think Atom	Finland
61719	41	25	42	2	Section 4.2.5.6 should include also the analysis of United Arab Emirates (AlFarr and Abu-Hijleh, 2012, https://doi.org/10.1016/j.enpol.2011.11.084) where nuclear was "found to be more practical option in mitigating CO2 than renewable energy and carbon capture and sequestration".	Noted. Due to space and length constraints, we have focused only on the largest emitters and nuclear power users but cannot add additional examples.	Rauli Partanen	Think Atom	Finland
61721	41	25	42	2	Section 4.2.5.6 should include also the analysis of Sweden (Wagner and Rachlew, 2016, https://doi.org/10.1140/epjg2016-16173-8 ; Hong et al., 2018, https://doi.org/10.1016/j.enpol.2017.10.013) which indicate that the existing high share of nuclear is essential in retaining the already achieved low carbon emissions from the power sector. Replacing nuclear with wind or solar would result in increased CO2 emissions and system costs (as is estimated to happen in Belgium as it aims to replace its nuclear fleet prematurely with wind and natural gas, see Ember 2020, https://ember-climate.org/wp-content/uploads/2020/11/NECP-Factsheet-Belgium.pdf).	Noted. Due to space and length constraints, we have focused only on the largest emitters and nuclear power users but cannot add additional examples.	Rauli Partanen	Think Atom	Finland
63585	41	25	42	2	As one of the tier 1 nuclear countries, we suggest adding a paragraph in this section to highlight Canada's nuclear industry to complement those from the USA, China, France and Italy. The two sources (IAEA Power Reactor Information System https://pris.iaea.org/pris/CountryStatistics/CountryDetails.aspx?country=CA) and (https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/electricity/report/2018-nuclear-energy/nuclear-generation-in-canada.html) can be consulted, but if it is helpful we suggest the following lines: In Canada, nuclear is an asset that has been consistently providing approximately 15% of the country's electricity for the past 15 years (IAEA PRIS). It is also the second largest source of non-emitting electricity in Canada, the first being hydroelectricity. In 2014 with the refurbishment of several of its CANDU reactors, the province of Ontario successfully phased out the use of coal, which used to contribute just under 20% of its electricity, and now operates a 90% non-emitting grid including approximately 13 500MW, or just under 60% of nuclear generation (CER).	Partially accepted. We have added another reference that noted potential for significant increase in nuclear capacity to decarbonize the power sector.	Government of Canada	Environment and Climate Change Canada	Canada
65747	41	25	42	2	Section 4.2.5.6 should include also the analysis of Canada (Vaillancourt et al., 2017, https://doi.org/10.1016/j.apenergy.2017.03.104) which reports a 7-10-fold increase in nuclear energy by 2050 and in Fig 9 shows that 90% of electricity generation is nuclear+hydro in 2050.	Partially accepted. We have added another reference that noted potential for significant increase in nuclear capacity to decarbonize the power sector.	Eero Hirvijoki	Aalto University	Finland
65749	41	25	42	2	Section 4.2.5.6 should include also the analysis of South-Korea (Hong and Brook, 2018, https://doi.org/10.1016/j.enpol.2017.10.012 ; Hong et al., 2014, https://doi.org/10.1016/j.enpol.2014.05.054 ; Cho and Yim, 2020, https://doi.org/10.1002/er.5109) which show the benefits of retaining and even increasing the role of nuclear in the energy mix as both a source of cheap electricity and an enabler for larger penetration of variable renewables via the load-following capabilities of the Korean APR-1400 and APR-1000 reactor types.	Accepted. We have added the relevant references and the point about nuclear enabling renewables in South Korea's case.	Eero Hirvijoki	Aalto University	Finland
65751	41	25	42	2	Section 4.2.5.6 should include also the analysis of mitigation scenarios for Australia (Hong et al., 2014, https://doi.org/10.1016/j.apenergy.2014.09.062) which show that the optimal scenario embraces nuclear and brings the power sector life-cycle emission below the level of 27g CO2-eq/kWh satisfying the IPCC targets and having the least aggregate negative environmental and economic impacts from all considered scenarios.	Noted. Due to space and length constraints, we have focused only on the largest emitters and nuclear power users but cannot add additional examples.	Eero Hirvijoki	Aalto University	Finland
65753	41	25	42	2	Section 4.2.5.6 should include also the analysis of United Arab Emirates (AlFarr and Abu-Hijleh, 2012, https://doi.org/10.1016/j.enpol.2011.11.084) where nuclear was "found to be more practical option in mitigating CO2 than renewable energy and carbon capture and sequestration".	Noted. Due to space and length constraints, we have focused only on the largest emitters and nuclear power users but cannot add additional examples.	Eero Hirvijoki	Aalto University	Finland
65755	41	25	42	2	Section 4.2.5.6 should include also the analysis of Sweden (Wagner and Rachlew, 2016, https://doi.org/10.1140/epjg2016-16173-8 ; Hong et al., 2018, https://doi.org/10.1016/j.enpol.2017.10.013) which indicate that the existing high share of nuclear is essential in retaining the already achieved low carbon emissions from the power sector. Replacing nuclear with wind or solar would result in increased CO2 emissions and system costs.	Noted. Due to space and length constraints, we have focused only on the largest emitters and nuclear power users but cannot add additional examples.	Eero Hirvijoki	Aalto University	Finland
18141	41	25	42	4	In the same way that there is critical analysis applied to BECCS in the previous section, recommend that this section on nuclear be subjected to a sentence or two of critical analysis at the end of this section too (along with a strength of evidence, confidence level)	Accepted. We have added more citations on limitations to nuclear, particularly public opposition.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
61727	41	25	42	4	The section 4.2.5.6 overall has a pessimistic view on nuclear energy. Instead of nuclear being "strategic" for some countries, it is an essential component for the majority of the top emitting countries to achieve carbon neutrality. Indeed, given real-world evidence so far, it plays a much larger role than any renewable energy source, save for hydro. This large role of nuclear should be better expressed in the report and the section title changed to reflect this fact. Now it seems biased against nuclear energy's potential.	Accepted. We have replaced "strategic" with "complementary to renewable power" and added more references and examples of analyses that find increasing role and potential for nuclear.	Rauli Partanen	Think Atom	Finland
65761	41	25	42	4	The section 4.2.5.6 overall has a rather pessimistic view on nuclear energy, even the title reflects this. Instead of nuclear being "strategic" for some countries, it is an essential component for the majority of the top emitting countries to achieve carbon neutrality. This should be better expressed in the report and the section title changed to reflect this fact.	Accepted. We have replaced "strategic" with "complementary to renewable power" and added more references and examples of analyses that find increasing role and potential for nuclear.	Eero Hirvijoki	Aalto University	Finland
82617	41	25	42	4	The list of countries analysed here is surprising. Italy especially doesn't seem like it should be included as it has no immediate plans for nuclear. There is however an increasing nuclear newcomer nations – countries which are developing nuclear power plants for the first time – none of which have been mentioned here. We strongly suggest noting this important trend and making mention of Turkey, Bangladesh, Egypt, Uzbekistan, and/or Poland	Partially accepted. We have removed Italy. The list of countries included are not intended to be comprehensive, but represents some of world's largest emitters and/or users of nuclear power.	Jonathan Cobb	World Nuclear Association	United Kingdom (of Great Britain and Northern Ireland)

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84445	41	25	42	4	The list with examples is rather short. Countries like Finland, UK, Canada, India, several East European countries, Kenya, Ghana, Bangladesh, Turkey, and more, also have nuclear power as part of their mitigation plans, or plans for introducing nuclear power. A few references below: Kenya: Diana Musyoka, Robert M. Field, Review of the environmental oversight framework in Kenya, in light of a nuclear power programme, Progress in Nuclear Energy, Volume 108, 2018, Pages 89-98, ISSN 0149-1970, https://doi.org/10.1016/j.pnucene.2018.05.005 ; Ghana: Seth Kofi Debrah, Mark Amoo Niyasapoh, Felix Ameyaw, Stephen Yamoah, Nii Kwabie Alloley, Frederick Agyeman, "Drivers for Nuclear Energy Inclusion in Ghana's Energy Mix", Journal of Energy, vol. 2020, Article ID 8873058, 12 pages, 2020. https://doi.org/10.1155/2020/8873058 ; Kwame Gyamfi, Sylvester Attakorah Birikorang, Emmanuel Ampomah-Amosko, John Justice Fletcher, Bernard Osei, "The Choice of Nuclear Energy for Ghana as a Result of Development of Its Energy Production", Journal of Energy, vol. 2020, Article ID 8823720, 6 pages, 2020. https://doi.org/10.1155/2020/8823720 ; Nigeria: Felix A. Ishola et al., "Sustainable Nuclear Energy Exploration in Nigeria – A SWOT Analysis", Procedia Manufacturing 35 (2019) 1165-1171, 10.1016/j.promfg.2019.06.072; Andrea Rezzonico and Christine Parthemore, "Converging Risks in Nigeria: Nuclear Energy Plans, Climate Fragility, and Security Trends", Council of Strategic Risks – Briefing, No. 3, August 28, 2019, https://climateandsecurity.org/2019/08/briefing-nuclear-climate-and-security-issues-in-nigeria/	Accepted. We have added South Korea as another example. However, the list of countries included are not intended to be comprehensive, but represents some of world's largest emitters and/or users of nuclear power. We cannot add more examples due to space and length constraints.	Mattias Lantz	Uppsala university	Sweden
5037	41	27	41	28	The sentence sounds contradictory, I suggest rewording it	Accepted.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
5271	41	27	41	28	On which basis the author can say that nuclear is "not expected to have a significant role currently or in the future"? Projections by BP, IAE and others show the contrary - and it is more or less obvious, that nuclear will be one of the major instrument to mitigate GHG emissions, used by most advanced countries. Please, moderate, for example by: "Nuclear is to day the only mass production tool of electricity with very low GHG emissions. Due to social acceptability limits, the deployment in the near future will be limited, up to the time where the consequences of climate change will hurt the public opinion and lead to recognition of the merits of nuclear energy.. In that perspective, and with sur consideration of security of electricity supply,nuclear energy will have an important rôle in GHG mitigation."	Accepted. The statement about "not expected to have a significant role currently or in the future" was specific to the case of Brazil from the one cited study, not a general statement for nuclear. This has been revised.	Michel SIMON	Retraité/ Pdt d'association	France
55279	41	27	41	28	Is this supposed to be a statement of bias of the author team or a statement of fact? Many people expect nuclear to play an important role in future low-carbon-emission energy systems. If authors are going say that something is not expected, they cannot put it in the passive voice. Who is it that is not expecting this?	Accepted. The statement about "not expected to have a significant role currently or in the future" was specific to the case of Brazil from the one cited study, not a general statement for nuclear. This has been revised.	Government of United States of America	U.S. Department of State	United States of America
82615	41	27	41	28	Suggest rewording "Although not expected to have a significant role currently or in the future, nuclear energy is considered necessary as part of accelerated mitigation pathways in Brazil (Lucena et al. 2016)." To "Nuclear energy is considered necessary as part of accelerated mitigation pathways in Brazil, although not expected to have a significant role currently or in the future (Lucena et al. 2016)." "significant" is poorly defined here and this should and this phrase should be made more specific or deleted.	Accepted. We have revised the wording and also attempted to quantify "significant" based on the cited reference.	Jonathan Cobb	World Nuclear Association	United Kingdom (of Great Britain and Northern Ireland)
48103	41	29	41	30	"In the USA, nuclear is expected to contribute 23% of CO2 reductions needed to reduce GHG emissions by 80% from 2005 levels by 2050 (Victor et al. 2018)." This claim is nonsensical. Nuclear today provides only 19% of U.S. electricity, and electricity is only 20% of end-use energy, so nuclear provides only 3.8% of U.S. end-use energy. There are only 2 reactors under construction in the US, and both will take 14-16 years between planning and operation and far more plants will retire than will be built during the next 20 years. Nuclear costs 5x new wind/solar (Lazard, 2020) and takes 8-18 years longer between planning and operation. Hardly anything will be built. As a result, it is nearly impossible for new nuclear to contribute to solving US climate emissions problem. Please remove this comment.	Noted. This statement is a finding from the peer-reviewed paper cited, and we have added text to clearly indicate the finding is a possibility from this particular analysis.	Mark Jacobson	Stanford University	United States of America
55281	41	29	41	31	Nuclear today provides 20-25% of U.S. power. Does this mean that the U.S. will expand to 50% nuclear? It takes at least 20 years to get a new nuclear plant approved and built - at best.	Noted. This statement is a finding from the peer-reviewed paper cited, and we have added text to clearly indicate the finding is a possibility from this particular analysis.	Government of United States of America	U.S. Department of State	United States of America
76601	41	29	41	31	These projections about nuclear capacity increase in the USA are at odds with the current state of the art and the recent literature. With only 2 reactors being built in the US (and more than 5 years behind schedule) and an ageing fleet, unable to endure competition with the falling costs of renewable energies, nuclear power would rather be expected to decrease. See also the conclusion of Morgan et al. : "Barring some dramatic policy changes, it is most unlikely that nuclear power will be able to contribute to decarbonization in the United States, much less provide a new carbon-free wedge on the critical time scale of the next several decades." Other studies also suggest meeting a 80% reduction of GHG emissions by 2050 in the USA is feasible with a reduced share or even a phaseout of nuclear power. See also Gowrishankar, V. and Levin, A., 2017, America's Clean Energy Frontier: The Pathway to a Safer Climate Future. Natural Resources Defense Council, or Aghahosseini A, Bogdanov D, Breyer C. "A Techno-Economic Study of an Entirely Renewable Energy-Based Power Supply for North America for 2030 Conditions." Energies. 2017; 10(8):1171. https://doi.org/10.3390/en10081171	Accepted. We have added text to clarify this was a finding from a specific cited analysis. We have added the new reference and point about nuclear having limited role in other analyses.	Charlotte MIJEON	Réseau "Sortir du nucléaire" (organization affiliated to the French Climate Action Network)	France
72769	41	32	41	33	These are projections, not facts. Please reword carefully	Accepted. We have revised the language.	Matthew Gidden	Climate Analytics	Germany
61713	41	35	41	36	"France developed its nuclear strategy in response to energy security concerns after the 1970s Oil Crisis, but has now committed to reducing nuclear power generation to 50% by 2035 (Millot et al. 2020)." Please revise and expand to give a better overall picture. While some of the older reactors will be shut down, likely in the late 2020s, new and bigger reactors (EPR) are also being discussed and planned to replace them. As the French economy electrifies further, the annual nuclear production should remain at roughly current levels. A significant part of nuclear electricity might also be diverted into clean hydrogen production as France has stated a target of 6.5 GW of electrolyser capacity by 2030. (See https://www.economie.gouv.fr/presentation-strategie-nationale-developpement-hydrogene-decarbone-france)	Accepted. We have revised the language to indicate the reduction is in nuclear share of power generation, not total nuclear generation.	Rauli Partanen	Think Atom	Finland
84447	41	35	41	36	The commitment in France to reduce the nuclear share to 50% takes into account an expected increase i electricity use, so does not necessarily mean a reduction of the nuclear power use in absolute terms.	Accepted. We have rephrased the language.	Mattias Lantz	Uppsala university	Sweden
76603	41	37	41	38	A revival of nuclear power in Italy seems highly unlikely and not worth being mentioned, since it would mean going against strong social preferences expressed twice by referendum (1986 and 2011) and ignoring the seismic nature of the peninsula. The nuclear option is not included in any mitigation scenario that the Italian government is taking into account in its 2030 National Energy and Climate Plan.	Accepted. We have deleted the Italy example.	Charlotte MIJEON	Réseau "Sortir du nucléaire" (organization affiliated to the French Climate Action Network)	France
76605	41	38	41	40	This sentence is policy prescriptive	Accepted. We have deleted the Italy example.	Charlotte MIJEON	Réseau "Sortir du nucléaire" (organization affiliated to the French Climate Action Network)	France
83121	41	41	41	41	it's either net zero CO2 or carbon neutrality	Accepted. We have revised it to net zero GHG emissions in the context of the EU.	Geden Oliver	German Institute for International and Security Affairs	Germany
61723	41	41	42	2	Should note that retaining nuclear in the EU-28 energy mix can reduce the costs by 30% in comparison to a 100%RE scenario (Zappa et al https://doi.org/10.1016/j.apenergy.2018.08.109) and that the EU Commission expects nuclear to contribute a major fraction of the clean energy in 2050 (European Commission https://doi.org/10.2833/10759 and https://doi.org/10.2834/02074 and https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0773&from=EN).	Accepted. Add	Rauli Partanen	Think Atom	Finland

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
61725	41	41	42	2	In stating that that "Some analyses find deep mitigation pathways [...] are possible for [...] Japan [...] without additional nuclear power" it would be useful to point out that several analyses explicitly call for a revived role of nuclear power in Japan (see, e.g., Oshiro et al., 2017, https://doi.org/10.1080/17583004.2017.1396842 ; Kuramochi et al., 2017, https://doi.org/10.1016/j.rser.2016.12.093 ; Saveyn et al., 2012, https://doi.org/10.1016/j.eneco.2012.04.010) all the way up to a 50% share of electricity by 2050 (Ashina et al., 2012, https://doi.org/10.1016/j.enpol.2011.11.020 , Fig. 13).	Accepted. Add	Rauli Partanen	Think Atom	Finland
64155	41	41	42	2	An emission pathway without nuclear power for 80% reduction by 2050 in Japan is feasible also by larger use of gas and CCS in the power sector (Silva Herran et al., 2019 Climate Policy).	Accepted. Add	Diego Silva Herran	National Institute for Environmental Studies	Japan
65757	41	41	42	2	It should be noted that (i) retaining nuclear in the EU-28 energy mix can reduce the costs by 30% in comparison to a 100%RE scenario (Zappa et al https://doi.org/10.1016/j.apenergy.2018.08.109) and that (ii) the EU comission expects nuclear to contribute a major fraction of the clean energy in 2050 (European Commision https://doi.org/10.2833/10759 and https://doi.org/10.2834/02074 and https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0773&from=EN).	Accepted. Add	Eero Hirvijoki	Aalto University	Finland
65759	41	41	42	2	In stating that that "Some analyses find deep mitigation pathways [...] are possible for [...] Japan [...] without additional nuclear power" it would be useful to point out that several analyses explicitly call for a revived role of nuclear power in Japan (see, e.g., Oshiro et al., 2017, https://doi.org/10.1080/17583004.2017.1396842 ; Kuramochi et al., 2017, https://doi.org/10.1016/j.rser.2016.12.093 ; Saveyn et al., 2012, https://doi.org/10.1016/j.eneco.2012.04.010) all the way up to a 50% share of electricity by 2050 (Ashina et al., 2012, https://doi.org/10.1016/j.enpol.2011.11.020 , Fig. 13).	Accepted. Add	Eero Hirvijoki	Aalto University	Finland
14963	42	3			This subsection is unacceptable for several reasons and highlights fundamental scientific concerns with section 4.2.5. "CCS may be needed [...]" is as unscientific as it gets and cannot be presented as part of an IPCC assessment. Please provide a quantitative assessment of technological options, clearly separating research results from national policy plans/promises. Currently this is mixed, which is highly problematic and cannot be kept as it is. A thorough overhaul of this section is needed.	Partially accepted. We have revised the language to distinguish findings from existing scenario analysis in the literature from targets or plans.	Government of Saint Kitts and Nevis	Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements	Saint Kitts and Nevis
397	42	5	42	38	Greater energy efficiency in refrigeration and air-conditioning equipment is part of an overall plan for climate change mitigation. An important part of improved efficiency for mitigation planning is reduction of short-lived climate forcers (SLCF). Section 4.2.5.15 (page 46) notes that recent research indicates temperature increases will likely exceed 1.5°C during the 2030s and 2°C by mid-century unless both SLCFs and CO2 emissions are reduced. With increasing temperatures worldwide due to climate change, improved energy efficiency is of paramount importance. Improved efficiency of refrigeration and air-conditioning equipment with phase-down of hydrofluorocarbons (HFC) will reduce future radiative forcing. Section 4.2.5.7 provides general information on SLCF reduction, but it does not cite literature on current reduction rates projected for SLCF in the short- or mid-term. These data are necessary to determine the relative significance of SLCF reduction to other climate change mitigation efforts to limit global warming during the next 30 years to well below 2°C, and to pursue limiting global warming to 1.5°C above average pre-industrial temperature levels.	Taken into account. Literature on SLCF is assessed in 4.2.5, whereas energy efficiency and demand side more generally is assessed in chapter 5. The reviewer provides no specific literature assessing the interactions of efficiency and SLCF	Michael Kenish	Rutgers University	United States of America
48423	42	5	42	38	I suggest adding figure on the SLCF and non-CO2 GHG emissions included in the AR6 scenario database by region, and adding summary of the emission trends, like energy-CO2 emission pathways in the Figure 4.2.	Taken into account. Regional disaggregation is assessed in chapter 2 for trends, and chapter 3 for long-term projections.	Ken Oshiro	Kyoto University	Japan
86227	42	5	42	5	HFCs with short lifetimes are part of the SLCFs, maybe here make clearer that what you call benefit on SLCFs is benefits on air pollutants.	Accepted. The language has been revised per other review comments.	Sophie Szopa	LSCE	France
18143	42	5	43	12	Section titled "Efficient buildings, cooler in summer, warmer in winter" is very heating focused. It does not currently include text or examples covering cooling, but there is an opportunity here to demonstrate how efficient building design can keep buildings naturally cool. And/or how water efficiency measures can support mitigation and adaptation objectives. Suggest authors include an example (shading, ventilation, insulation of hot pipes etc) to fill this gap. Equally the section above on "Sustainable Cooling" needs to reference building design as the first principle of sustainable cooling - minimising the need for active cooling from the offset. Could be beneficial to reference the cooling hierarchy in this section (as promoted by eg World Bank Cool Coalition amongst others).	Noted. This may be discussed further in the buildings chapter. The emphasis here is on heating based on the studies cited and there is a separate subsection on cooling (primarily focused on cooling efficiency). Unfortunately no references were provided to add insights about passive cooling or design changes.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
315	42	8	42	8	The sentence "...benefits for climate mitigation as well as short-lived climate forcers (SLCF) reduction..." should read better as "...benefits for climate mitigation as well as for air quality and human health..." In fact, the reduction of SLCFs is not per-se a benefit to be compared to climate mitigation.	Accepted. Revise language	Sandro Fuzzi	ISAC CNR	Italy
80619	42	25	42	38	Note that pairing the HFC phase-down with improving the energy efficiency of cooling could double or even triple the mid-century climate benefits in carbon equivalent terms. The Global Cooling Prize launched in 2018 has demonstrated that multiple prototypes are able to meet the prize criteria of 5X lower climate impacts (from energy use and refrigerant gas) (see https://globalcoolingprize.org/ -- winner(s) will be announced April 29, 2021). CITATION: Dreyfus G., Borgford-Parnell N., Christensen J., Fahey D.W., Motherway B., Peters T., Picolotti R., Shah N., & Xu Y. (2020) Assessment of Climate and Development Benefits of Efficient and Climate-Friendly Cooling. Accessed at https://cecoalition.org/cooling-policy . Purohit P., Höglund-Isaksson L., Dulac J., Shah N., Wei M., Rafaj P., & Schöpp W. (2020) Electricity savings and greenhouse gas emission reductions from global phase-down of hydrofluorocarbons, Atmospheric Chemistry and Physics 20(19): 11305–11327. Accessed at https://acp.copernicus.org/articles/20/11305/2020/ . ("The combined effect of HFC phase-down, energy efficiency improvement of the stationary cooling technologies, and future changes in the electricity generation fuel mix would prevent between 411 and 631 PgCO2 equivalent of GHG emissions between 2018 and 2100, thereby making a significant contribution towards keeping the global temperature rise below 2 °C.").	Noted. This specific instance is beyond the general scope of this section.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
80763	42	25	42	38	Note that pairing the HFC phase-down with improving the energy efficiency of cooling could double or even triple the mid-century climate benefits in carbon equivalent terms. The Global Cooling Prize launched in 2018 has demonstrated that multiple prototypes are able to meet the prize criteria of 5X lower climate impacts (from energy use and refrigerant gas) (see https://globalcoolingprize.org/ -- winner(s) will be announced April 29, 2021). CITATION: Dreyfus G., Borgford-Parnell N., Christensen J., Fahey D.W., Motherway B., Peters T., Picolotti R., Shah N., & Xu Y. (2020) Assessment of Climate and Development Benefits of Efficient and Climate-Friendly Cooling. Accessed at https://cecoalition.org/cooling-policy . Purohit P., Höglund-Isaksson L., Dulac J., Shah N., Wei M., Rafaj P., & Schöpp W. (2020) Electricity savings and greenhouse gas emission reductions from global phase-down of hydrofluorocarbons, Atmospheric Chemistry and Physics 20(19): 11305–11327. Accessed at https://acp.copernicus.org/articles/20/11305/2020/ . ("The combined effect of HFC phase-down, energy efficiency improvement of the stationary cooling technologies, and future changes in the electricity generation fuel mix would prevent between 411 and 631 PgCO2 equivalent of GHG emissions between 2018 and 2100, thereby making a significant contribution towards keeping the global temperature rise below 2 °C.").	Noted. This specific instance is beyond the general scope of this section.	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
48105	42	40	42	41	"Countries in cold regions often focus more on building sector GHG emissions mitigation measures such as improving building envelopes and home appliances, and electrifying space heating and water heating." This new paper seems relevant for this section: Jacobson, M.Z., On the correlation between building heat demand and wind energy supply and how it helps to avoid blackouts, Smart Energy, 2021	Noted.	Mark Jacobson	Stanford University	United States of America
50011	42	42	42	43	Sakamoto et al. (2021, https://doi.org/10.1007/s11625-021-00935-w) also find buildings electrification as a robust strategy across models	Accepted. Added reference	Masahiro Sugiyama	University of Tokyo	Japan

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
16933	43	3	43	6	In its long-term strategy for 2050, the European Commission recognises the need for a near-complete decarbonisation of the building sector to meet its climate goals	Accepted. We have added text and a related reference.	Government of Spain	Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica	Spain
72771	43	13			This subsection appears to be not comprehensive and the title is too narrow. What about changing transport systems? public transport / cycling and walking?	Noted. This is captured in the subsequent section, as this first of 2 transport sections focuses explicitly on electrification.	Matthew Gidden	Climate Analytics	Germany
78153	43	13			This subsection appears to be not comprehensive and the title is too narrow. What about changing transport systems? public transport / cycling and walking?	Noted. This is captured in the subsequent section, as this first of 2 transport sections focuses explicitly on electrification.	Charlotte Plinke	Climate Analytics	Germany
48425	43	13	43	32	I suggest adding figures on electrification rate in energy demand sectors for each region based on the national scenarios in the AR6 scenario database. Also, electrification is effective to accelerate mitigation not only in the transport but buildings sector.	Noted. Despite efforts to collect scenarios from national modeling for AR6, with more granularity, we do not have data to add this figure.	Ken Oshiro	Kyoto University	Japan
49707	43	13	43	32	Earlier (page 37, line 27) it was stated that "reducing energy use in all energy demand sectors" is a required accelerated mitigation option but then there's little content and none example about it. For transport, the section can be expanded to include examples by a few countries, as summarised on page 373 of the referenced article below. For instance, it shows the "Improve measures" for the following countries (with % corresponding to 2050 reduction relative to BAU): Brazil (59.3%), Germany (71.0%) and Canada (96.4%). Details are provided in the source: Gota, S., Huizenga, C., Peet, K. et al. Decarbonising transport to achieve Paris Agreement targets. Energy Efficiency 12, 363–386 (2019). https://doi.org/10.1007/s12053-018-9671-3	Accepted. Add reference	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
52081	43	13	43	32	claiming that the electrification of transportation, hydrogen, and biofuel are the only way to decarbonize the sector while totally exclude the ICEs from the scene. Other options should be included.	Noted. We do not claim that electrification is the only way to decarbonize transport, but rather, that it is one common theme for decarbonizing transportation. The following subsection discusses additional strategies for decarbonizing transport that could be based on ICEs.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
76453	43	13	43	32	Hydrogen and synthetic fuels are energy carriers and not primary energy sources. Nuclear energy remains the most economic means of obtaining the electricity to enable these transport fuels to be manufactured	Noted. Reviewer states a view, without providing substantiation or literature	Robert Parker	Nuclear for Climate Australia	Australia
79447	43	13	43	32	Earlier (page 37, line 27) it was stated that "reducing energy use in all energy demand sectors" is a required accelerated mitigation option but then there's little content and none example about it. For transport, the section can be expanded to include examples by a few countries, as summarised on page 373 of the referenced article below. e.g. it shows that "Improve measures" for the following countries (with % corresponding to 2050 reduction relative to BAU): Brazil (59.3%), Germany (71.0%) and Canada (96.4%). Details are provided in the source: Gota, S., Huizenga, C., Peet, K. et al. Decarbonising transport to achieve Paris Agreement targets. Energy Efficiency 12, 363–386 (2019). https://doi.org/10.1007/s12053-018-9671-3	Accepted. Add reference	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
37055	43	14	43	15	Prior to electrification of transport, there is need of decarbonisation of electricity.	Noted. We recognized this with "in tandem with power sector decarbonisation"	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
20197	43	14	43	17	Although spillover (e.g. passenger LDV to shipping) has been found possible, e.g. in Norway. Koussids, K., Karamameas, A., Nikas, A., Neofytou, H., Hermanson, E. A., Vaillancourt, K., & Djojias, H. (2020). Many miles to Paris: A sectoral innovation system analysis of the transport sector in norway and canada in light of the Paris Agreement. Sustainability, 12(4), 5832.	Noted. We did not focus on shipping in this subsection so have not added this reference, but it may be more relevant in the transport chapter.	Nikas Alexandros	National Technical University of Athens	Greece
5119	43	18	43	18	See comment before. Again you refer to Schmid and Knopf while more up-to-date sources are available. Also, "widespread" might not be exact even though the government aims for 7-10 million electric vehicles until 2030 (which still is not the majority of privately owned vehicles)	Accepted. We have deleted the old reference and update the text with a new reference.	Lina Hollender	n/a	Germany
45871	43	18	43	18	Old quote. Still accurate?	Accepted. We have deleted the old reference and update the text with a new reference.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
83123	43	18	43	18	Given the massive delay in passenger transport electrification in Germany, this claim seems to be outdated. There should be more recent literature on this. You could use the already cited Görtz et al. 2020 study (https://www.agora-energiewende.de/en/publications/towards-a-climate-neutral-germany-executive-summary/) as a starting point	Accepted. We have deleted the old reference and update the text with a new reference.	Geden Oliver	German Institute for International and Security Affairs	Germany
16935	43	18	43	23	In its long-term strategy for 2050, the European Commission recognises the need for a near-complete decarbonisation of the transport sector to meet its climate goals	Accepted.	Government of Spain	Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transicion Ecologica	Spain
55283	43	20	43	21	This citation needs to be trimmed back to Ducha et al. (2019).	Noted. The citation format is based on the citation software used.	Government of United States of America	U.S. Department of State	United States of America
55285	43	23	43	23	This citation needs to be trimmed back to Ducha et al. (2019).	Noted. The citation format is based on the citation software used.	Government of United States of America	U.S. Department of State	United States of America
49709	43	24	43	32	There are various more quick-wins for transport decarbonisation, some useful examples from low-income countries can be found here: Bakker, S.; Haq, G.; Peet, K.; Gota, S.; Medimorec, N.; Yiu, A.; Jennings, G.; Rogers, J. Low-Carbon Quick Wins: Integrating Short-Term Sustainable Transport Options in Climate Policy in Low-Income Countries. Sustainability 2019, 11, 4369. https://doi.org/10.3390/su11164369 https://www.mdpi.com/2071-1050/11/16/4369	Reject. Chapter 11 assesses literature on transport decarbonisation	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
79449	43	24	43	32	There are various more quick-wins for transport decarbonisation, some useful examples from low-income countries can be found here: Bakker, S.; Haq, G.; Peet, K.; Gota, S.; Medimorec, N.; Yiu, A.; Jennings, G.; Rogers, J. Low-Carbon Quick Wins: Integrating Short-Term Sustainable Transport Options in Climate Policy in Low-Income Countries. Sustainability 2019, 11, 4369. https://doi.org/10.3390/su11164369 https://www.mdpi.com/2071-1050/11/16/4369	Reject. Chapter 11 assesses literature on transport decarbonisation	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
20669	43	33	43	33	Please consider mentioning low tech as well. Low Appetite for High Tech: When the Indifference of Inhabitants to Digital Mobilities Impedes a Smart Suburbs Project Claire Tollis (LVMT, Univ Gustave Eiffel, IFSTTAR, UPEM, ENPC, Marne-la-Vallée, France), Alain L'Hostis (LVMT, Univ Gustave Eiffel, IFSTTAR, UPEM, ENPC, Marne-la-Vallée, France) and Redha Boubakour (Université Paris-Est - IFSTTAR-AME-DEST, Paris, France) Source Title: International Journal of Urban Planning and Smart Cities (IJUPSC) (1) 2020 Pages: 13 DOI: 10.4018/IJUPSC.2020010104	Reject. Chapter 11 assesses literature on transport decarbonisation (whether low or high tech)	Government of France	Ministère de la Transition écologique et solidaire	France
84499	43	33	44	6	The emphasis on the urban context within accelerated mitigation pathways is very appropriate while a sustainable urban system planning perspective can also be emphasized in section 4.2.5.10 beyond an emphasis on ICT.	Accept. We have revised the text to include urban system planning and added related references.	Siir KILKIS	The Scientific and Technological Research Council of Turkey	Turkey
61729	44	7	44	26	Heating is rightly recognized as one of the key areas to reduce emissions in housing. Nuclear energy's significant potential in providing low-carbon and low-cost district heating should be recognized and discussed. In China, district heating with nuclear already has "social, environmental, and economic benefits" (Chen et al., 2021. https://doi.org/10.1016/j.energy.2020.119546). Nuclear can be implemented into existing networks, enabling large urban communities to switch into clean heating with minimal changes to the infrastructure and even at negative costs (see Lindroos et al. 2019, https://doi.org/10.1080/15567249.2019.1595223 ; Viiri et al. 2019, https://doi.org/10.3390/en12112195 and Teräsvirta et al. 2020, https://doi.org/10.3390/en13153782). Some of these benefits have already materialized (https://www.world-nuclear-news.org/Articles/Haiyang-begins-commercial-scale-district-heat-supply) and should be mentioned and emphasized in the report.	Accepted. We have added this point and associated reference.	Rauli Partanen	Think Atom	Finland

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
65763	44	7	44	26	Heating is rightly recognized as a key area to reduce emissions. Nevertheless, the report unjustly dismisses nuclear in this matter. In China, district heating with nuclear already has "social, environmental, and economic benefits" (Chen et al., 2021, https://doi.org/10.1016/j.energy.2020.119546). Nuclear district heating can be implemented into existing heating networks, enabling large urban communities to switch into clean heating with minimal changes to the infrastructure (Lindros et al. 2019, https://doi.org/10.1080/15567249.2019.1595223 ; Varsi et al. 2019, https://doi.org/10.3390/en11121915 ; Teräsvirta et al. 2020, https://doi.org/10.3390/en13153782). This is especially viable by retrofitting existing nuclear plants with turbine bypass systems directing some of the steam to a district heating network. These benefits have already materialized (https://www.world-nuclear-news.org/Articles/Haiyang-begins-commercial-scale-district-heat-supply) and should be mentioned and emphasized in the report.	Accepted. We have added this point and associated reference.	Eero Hirvijoki	Aalto University	Finland
12009	44	7	44	27	Buildings move to net-zero could be enhanced by the embedding of carbon in building materials (i.e., building with biomass). This is not referenced in the section. McLaren (2012) has suggested between 0.5 and 1 GtCO2 per annum could be sequestered by building with biomass in place of conventional materials, whilst Oliver (Oliver, 2014) indicates that the approach could save between 12% to 19% of global fossil fuel use. See the Royal Society review of greenhouse gas removal for an overview. MCLAREN, D. 2012. A comparative global assessment of potential negative emissions technologies. Process Safety and Environmental Protection, 90, 489-500. GEDEEN, O., 2020. Unconventional Mitigation Carbon Dioxide Removal as a New Approach in EU Climate Policy. In: Affairs (ed.) SWP Research Paper 2020/RP 08 and RS/RAE 2018. Greenhouse Gas Removal. London: Royal Society and Royal Academy of Engineering	Taken into account. Assessed in buildings chapter	Paul Rouse	Carnegie Climate Governance Initiative (C2G) - The Carnegie Council for Ethics and International Affairs	United Kingdom (of Great Britain and Northern Ireland)
52083	44	7	44	29	phasing out fossil fuels and ignoring their cleaner technologies in energy buildings to achieve net zero by 2050. These should be included.	Noted. Reviewer states a view, without providing substantiation or literature	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
71435	44	11	44	13	The statement is not correct. The EU has already implemented an obligation for Member State to set the level for all new buildings (not just public buildings) at Near Zero Buildings from the start of 2021 (not at 2030). It is recommended to cite here the following article, which provides the details: M. Economidou, V. Todeschi, P. Bertoldi, D. D'Agostino, P. Zangheri, L. Castellazzi, Review of 50 years of EU energy efficiency policies for buildings, Energy and Buildings, Volume 225, 2020, ISSN 0378-7788, https://doi.org/10.1016/j.enbuild.2020.110322 . (https://www.sciencedirect.com/science/article/pii/S0378778820317229)	Accepted. We have revised the text.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72277	44	11	44	13	The statement is not correct. The EU has already implemented an obligation for Member State to set the level for all new buildings (not just public buildings) at Near Zero Buildings from the start of 2021 (not at 2030). It is recommended to cite here the following article, which provides the details: M. Economidou, V. Todeschi, P. Bertoldi, D. D'Agostino, P. Zangheri, L. Castellazzi, Review of 50years of EU energy efficiency policies for buildings, Energy and Buildings, Volume 225, 2020, 110322, https://doi.org/10.1016/j.enbuild.2020.110322 . (https://www.sciencedirect.com/science/article/pii/S0378778820317229)	Accepted. We have revised the text.	bertoldi paolo	europaen commission	Italy
16937	44	18	44	20	Not only subnational regions in Spain have set local commitments to achieving net zero carbon new buildings by 2050, but also at national level (Spanish Long Term Decarbonization Strategy) and Estrategia a largo plazo para la rehabilitación energética en el sector de la edificación en España (https://www.mitma.gob.es/el-ministerio/planes-estrategicos/estrategia-a-largo-plazo-para-la-rehabilitacion-energetica-en-el-sector-de-la-edificacion-en-espana)	Accepted. We have revised the text.	Government of Spain	Area de Estrategias de Adaptacion - Oficina de Cambio Climatico - Ministerio de la Transición Ecológica	Spain
71437	44	21	44	22	Again here the statement is not correct. In the EU since 2014 it is mandatory to refurbish 30% of central government public buildings, but there is no obligation to reach net or near zero energy. It is recommended to cite here the following article, which provides the details: M. Economidou, V. Todeschi, P. Bertoldi, D. D'Agostino, P. Zangheri, L. Castellazzi, Review of 50 years of EU energy efficiency policies for buildings, Energy and Buildings, Volume 225, 2020, ISSN 0378-7788, https://doi.org/10.1016/j.enbuild.2020.110322 . (https://www.sciencedirect.com/science/article/pii/S0378778820317229)	Accepted, we have deleted the sentence	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72279	44	21	44	22	Again, here the statement is not correct. In the EU since 2014 it is mandatory to refurbish 3% of central government public buildings per year, but there is no obligation to reach net or near zero energy. It is recommended to cite here the following article, which provides the details: M. Economidou, V. Todeschi, P. Bertoldi, D. D'Agostino, P. Zangheri, L. Castellazzi, Review of 50years of EU energy efficiency policies for buildings, Energy and Buildings, Volume 225, 2020, 110322, https://doi.org/10.1016/j.enbuild.2020.110322 . (https://www.sciencedirect.com/science/article/pii/S0378778820317229)	Accepted, we have deleted the sentence	bertoldi paolo	europaen commission	Italy
71439	44	23	44	24	Again the reviewer finds the statement not fully correct. In the EU the 2018 amendment of the Directives EPBD requires all Member States to establish a comprehensive strategy aimed at achieving a highly efficient decarbonised building stock by 2050 and cost-effective transformation of existing buildings into NZEBs. In 2020 the national Long Term Strategies have been submitted. You could cite the following paper M. Economidou, V. Todeschi, P. Bertoldi, D. D'Agostino, P. Zangheri, L. Castellazzi, Review of 50 years of EU energy efficiency policies for buildings, Energy and Buildings, Volume 225, 2020, ISSN 0378-7788, https://doi.org/10.1016/j.enbuild.2020.110322 . (https://www.sciencedirect.com/science/article/pii/S0378778820317229)	Accepted. We have revised text and updated reference.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72281	44	23	44	24	Again, the reviewer finds the statement not fully correct. In the EU the 2018 amendment of the Directives EPBD requires all Member States to establish a comprehensive strategy aimed at achieving a highly efficient decarbonised building stock by 2050 and cost-effective transformation of existing buildings into NZEBs. In 2020 the National Long Term Strategies have been submitted. You shall cite the following paper: M. Economidou, V. Todeschi, P. Bertoldi, D. D'Agostino, P. Zangheri, L. Castellazzi, Review of 50years of EU energy efficiency policies for buildings, Energy and Buildings, Volume 225, 2020, 110322, https://doi.org/10.1016/j.enbuild.2020.110322 . (https://www.sciencedirect.com/science/article/pii/S0378778820317229)	Accepted. We have revised text and updated reference.	bertoldi paolo	europaen commission	Italy

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
61731	45	1	45	27	Section 4.2.5.12, "Industrial energy efficiency", mentions several times clean heat for industrial processes. There is very significant potential for providing industrial heat reliably and affordably with advanced small nuclear reactors that are now under development and are entering the market starting in the 2020s. This potential should be mentioned, as they are among the very few ways to provide scalable high-quality heat at affordable (comparable to fossil fuel combustion) costs.	Noted. We did not come across this example in the literature we found and there is no specific literature provided here to review and add. Assessed in the industry chapter	Rauli Partanen	Think Atom	Finland
65765	45	1	45	27	Section 4.2.5.12, "Industrial energy efficiency", mentions several times clean heat for industrial processes but no nuclear in this context. Nevertheless, several small-modular-reactor designs are devoted for providing high-grade industrial heat. Revise and add the information regarding small modular reactors.	Noted. We did not come across this example in the literature we found and there is no specific literature provided here to review and add. Assessed in the industry chapter	Eero Hirvijoki	Aalto University	Finland
76455	45	5	45	25	To achieve significant CO2 reductions in industry and especially in China will require a significant expansion of nuclear energy capacity. In China the HTR-PM high temperature nuclear power plant is being constructed to enable high efficiency thermolytic splitting of water to produce hydrogen for steel making. Similarly in India, the national expansion of the nuclear sector is underway to facilitate an industrial transformation.	Noted. We did not come across this example in the literature we found and there is no specific literature provided here to review and add. Assessed in the industry chapter	Robert Parker	Nuclear for Climate Australia	Australia
5273	45	5	45	5	Add "nuclear" after renewable!	Reject. The cited paper did not consider nuclear; renewable here refers to solar thermal.	Michel SIMON	Retraité/ Pdt d'association	France
5275	45	12	45	13	In India, Nuclear development is officially recognized as necessary for the industrial sector.	Reject. India considers nuclear as well as other decarbonisation choices eg. RE as contributors to its NDC objectives, but we need not include it specifically as such. Rewording in line 3-5, to include nuclear is suggested.	Michel SIMON	Retraité/ Pdt d'association	France
37057	45	12	45	13	CCS is often associated with increased costs and resulting in high tariff.	Noted. Language around CCS to reflect the high cost and uncertainty related to CCS	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37059	45	12	45	13	For example, using CCS for 200 GW installed capacity may not be economically feasible.	Reject. Here we make broad based statements on the necessary options that literature suggests - we do not talk about any levels	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37061	45	12	45	13	There are strong concerns towards economic viability for CCS in India,	Agreed - literature reflects the concerns regarding economic as well as technical viability of CCS in India, have assessed.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37063	45	12	45	13	making policy incentives a crucial precondition for technology commercialization.	Noted	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37065	45	12	45	13	"Viebahn, P., Vallentin, D., and Höller, S., Prospects of carbon capture and	Accepted. Addressed by adding a general statement at the start of 4.2.5.2 viz depending on country specific contexts regarding economic and technological viability , alternative low carbon choices including gas, nuclear, hydro, biofuels and RE may have varying roles to play across regions and over	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37067	45	12	45	13	storage (CCS) in China's power sector - An integrated assessment. Appl. Energy, 2015."	Accepted. Revised text to include the concerns regarding CCS. Viebahn et al 2014 specific to India also reviewed and text added in CCS section of 4.2.2.5.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37513	45	12	45	13	other studies for India do not consider CCS but include gas and other low carbon options (Mathur R & Shekhar S, 2020)	Accepted. Depending on country specific contexts regarding economic and technological viability , alternative low carbon choices including gas, nuclear, hydro, biofuels and RE may have varying roles to play across regions and over time.	Government of India	Ministry of Environment, Forests and Climate Change	India
37535	45	12	45	13	"In India, renewable energy and CCS are needed for the industrial sector to achieve 1.5°C and 2°C compatible pathways in 2050". Policy prescriptive sentence- should be removed.	Accepted. We have revised the language.	Government of India	Ministry of Environment, Forests and Climate Change	India
20199	45	14	45	17	Another references here: Koussidis, K., Nikas, A., Neofytou, H., Karamaneas, A., Gambhir, A., Wachsmuth, J., & Doukas, H. (2020). The UK and German low-carbon industry transitions from a sectoral innovation and system failures perspective Energies, 13(19), 4994.	Accepted. Added.	Nikas Alexandros	National Technical University of Athens	Greece
5277	45	17	45	17	Add at the end of paragrah. Nevertheless, if hydrogen is to be produced by electrolysis, the lectricity must be carbon free, and produced at reasonable cost, a constraint which may be in conflict with social acceptance of nuclear energy.	Noted.	Michel SIMON	Retraité/ Pdt d'association	France
55287	45	20	45	23	This is an important point that should be elevated to the SPM.	Noted. This is a comment for the SPM.	Government of United States of America	U.S. Department of State	United States of America
55289	45	20	45	27	This paragraph provides a good argument to become more aggressive with known solutions.	Noted.	Government of United States of America	U.S. Department of State	United States of America
317	45	26	45	26	the term should be "short-lived climate forcers" (all pollutants are short-lived). Also, the reduction of SLCFs is not per-se benefit. The benefit is the environmental effect that this reduction causes, i.e. the decrease of air pollution and the deleterious effects on human health.	Accepted. The language has been revised.	Sandro Fuzzi	ISAC CNR	Italy
55291	45	28	45	28	This subsection speaks to the role of equity between developed and developing countries. In as much as demand for fossil fuels or products with high carbon footprints are critical drivers of GCC in developed countries, a carbon price reflects a natural way to decrease carbon. This is only an example but reflects sacrifices that need to be made by wealthier countries or wealthier people within countries -- that can either be mandated through policy or potentially promoted through other means. Section 4.3.2 does this quite well and it might be worth pointing ahead to that here.	Noted. This point is covered in section 4.3.2.	Government of United States of America	U.S. Department of State	United States of America
48419	45	28	46	8	Some national studies have also focused on the role of energy demand reduction in the national mitigation target. For example, Oshiro et al. indicated that final energy demand in 2050 can be cut by 37% relative to the baseline through energy service demand reduction measures, and it can offset the economic impacts due to the constraint on energy supply side technology availability, such as limited use of CCS. * Oshiro, K. et al. Enabling energy system transition toward decarbonization in Japan through energy service demand reduction, Energy (in review)	Accepted. Added.	Ken Oshiro	Kyoto University	Japan
55293	45	28	46	8	This subsection on lowering long-term energy demand brings in important points, but fails to acknowledge that population growth over the long-term is a key driver of demand -- one that is far from fixed and responsive to other development drivers (education, healthcare access, etc.). See the latest UN population projections: https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf O'Neill et al., 2010, https://www.pnas.org/content/107/41/117521?ijkey=8e23bbee5e0153b6aa83983d970185af72b2d&keytype=tf_ipsecsh a Bradshaw and Brook, 2015, https://www.pnas.org/content/111/46/16610	Noted. This section focuses on reduction, not directly the drivers of long-term demand. Chapter 2 assesses trends and 5 demand side	Government of United States of America	U.S. Department of State	United States of America
55295	45	29	45	36	Should read "policy pathways that can hold mean planetary temperature increases to..." Also needs an additional sentence like "Most of these pathways rely on changes in consumer demand." Do any of the demand-side pathways depend on reduced demand for land, for example through dietary shifts? The text makes it sound like the only demand issue is energy. See Chapter 7 and cross-reference for evidence that demand for food and land is a huge driver of emissions and that reducing food loss and waste, and shifting diets away from ruminant meat and dairy, could make a big dent in emissions.	Noted. We have added a cross-reference to Chapter 7	Government of United States of America	U.S. Department of State	United States of America
8251	45	29	46	8	When discussing the alternative of also mitigate emission via a decrease of the demand side, important factors such as change of diet and less consumption has currently been left out.	Accepted. We have added dietary changes as an example. Less consumption is implied by some noted strategies such as increased use value from services, and sharing economies.	Frida Zahlander	DanChurchAid	Denmark
52085	45	45	36		imposing higher carbon prices to lower demand will effect the quality of life and economy, and it is not suitable for many countries	Noted. Carbon pricing assessed in chapter 13	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
55297	46	3	46	8	The text states that dominant analytical perspectives are rooted in neoclassical economics. The meaning might be intuitively obvious to economists but isn't necessarily to many others who need the information in this report (policymakers, ecologists, chemists, sociologists). What does this actually mean in plain speak?	Noted. The particular sentence here refers not only to neoclassical economics, but also social psychology, citing Geels 2018. A broader framing of four analytical frameworks is in chapter 1. Dominance of some frameworks is an assessment of literature	Government of United States of America	U.S. Department of State	United States of America
73037	46	8			Add at the end of the paragraph: "One study considers a rapidly declining cap on fossil fuels entering a national economy through domestic extraction and fuel imports, and coping with that decline through a Green New Deal type policy plus rationing of fuel or goods to the degree that also may become necessary. (Edwards & Cox 2020)." (See details in one of the comments above.)	Noted. This may be too specific for the scope of this subsection.	Larry Edwards	Larry Edwards Environmental Consulting	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
399	46	9	46	40	What will be the economic costs of implementing steep mitigation measures worldwide, including technological innovations and their applications that will lead to significant transformations such as decarbonization and the predominance of renewable energy systems? Wealthy countries will push forward with these applications, while poorer countries with limited resources will lag behind. What will this discrepancy do to address the global ramifications of climate change? These issues have not been adequately addressed in this section or other sections of the chapter. In addition, there is a general discussion about the economic costs in the chapter, but there needs to be greater focus on the costs presented in real dollars and quantitative assessment of these dollars.	Noted. The costs discussion is beyond the scope of this subsection but we have added reference to Ch 12 (and 6-11)	Michael Kennish	Rutgers University	United States of America
16305	46	9	46	40	This subsection doesn't seem to fit well here. From 4.2.5.3, each subsection introduces important options and measures to accelerate GHG emissions. The whole part can be better placed after 4.2.5.15, at the end of the section 4.2.	Accepted. Good point on structure of 4.2.5, and we have updated the structure.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
27649	46	16	46	27	The option of carbon circular economy (CCE) could also be considered, as recently adopted by G20 countries.	Noted. But there is no literature provided to incorporate this specific concept.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
3467	46	21	46	21	After "from low carbon cement, or designed to absorb CO2 from the atmosphere.", it is suggested to add a more appropriate reference: Sanjuán, M.A.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. <i>Energies</i> 2019, 12, 2346. https://www.mdpi.com/1996-1073/12/12/2346	Accepted. We have updated the reference.	Miguel Angel Sanjuán	IECA	Spain
10357	46	21	46	21	After "from low carbon cement, or designed to absorb CO2 from the atmosphere.", it is suggested to add a more appropriate reference: Sanjuán, M.A.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. <i>Energies</i> 2019, 12, 2346. https://www.mdpi.com/1996-1073/12/12/2346	Accepted. We have updated the reference.	Aniceto Zaragoza	Oficemen	Spain
11513	46	21	46	21	After "from low carbon cement, or designed to absorb CO2 from the atmosphere.", it is suggested to add a more appropriate reference: Sanjuán, M.A.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. <i>Energies</i> 2019, 12, 2346. https://www.mdpi.com/1996-1073/12/12/2346	Accepted. We have updated the reference.	PEDRO MORA PERIS	UNIVERSITY	Spain
3465	46	22	46	22	This reference is wrong: 43 Faló-Sanjuán, J., N. C. Lammers, H. G. Garcia, and S. J. Bray, 2019: Enhancer Priming Enables Fast and Sustained Transcriptional Responses to Notch Signaling. <i>Dev. Cell</i> , 50, 411-425.e8, https://doi.org/10.1016/j.devcel.2019.07.002 .	Accepted. We have updated the reference.	Miguel Angel Sanjuán	IECA	Spain
10355	46	22	46	22	This reference is wrong: 43 Faló-Sanjuán, J., N. C. Lammers, H. G. Garcia, and S. J. Bray, 2019: Enhancer Priming Enables Fast and Sustained Transcriptional Responses to Notch Signaling. <i>Dev. Cell</i> , 50, 411-425.e8, https://doi.org/10.1016/j.devcel.2019.07.002 .	Accepted. We have updated the reference.	Aniceto Zaragoza	Oficemen	Spain
11511	46	22	46	22	This reference is wrong: 43 Faló-Sanjuán, J., N. C. Lammers, H. G. Garcia, and S. J. Bray, 2019: Enhancer Priming Enables Fast and Sustained Transcriptional Responses to Notch Signaling. <i>Dev. Cell</i> , 50, 411-425.e8, https://doi.org/10.1016/j.devcel.2019.07.002 .	Accepted. We have updated the reference.	PEDRO MORA PERIS	UNIVERSITY	Spain
3469	46	27	46	27	It is suggested to add the following phrase: "The cement industry is defining different Roadmaps in order to achieve the net carbon neutrality by 2050" (Sanjuán et al. 2020) ==> Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. <i>Energies</i> 2020, 13, 3452. https://doi.org/10.3390/en13133452	Noted. This section focuses more on circular economy and material efficiency so this proposed new sentence does not appear to be directly relevant here. It may be more relevant for the industry chapter.	Miguel Angel Sanjuán	IECA	Spain
10359	46	27	46	27	It is suggested to add the following phrase: "The cement industry is defining different Roadmaps in order to achieve the net carbon neutrality by 2050" (Sanjuán et al. 2020) ==> Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. <i>Energies</i> 2020, 13, 3452. https://doi.org/10.3390/en13133452	Noted. This section focuses more on circular economy and material efficiency so this proposed new sentence does not appear to be directly relevant here. It may be more relevant for the industry chapter.	Aniceto Zaragoza	Oficemen	Spain
11515	46	27	46	27	It is suggested to add the following phrase: "The cement industry is defining different Roadmaps in order to achieve the net carbon neutrality by 2050" (Sanjuán et al. 2020) ==> Reference A1. Reference A1: Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry: Sanjuán, M.A.; Argiz, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake in the Roadmap 2050 of the Spanish Cement Industry. <i>Energies</i> 2020, 13, 3452. https://doi.org/10.3390/en13133452	Noted. This section focuses more on circular economy and material efficiency so this proposed new sentence does not appear to be directly relevant here. It may be more relevant for the industry chapter.	PEDRO MORA PERIS	UNIVERSITY	Spain
55299	46	28	46	32	Good to see an example from AFOLU here. It could be developed further with just a couple of sentences to note that land is required for many development and societal priorities including biodiversity conservation, carbon storage in forests and peatlands, food production, and preservation of livelihoods and cultural heritage. Cross-reference the Land SR.	Taken into account. Details on bioenergy in chapter 6 and AFOLU in chapter 7	Government of United States of America	U.S. Department of State	United States of America
5039	46	33	46	33	The authors write "A systems approach is also needed to support...". I suggest they meant "A systemic approach is also needed to support..."	Accepted. We have revised the language.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
55301	46	37	46	40	"makes it difficult to understand what is needed ..." Isn't this an understatement? Without considering the types of interactions described in the above paragraphs, isn't there a decent chance that conclusions from these narrowly bounded models will lead to policy decisions that will have all manner of destructive and undesired outcomes? If that is an overstatement, it would be worth explaining why, even in the absence of a systems treatment, such an outcome is unlikely.	Taken into account. Systems transitions are addressed later in this chapter, and across the Working Group III report	Government of United States of America	U.S. Department of State	United States of America
64277	46	41	47	14	Fugitive methane emissions from the production and transport of fossil fuels should not be considered intractable. Monitoring systems based on satellite imagery can identify the size and location of methane sources along the energy value chain. This data can result in lower emissions from upgraded infrastructure and/or modified operating practices (https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Mapping_methane_emissions_on_a_global_scale).	Accepted. We have revised language to clarify that intractable refers specifically to agricultural methane emissions.	Christian Lelong	Kayros	United Kingdom (of Great Britain and Northern Ireland)

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
80611	46	41	47	28	Policies should also incentivize further participation of corporate actors that develop fast-acting, cost-effective CH4 and N2O reduction measures, especially as concerns over loss in productivity and competitiveness (Blandforth & Hassapoyannes, 2018). For instance, two manure additives by SOP—SOP LAGOON and Star COW—have shown potential to reduce CH4 and N2O emissions (Peterson et al., 2019; Ross, 2020). Nitrogen inhibitors have the potential to reduce agricultural N2O emissions by 12 MtCO2e (GWP100) (U.S. E.P.A. (2019)). See Blandforth, D. and Hassapoyannes, K. The role of agriculture in global GHG mitigation, OECD Food, Agriculture, and Fisheries Papers No. 112 at 36 (“Another challenge associated with technical mitigation options in agriculture relates to risks to food security. This is because the technical mitigation options, focusing on reducing emissions per unit of land or animal, most of the time do not have a significant positive effect on output. In some cases they may even reduce output level (e.g. reduced tillage or reweeding of organic soils) in the absence of compensating changes in productivity. Thus, the required increases in output to meet the anticipated future growth in demand may not be achievable with technical mitigation options under current land use.”). Peterson, C., et al. (2020). Effects of SOP Lagoon Additive on Gaseous Emissions from Stored Liquid Dairy Manure, Sustainability 12: 1–17, 12 (“Compared to the CONT, the HIGH treatment achieved average emission reductions of 22.7% and 14.7% for CH4 and CO2, respectively (p < 0.05). The HIGH vs CONT treatment also showed an emission reduction of 45.4% for N2O.”). Ross E. G., et al. (2020) Effect of SOP “STAR COW” on Enteric Gaseous Emissions and Dairy Cattle Performance, Sustainability 12(24): 1–12, 1 (“The aim of this study was to investigate the efficacy of the commercial feed additive SOP STAR COW (SOP) to reduce enteric emissions from dairy cows and to assess potential impacts on milk production. ... SOP-treated cows over time showed a reduction in CH4 of 20.4% from day 14 to day 42 (p = 0.014), while protein % of the milk was increased (+4.9% from day 0 to day 14 (p = 0.036) and +6.5% from day 0 to day 42 (p = 0.002)).”, Borgonovo F., et al (2019) Improving the Sustainability of Dairy Slurry by A Commercial Additive Treatment, Sustainability 11(18): 4998 (“Ammonia (NH3), methane (CH4), nitrous oxide (N2O), and carbon dioxide (CO2) emissions from livestock farms contribute to negative environmental impacts such as acidification and climate change. A significant part of these emissions is produced from the decomposition of slurry in livestock facilities, during storage and treatment phases. This research aimed at evaluating the effectiveness of the additive “SOP LAGOON” (made of agricultural gypsum processed with proprietary technology) on (i) NH3 and Greenhouse Gas (GHG) emissions, (ii) slurry properties and N loss. Moreover, the Life Cycle Assessment (LCA) method was applied to assess the potential environmental impact associated with stored slurry treated with the additive. Six barrels were filled with 65 L of cattle slurry, of which three were used as a control while the additive was used in the other three. The results indicated that the use of the additive led to a reduction of total nitrogen, nitrates, and GHG emissions. LCA confirmed the higher	Taken into account. This would be better addressed in other chapters focused on policies (13) and trends including in non-CO2 GHGs (ch 2)	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
80755	46	41	47	28	Policies should also incentivize further participation of corporate actors that develop fast-acting, cost-effective CH4 and N2O reduction measures, especially as concerns over loss in productivity and competitiveness (Blandforth & Hassapoyannes, 2018). For instance, two manure additives by SOP—SOP LAGOON and Star COW—have shown potential to reduce CH4 and N2O emissions (Peterson et al., 2019; Ross, 2020). Nitrogen inhibitors have the potential to reduce agricultural N2O emissions by 12 MtCO2e (GWP100) (U.S. E.P.A. (2019)). See Blandforth, D. and Hassapoyannes, K. The role of agriculture in global GHG mitigation, OECD Food, Agriculture, and Fisheries Papers No. 112 at 36 (“Another challenge associated with technical mitigation options in agriculture relates to risks to food security. This is because the technical mitigation options, focusing on reducing emissions per unit of land or animal, most of the time do not have a significant positive effect on output. In some cases they may even reduce output level (e.g. reduced tillage or reweeding of organic soils) in the absence of compensating changes in productivity. Thus, the required increases in output to meet the anticipated future growth in demand may not be achievable with technical mitigation options under current land use.”). Peterson, C., et al. (2020). Effects of SOP Lagoon Additive on Gaseous Emissions from Stored Liquid Dairy Manure, Sustainability 12: 1–17, 12 (“Compared to the CONT, the HIGH treatment achieved average emission reductions of 22.7% and 14.7% for CH4 and CO2, respectively (p < 0.05). The HIGH vs CONT treatment also showed an emission reduction of 45.4% for N2O.”). Ross E. G., et al. (2020) Effect of SOP “STAR COW” on Enteric Gaseous Emissions and Dairy Cattle Performance, Sustainability 12(24): 1–12, 1 (“The aim of this study was to investigate the efficacy of the commercial feed additive SOP STAR COW (SOP) to reduce enteric emissions from dairy cows and to assess potential impacts on milk production. ... SOP-treated cows over time showed a reduction in CH4 of 20.4% from day 14 to day 42 (p = 0.014), while protein % of the milk was increased (+4.9% from day 0 to day 14 (p = 0.036) and +6.5% from day 0 to day 42 (p = 0.002)).”, Borgonovo F., et al (2019) Improving the Sustainability of Dairy Slurry by A Commercial Additive Treatment, Sustainability 11(18): 4998 (“Ammonia (NH3), methane (CH4), nitrous oxide (N2O), and carbon dioxide (CO2) emissions from livestock farms contribute to negative environmental impacts such as acidification and climate change. A significant part of these emissions is produced from the decomposition of slurry in livestock facilities, during storage and treatment phases. This research aimed at evaluating the effectiveness of the additive “SOP LAGOON” (made of agricultural gypsum processed with proprietary technology) on (i) NH3 and Greenhouse Gas (GHG) emissions, (ii) slurry properties and N loss. Moreover, the Life Cycle Assessment (LCA) method was applied to assess the potential environmental impact associated with stored slurry treated with the additive. Six barrels were filled with 65 L of cattle slurry, of which three were used as a control while the additive was used in the other three. The results indicated that the use of the additive led to a reduction of total nitrogen, nitrates, and GHG emissions. LCA confirmed the higher	Noted	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
86231	46	41	47	28	Please also refer to WG1 chapter 6 here. The content seems consistent though. Clarify what is included in SLCFs in the example p47 line 1 as the avoided warming seems high compared with what we find across the SSP (considering only the warming effect of CH4,O3 and HFC, the difference is 0.3°C in 2040 and 0.9°C in 2100, see the executive summary of chapter 6 and section 6.7.3).	Taken into account. Checked consistency	Sophie Szopa	LSCE	France
8253	46	42	47	28	When discussing reduction of methane gases, the change of diet should also be mentioned	Taken into account. This section focuses specifically on co-benefits of SLCF reductions and do not include all mitigation measures for methane. This point is addressed in WG1 chapter 6.	Frida Zahlander	DanChurchAid	Denmark
30475	46	43	46	43	The Shindell reference here is not appropriate. This work has never been replicated.	Noted. This is a peer-reviewed journal article. We have added updated references.	Steven Smith	PNNL/JGCRI	United States of America
86233	46	43	46	43	Note that in the SR1.5, it is said rather unless reduction of CO2 and non-CO2 as it includes N2O and the key SLCF compound is clearly CH4 (when looking in detail in the chapter from Rogelj).	Accepted. We have revised the language to include N2O.	Sophie Szopa	LSCE	France
30477	47	1	47	2	This is out of date. These results have not been replicated. Literature since then has found much smaller impacts from SLCFs, with a consistently significant impact only from methane reduction. See detailed analysis in Smith and Mizrahi (2013) “Near-Term Climate Mitigation by Short-Lived Forcers” 110, 14202-14206. PNAS. doi: 10.1073/pnas.1308470110 (SI) as to some of the issues with these studies. More recent multi-model results find much smaller temperature reductions from SLCF reductions (Smith A et al (2015) https://doi.org/10.5194/acp-15-10529-2015, Smith et al 2020 https://doi.org/10.1007/s10584-020-02794-3)	Noted. We have added the Smith et al. 2020 reference, which also found 0.3-0.7C reduction by 2040 in scenarios reviewed for methane and BC. In our text, we also noted that this reduction is “potentially” possible based on the cited analysis.	Steven Smith	PNNL/JGCRI	United States of America
48107	47	2	47	2	“potentially avoiding warming of up to 0.6°C at 2050...” Please also cite (1)Jacobson, M. Z., Control of fossil-fuel particulate black carbon plus organic matter, possibly the most effective method of slowing global warming, J. Geophys. Res., 107 (D19), 4410, doi:10.1029/2001JD001376, 2002; (2) Jacobson, M.Z., Short-term effects of controlling fossil-fuel soot, biofuel soot and gases, and methane on climate, Arctic ice, and air pollution health, J. Geophys. Res., 115, D14209, doi:10.1029/2009JD013795, 2010.	Noted. However, these references are too dated to include.	Mark Jacobson	Stanford University	United States of America
30479	47	5	47	5	This “Including the co-benefits of reduction of climate forcing adds significantly to the benefits reducing air pollutants” is not accurate in general. As shown in WG I, the net forcing by air pollutants is cooling, so in general, reducing air pollution will cause net warming. Note that the paper referenced here does not come to this conclusion. That paper does not even estimate forcing, it only focuses on emissions.	Accepted. We have deleted this sentence.	Steven Smith	PNNL/JGCRI	United States of America
64279	47	7	47	14	The mitigation potential in the energy sector is significant, and the technology to guide mitigation activities in the field is already available. Eliminating large methane sources from the energy sector with the use of monitoring satellites can eliminate methane sources equivalent to 1 to 2 Gt of CO2.	Accepted. We have revised language to clarify that intractable refers specifically to agricultural methane emissions.	Christian Lelong	Kayrros	United Kingdom (of Great Britain and Northern Ireland)

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
30481	47	9	47	10	This wording "Measures to reduce methane emissions from anthropogenic sources are considered intractable" needs to be refined. Many methane mitigation measure are considered to be highly feasible and low cost. This statement seems to be referring to just agricultural sources.	Accepted. We have revised language to clarify that intractable refers specifically to agricultural methane emissions.	Steven Smith	PNNL/JGCRI	United States of America
55303	47	9	47	11	Explain what "where they sustain livelihoods" means. Does this mean "where methane emissions come from infrastructure used to transmit natural gas used for heating and cooking?" The next phrase suggests opportunities to reduce methane emissions from livestock, and livestock are integral to livelihoods in many parts of the world.	Accepted. We have revised language to clarify that intractable refers specifically to agricultural methane emissions.	Government of United States of America	U.S. Department of State	United States of America
1351	47	13	47	13	Including SLC targets in the NDCs raises several issues: the question of the equivalence metric to compare it to CO2 (Cairn et al. (2019). Improved calculation of warming-equivalent emissions for short-lived climate pollutants), the equity of this metric (Rogelj et al. (2019). Unintentional unfairness when applying new greenhouse gas emissions metrics at country level), the impact on food security (Smith et al. (2013). How much land based greenhouse gas mitigation can be achieved without compromising food security and environmental goals?) and consistency with other climate targets (see NZ's 2050 emission targets)	Noted. This section is discussing consideration of SLCFs in accelerated mitigation pathways, not specifically in NDCs.	Rémi Prudhomme	CIREC	France
20623	47	14	47	14	Including SLC targets in the NDCs raises several issues: the question of the equivalence metric to compare it to CO2 (Cairn et al. (2019). Improved calculation of warming-equivalent emissions for short-lived climate pollutants), the equity of this metric (Rogelj et al. (2019). Unintentional unfairness when applying new greenhouse gas emissions metrics at country level), the impact on food security (Smith et al. (2013). How much land based greenhouse gas mitigation can be achieved without compromising food security and environmental goals?) and consistency with other climate targets (see NZ's 2050 emission targets)	Noted. This section is discussing consideration of SLCFs in accelerated mitigation pathways, not specifically in NDCs.	Government of France	Ministère de la Transition écologique et solidaire	France
30483	47	23	47	25	This statement is not supported by more recent research. BC mitigation has not been found to have large climate benefits overall (although there may be benefits in specific regions where black carbon on snow has significant forcing).	Accepted. We have added more recent references on the weaker impact of BC on climate benefits, and revised the text.	Steven Smith	PNNL/JGCRI	United States of America
55305	47	25	47	25	When the authors determine the near-term critical, state the need to focus heavily on what is available now: renewables and efficiency plus conservation. Also recommend including the associated impacts on employment.	Accepted. We have added this summary sentence to the beginning of the section. Thanks, very useful	Government of United States of America	U.S. Department of State	United States of America
18145	47	25	47	28	Recommend adding a strength of evidence, confidence level here	Accepted. Adding confidence statement	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
30485	47	27	47	28	Some of this literature is out of date and no longer supported by more recent research.	Noted. We have added more updated references to this entire subsection.	Steven Smith	PNNL/JGCRI	United States of America
83581	48	1			The insights of this section are very important and should be more deeply integrated with the presentation of long-term pathways in TS and SPM.	Taken into account. For SPM	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
12011	48	1	70	34	Mitigation options, the subject of this section include (see the Glossary Annex A) 'A technology or practice that reduces greenhouse gas (GHG) emissions or enhances sinks' However, there is no reference in the text to a range of CDR technologies, e.g., DACCS. It would be helpful for these to be added, or for a note to be included explaining their absence from the discussion in the text.	Accepted - will add comment on CDR vis front- vs back-loading of effort	Paul Rouse	Carnegie Climate Governance Initiative (C2G) - The Carnegie Council for Ethics and International Affairs	United Kingdom (of Great Britain and Northern Ireland)
10585	48	3	48	22	These paragraphs emphasize how what people call development pathways may have very different meanings. Regrettably, you neglect to mention the feature common to these descriptions (apparently): all of them are "positive", in the sense that the situation is implicitly "improving" as the pathway is followed. Let me try to make this point clearer: "Development pathway" does not sound as "evolution pathway", does it? Alternate way to frame the question: do you consider a "collapse pathway" as "encompassed" by the "development pathway" expression? Still, collapse pathways deserve to be considered.	Accept - will note can be positive or negative	Philippe Waldeufel	CNRS	France
16307	48	4	49	12	Citations are not properly included where various definitions of development pathways in the literature are discussed.	Rejected. This section is framing following discussions, with in-text citations. In this section, Table 4.7 provides citations	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
78409	48	16	48	22	Refer also to CRDPs from SR15 (if not WG II)	Accepted - noted overlaps with WG2	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
20625	48	26	48	26	Where do the Climate Resilient Development Pathways developed in Volume 2 fit in this mapping exercise?	Accepted - noted overlaps with WG2	Government of France	Ministère de la Transition écologique et solidaire	France
9539	48				4.3 Development pathways and mitigation options: Missing references to resilient farming systems (including livestock production)	Taken into account. Farming systems assessed in 4.4 and chapter 7	Blanca Casares Guillén	EfecTo TP	Spain
84501	49	1	49	1	The development pathways at global, national and local scale in Table 4.7 may benefit from the inclusion and/or referral to the urban emission scenarios that are provided in Figure 8.14 (Chapter 8).	Taken into account. Section 4.2.3 is where we assess literature on non-state action, so urban emission scenarios covered there. In Table 4.7, we focus on country-level	Siir KILKIS	The Scientific and Technological Research Council of Turkey	Turkey
55307	49	3	49	5	Can the topic sentence be written more concisely to say what research tells us (or doesn't)? It's pretty philosophical. Not sure what the reader is really supposed to understand about what research findings say about mitigation. A reader not steeped in modeling comes out of this paragraph thinking "Does this mean all these models are based on made-up assumptions so none of the results are any more important or realistic than others?"	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
55309	50	18	50	25	Additional information on ecological risks, their impacts, and solutions would be ideal to include: https://councilonstrategicrisks.org/wp-content/uploads/2021/01/The-Security-Threat-That-Binds-Us_2021_2-1.pdf	Accepted - specific reference to ecological risks included w. citation	Government of United States of America	U.S. Department of State	United States of America
20627	50	20	50	24	It is worth adding a statement to make the link between these ecological and socioeconomic components of sustainability. The following sentence could be added here: "Furthermore, these ecological and social sustainability challenges are highly inter-dependent (Kayal et al. 2019)". The cited paper summarizes several major issues pertaining socio-ecological sustainability on the global scene. Kayal, M., Lewis, H., Ballard, J., Kayal, E. 2019. Humanity and the 21st century's resource gauntlet: a commentary on Ripple et al.'s article "World scientists' warning to humanity: a second notice". Rethinking Ecology 4: 21–30. https://doi.org/10.3897/rethinkingecology.4.32116	Accepted, text revised	Government of France	Ministère de la Transition écologique et solidaire	France
55311	50	28	50	40	The second point appears multiple times in this chapter (see, e.g., page 50, lines 8-9). The statement is more or less intuitive but nevertheless foundational and at least in this paragraph there's no basis. In fact, after the first sentence, the paragraph lacks citations entirely.	Taken into account. WGIII in AR6 addresses systems transformations much more extensively - based on much literature	Government of United States of America	U.S. Department of State	United States of America
75037	50	31	50	31	National mitigation efforts (e.g., NDCs) vs. International mitigation efforts - Do UNFCCC inventories (territorial emissions) target effectively national mitigation efforts? One could ask the question if a country is also responsible of the consumption of goods produced in other countries, e.g., consumption-based emissions (Peters, et al. 2012; Global Carbon Project 2020)? Maybe it is relevant to not only count emissions produced inside countries, i.e., territorial emissions, as done today by the UNFCCC?	Noted.	Jesper Pedersen	University of Lisbon	Portugal
55313	50	34	50	39	Provide more robust evidence to support the claim that incremental change is not enough.	Accepted. Have revised across the chapter to substantiate assessment of literature, that mitigation conceived as incremental change is not enough. The emissions gap, assessed in cross-chapter box 6, is among that evidence. The summary of the argument is in our Executive Summary	Government of United States of America	U.S. Department of State	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
2467	50	34	50	40	Why do interactions between SDGs imply that change cannot be incremental? Aren't important trade-offs between SDGs, most notably between mitigation and economic development, precisely the reason why the required transformative change is not happening? In my view, the narrative, of a - partially painful - transformation that we cannot escape is often counterproductive. A more useful narrative (with corresponding actions), which does not call into question the need for transformative change, probably leads to quicker change (or any change at all): It is one that explicitly addresses the trade-offs and prepares societies for transformative change. This is a very important first step for successful and eventually transformative mitigation efforts. This step is incremental - so not transformative at first sight. Examples include the installation of appropriate compensation measures for groups hurt by mitigation measures (from informal transport service providers in Latin America to homeowners in Europe) or the introduction of relatively low carbon taxes that can be scheduled to rise quickly. The distinction between incremental and transformative change may thus be less clear than is suggested here. My concrete recommendation for this paragraph is to add that the interactions between SDGs may be a driver of transformative change if major synergies (or co-benefits) exist, but that they may also impair mitigation efforts if trade-offs are present. Any I guess my point on incremental versus transformative change is a general one. On this one can obviously have different views. Reading further I noted that there are quite some overlap of the discussion here with the discussion on development pathways (Cross-chapter box 4, p. 64-66). In fact, I find the latter more useful and more balanced and would suggest to only include a reference to the box here (and use the opportunity to shorten the text a bit).	Accepted. Have revised across the chapter to substantiate assessment of literature, that mitigation conceived as incremental change is not enough. The emissions gap, assessed in cross-chapter box 6, is among that evidence. The summary of the argument is in our Executive Summary	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
55315	50	40	50	40	Add a line at the end of this sentence elaborating a bit on the implications for equity. A later section goes into this, but it would make the chapter much stronger to thread that idea throughout. This is a good opportunity to do that.	Taken into account. Point to 4.5 here, that section has been revised, checking consistency with 4.2.2.7 - on fairness and ambition of NDCs	Government of United States of America	U.S. Department of State	United States of America
5041	50	42	50	42	Substitute "toward" with "towards"	Rejected. Both terms are used, different conventions	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
55317	50	45	51	1	Delete this sentence. Adds no information.	Partially accepted - reframe issue of intentional change	Government of United States of America	U.S. Department of State	United States of America
2469	51	4	51	12	"development pathways unfold over time in response to complex dynamics among various drivers and diverse actors with varying interests and motivations" - Very generic insight, should be dropped or specified. As I outline in my previous comment, incremental change may have a key role to play in preparing the ground to enable/lever transformative change, particular the fact that the call for transformative/disruptive change may - for understandable reasons - make people (or other agents) reject this call - although they may agree with the transformative change. Such mechanisms may render the distinction between incremental and transformative change even less useful politically than it is analytically.	Accepted. Have revised across the chapter to substantiate assessment of literature, that mitigation conceived as incremental change is not enough. The emissions gap, assessed in cross-chapter box 6, is among that evidence. The summary of the argument is in our Executive Summary	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
55319	51	9	51	12	Delete this sentence. All it says is "public policy is useful".	Partially accepted. Rephrased to make clear that the ability to shift development pathways is not a given	Government of United States of America	U.S. Department of State	United States of America
71441	51	13	51	13	It would be useful to begin this section with i) an explanation of whether the concept of "development pathways" is well established in the literature or is simply imposed because it is written in the chapter outline agreed by the Panel? At the moment the section implies that the development literature has its own frameworks and makes less use of the 'pathways' concept. This in turn raises the question as to why the report emphasises it. If the answer to this question is simply that the Panel requested the authors to look into, perhaps it is simplest just to say so. ii) a couple of paragraphs summarising the evidence on whether how existing sustainable development practices as described in the sector incorporate climate issues. e.g. Do countries frame their development priorities in terms of the SDGs? Do national development plans tend to incorporate climate change? In the current text, the reader has to go through several pages before the relevance to climate change is addressed directly.	Taken into account. Cross-chapter box 7 outlines what is meant by development pathways, and starts "In the present report". The concept is in the plenary-approved title of chapter 4, and new in AR6	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
55321	51	13	52	2	Section 4.3.2 doesn't have any takeaways about the implications of development pathways for mitigation and adaptation except, of course, that different development pathways impact both mitigation and adaptation, and that small changes in development pathways probably aren't sufficient to address the needed mitigation and adaptation. That conclusion seems both intuitively so obvious as to not merit saying it and also was poorly supported by references.	Taken into account. We have revised the chapter, seeking to make clearer the policy implications (without being prescriptive), and to integrated adaptation more fully	Government of United States of America	U.S. Department of State	United States of America
55323	51	28	51	31	Add "realizing/reinforcing rights" to the list of objectives of development plans (the SDGs are grounded in international human rights).	Partially accepted. Have not included the language suggested, but the sentence refers to including other objectives	Government of United States of America	U.S. Department of State	United States of America
49711	51	32	51	38	This subsection connects mitigation plans (NDCs etc.) to SDGs but it misses out to refer to the Voluntary National Reviews, the major reporting tool for countries to report on their progress on achieving the SDGs. It is a valuable indicator to see where the countries priorities lie in terms of sustainable development. An example is the transport sector, which is referenced in an increasing number of submissions. 47% of submitted VNRs of 2020 connect transport activities to climate action. More information can be found here: https://slocat.net/vnr/	Taken into account. 4.3.2.2 addresses voluntary national reviews	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
55325	51	32	51	38	Reducing inequality is also a goal in high-income countries.	Rejected. Opening clause is "across many countries". No specific examples of high-income countries with inequality provided	Government of United States of America	U.S. Department of State	United States of America
79451	51	32	51	38	This subsection connects mitigation plans (NDCs etc.) to SDGs but it misses out to refer to the Voluntary National Reviews, the major reporting tool for countries to report on their progress on achieving the SDGs. It is a valuable indicator to see where the countries priorities lie in terms of sustainable development. An example is the transport sector, which is referenced in an increasing number of submissions. 47% of submitted VNRs of 2020 connect transport activities to climate action. More information can be found here: https://slocat.net/vnr/	Accepted, text revised	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
1941	52	3			Title seems nonsensical	Accepted, text revised (though 'nonsensical' is harsh)	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71443	52	3			Title seems nonsensical. The point seems to be that more and more plans are appearing - or is it also that proportionally, the plans are doing a better job of reflecting countries' 'true' priorities?	Accepted, text revised (though 'nonsensical' is harsh)	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
55327	52	5	52	5	Delete "There is evidence that" and instead provide several references at the end of the sentence.	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
55329	52	7	52	8	Need citations to substantiate the 134 published plans. The clear findings in this section are refreshing.	Accepted, references added and moved	Government of United States of America	U.S. Department of State	United States of America
55331	52	11	52	15	Include only if authors can tie it directly and clearly to the topic of this chapter - near and mid-term mitigation. Otherwise delete this sentence.	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
55333	52	16	52	24	Language on debt forgiveness could be strengthened -- that is, debt forgiveness for individuals and nations. There is a very long history, starting in ancient Babylonia and Assyria, of money lenders extracting interest payments from the productive economy (mostly farmers) which gradually reduced them to indentured servants or slavery. The rulers rectified this regularly by forgiving all farmer debts, to get society functioning again. The debt cancellation did not apply to debts among merchants and money lenders (Michael Hudson, ...and forgive them their debts, Islet Verlag, 2018, ISBN 13: 9783981826036). It would be social justice to apply this to debts owed by poor countries to the very rich in wealthy countries.	Noted.	Government of United States of America	U.S. Department of State	United States of America
15229	52	19	52	20	The word "liberalisation" is inappropriate. It is suggested to delete "even in the wake of liberalisation".	Accepted, text revised	Government of China	China Meteorological Administration	China
55335	52	25	52	25	"established before ...": before what?	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
55337	52	36	52	41	While the national development plans of India and China are highly relevant, it would also be helpful to include reference to one or more Least Developed Countries to provide a more well-rounded view of how mitigation can be reflected in development plans at all income levels.	Rejected. We have outlined the broader spread earlier, and assessed a few case studies (not limited to China and India) to add texture	Government of United States of America	U.S. Department of State	United States of America
15231	52	37	52	41	It is suggested to add the relevant content to reflect the latest strategy of the Chinese government to address climate change that is "China will increase its NDC, adopt more vigorous policies and measures, and strive to reach CO2 emissions peak by 2030 and achieve carbon neutrality by 2060".	Accepted, text revised	Government of China	China Meteorological Administration	China
66785	53	1	53	20	It is incorrect to present this planning process as continuing in an unbroken line. The Planning Commission was abolished sometime around 2015-16 and replaced with a different organisation, Niti Aayog. The new organisation did not explicitly continue with plans. So there is no 13th FYP. The India@75 doc is not a traditional plan in the model of past plans. If anything, this example somewhat undercuts the point being made in this section on the continuation and revitalisation of planning processes.	Accepted, text revised	Navroz Dubash	Centre for Policy Research	India
66787	53	20	53	20	A paper by Spencer and Dubash is under review with Climate Policy showing precisely that a focus on mitigation scenarios without paying attention to structural features of the economy fails to explain divergences in emissions outcomes projected by models looking at India's emissions futures. It calls for models to be more explicit about implicit assumptions about structural economic shifts.	Noted	Navroz Dubash	Centre for Policy Research	India
55339	53	21	53	29	It would be helpful to explicitly include population growth as a driver of emissions, since "development" does not imply population growth or any particular population projection. In the final sentence of this paragraph, include "population growth" as one of the channels through which development pathways have implications for GHG emissions (see O'Neill et al., 2015, https://www.pnas.org/content/112/6/E506).	Taken into account. population growth is one factor, not the only one, in the Kaya identity. We say that "Chapter 2 notes that overall, affluence (GDP per capita), economic growth and population growth have remained the main upward drivers of CO2 emissions from fossil-fuel combustion in the past decade, with energy efficiency the main countervailing force (2.4) (Wang and Feng 2017; Lin and Liu 2015)."	Government of United States of America	U.S. Department of State	United States of America
401	53	21	54	10	Development pathways drive underlying economic structure, which will affect how countries implement GHG mitigation measures. Some countries convey negative impacts of mitigation on GDP over the next 30 years. How many countries indicate these impacts based on mitigation modeling studies, and how significant will they be in achieving 1.5°C to 2°C temperature targets? More details are needed in this section of the chapter.	Accepted, text revised; however, population growth is one factor, not the only one, in the Kaya identity	Michael Kemish	Rutgers University	United States of America
55341	53	31	53	31	include "growth" after the word population.	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
5043	53	36	53	36	The authors write "sChen..." I suppose the authors meant "Chen..."	Accepted, text revised	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
20629	53	38	53	39	Please consider giving some indications about the relationship between CO2 emissions and economic indicators.	Noted	Government of France	Ministère de la Transition écologique et solidaire	France
55343	53	38	53	40	GDP per capita is not a useful metric, and it is inflated by how the financial sector rents are included. How GDP is distributed is more important.	Rejected. Some literature uses income (GDP/cap), other studies focus on distribution, we assess both	Government of United States of America	U.S. Department of State	United States of America
57	53	40	53	41	"And absolute decoupling of economic growth and GHG emissions has been found to occur in some countries (Le Quéré et al., 2019)". The much larger, systematic review by Haberl et al 2019 found limited evidence, and should also be referenced here: Haberl H, Wiedenhofer D, Virág D, Kalt G, Plank B, et al. A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: Synthesizing the insights. Vol. 15, Environmental Research Letters. Institute of Physics Publishing; 2020.	Accepted, reference added	Paul Brockway	University of Leeds	United Kingdom (of Great Britain and Northern Ireland)
55345	54	11	54	11	"outlines" should be "notes"	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
74167	54	13	54	16	On line 13, it mentions India's solar program, but the same points can be said for its nuclear program (which should be included in the comment) https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx	Rejected. suggestion to consider nuclear program in the same light as India's solar program, but did not find this located at the point mentioned	Jeffrey Merrifield	Pillsbury Law Firm	United States of America
55347	54	26	54	46	It would be helpful to mention in this subsection on inequality that issues of gender inequality also have implications for GHG emissions and mitigation pathways. See, for example, Andrijevic et al., 2020, https://www.nature.com/articles/s41467-020-19856-w	Accepted, text revised and reference added	Government of United States of America	U.S. Department of State	United States of America
2471	54	32	54	36	The income-elasticity of emissions across the within-country income distribution certainly depends on the level of economic development. In most developing countries, the increase in GHG emissions from additional consumption is (still) higher for richer households. In fact, that this what some of the literature cited in the subsequent paragraph suggests (although the critique of this literature is valid).	Accepted, text revised	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
5045	54	37	54	37	"is amongst a major development..."	Rejected. Stylistic	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
403	55	9	56	18	How will shifts in development pathways impact economies of countries in a post-Covid 19 world already reeling from severe budget shortfalls? How will limitations on development pathways affect deep mitigation measures necessary to enable temperature targets to be achieved during the next 30 years?	Taken into account. Literature on COVID is emergent, assessed in 4.2.2.5 for mitigation; and recovery plans, which may (but not yet clear) shift dev pathways	Michael Kemish	Rutgers University	United States of America
76457	55	13	55	18	India's solar programme does not provide real energy to the nations poor villagers. They have expressed a desire for real energy - 24/7 reliability. Nuclear energy provides this far more successfully and with lower emissions than an unrealistic solar programme.	Rejected. No evidence or references provided	Robert Parker	Nuclear for Climate Australia	Australia
76459	55	20	55	37	The South African Energy Plan, released in October 2019, called for the country to construct two small modular nuclear reactors by 2030. The document also called for the completion of a 20-year operating lifetime extension at the Koeberg plant to ensure continued energy security beyond 2024, ensuring security of supply. In May 2020, South Africa's Department of Mineral Resources and Energy stated that it was to begin working on a roadmap for the procurement of 2500 MWe of new nuclear capacity in addition to the existing 1860MW. It would consider all options, including small modular reactors.	Rejected. The box is about the NDP, not IRP	Robert Parker	Nuclear for Climate Australia	Australia
55349	55	23	55	23	"address" should be "addresses"	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
80561	55	39	56	3	The language structures in this paragraph are rather informal and imprecise. It is not clear what the main objective was.	Accepted, text revised	Olga Savchuk	Instituto Superior Tecnico	Portugal
9693	56	4	56	10	Sustainability is not a binary scale but rather a continuum. Hence, the changes along sustainable development trajectories will mostly be incremental/transitional than transformational.	Taken into account. Unclear what change is being suggested, but text has been revised	Mustafa Babiker	Saudi Aramco	Saudi Arabia
55351	56	8	56	8	"it is" should be "they are"	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
55353	56	9	56	9	"it" should be "they" (two places)	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
63587	56	16	56	18	Would argue to also include reducing inequality and poverty in developed countries as well.	Taken into account. Here, are summarising from cases of NDPs, earlier, have pointed to all countries on inequality	Government of Canada	Environment and Climate Change Canada	Canada
14839	57	1	57	3	Backcasting can also support the analysis of onfits and synergies between environmental policy goals. See e.g., van der Voorn, T., Svenfelt, Å., Björnberg, K.E. et al. Envisioning carbon-free land use futures for Sweden: a scenario study on conflicts and synergies between environmental policy goals. Reg Environ Change 20, 35 (2020). https://doi.org/10.1007/s10113-020-01618-5	Taken into account. Detailed information on modeling in Annex III of the report	Tom van der Voorn	Institute of Environmental Systems Research	Netherlands
8315	57	12	62	32	There are quite some overlap with the discussion of SD co-benefits in Section 3 - would be good to clearly delineate what is where and why.	Noted. Comment is not clear -- which Section 3 is this about.	Michael Jakob	MCC Berlin	Germany

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
55355	57	12	62	32	Do the models all assume good governance in place? So many countries in the global south -- where the main source of emissions and also the main opportunities for mitigation lie in avoided land use change and wise land management -- have severe challenges with respect to governance. Many have numerous plans that are not implemented, for example. If these models reflect such, explain it. If they do not, explain that. It's a critical variable so readers need to understand how it is or is not incorporated.	Noted. In general, scenarios based on simulation models assume good governance only in the sense that they assume that governments are able to implement the policies that are simulated. Thus, scenarios based on complex policy packages for countries with low levels of governance should not be viewed as providing realistic evidence of policy impact in IPCC reports or elsewhere. Accordingly, such criticism has to be more specific, levelled against individual studies, not against simulation modeling in general.	Government of United States of America	U.S. Department of State	United States of America
78411	57	21	57	21	Most BAU scenarios now have a lot of mitigation - no mitigation is not BAU.	Accepted. Paragraph has been revised to clarify this.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
55357	57	27	57	38	This is a great section. Clear and important. However, it comes as a surprise given the section heading. Add a subheading to the effect of: "Model limitations for estimating mitigation potential". And perhaps move earlier in the chapter.	Taken into account. Thank you. We consider this comment as we restructure the chapter. However, in the section, it is only the first paragraph that is focused on model limitations.	Government of United States of America	U.S. Department of State	United States of America
8169	57	27	60	22	Please revise this text. It is not always clear whether a statement refers to absolute GDP or Growth of GDP. For example, lines 39 - 40, the text reads "negative effects ... relative to a reference", in line 1 (page 58) it is stated "in all ... studies, GDP continues to grow", but in lines 10 - 15 (p. 58) it reads "Magnitude and duration of GDP loss ...". Either GDP grows, then there is no loss (a reduction in growth rate is no loss), or there is a real loss, then there can not be continued growth.	Rejected. Contrary to what the reviewer says, a reduction in a GDP growth rate for a scenario relative to the growth rate of the reference scenario is and should be defined as a loss, both in terms of growth of GDP during the period and its level at the end of the period. The wording of the text in this segment is clear. In fact, there is little room for any misunderstanding since a lower (higher) growth rate during a period invariably brings about a lower (higher) GDP at the end of the period.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
20631	57	29	57	32	Please consider rephrasing this sentence along those lines: "First, computable equilibrium models, on which these assessments are mostly based, capture all the direct links from mitigation to GDP, but generally do not capture indirect links such as the economic benefits derived for example from increased air quality or modification of the diet."	Accepted, text revised	Government of France	Ministère de la Transition écologique et solidaire	France
12235	57	29	57	37	Overall very well done with the Chapter! Some suggestions for making some passages more precise: I think the drafting here is too loose and this should be revised for clarity. First, I'm not sure "computable general equilibrium models" does justice to the range of approaches (are IAMs CGE models?). Second, more importantly, the second and third caveat are not precisely formulated. GDP never was a welfare indicator in the past as seen by economic research. It is not clear how that actually different from "criticising GDP as a goal". In welfare economics the goal is "welfare" not GDP. Finally, if "a stream of literature" is mentioned in some reference to an overview article should perhaps be given. Fleurbaey and Blanchet (2013) is at least a major starting point.	Accepted, text revised and reference added - Fleurbaey and Blanchet (2013)	Linus Mattauch	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
78413	57	30	57	30	They're not all CGEs. Please check with Chapter 3.	Accepted. A reference to the relevant section in Ch. 3 as well as Annex C was added to the text.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
55359	57	36	57	36	Add "approaches" after "alternative"	Accepted. Sentence has been edited.	Government of United States of America	U.S. Department of State	United States of America
55361	57	36	57	36	Many economic analyses seem to assume that the earth is infinite. There is debate about whether never-ending economic growth is feasible or compatible with sustainability. It is refreshing to see this chapter acknowledge the literature (and perspective) that rejects the idea that unending economic growth is possible or desirable.	Noted. Thank you.	Government of United States of America	U.S. Department of State	United States of America
55363	57	36	57	36	"alternatives" (not alternative)	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
37489	57	39	57	40	"Most country-level mitigation modelling studies in which GDP is an endogenous variable report negative impacts of mitigation on GDP in 2030 and 2050, relative to the reference". This is not true for every model.	Noted. The text makes a statement about "most models"; it does not claim that it applies to every model.	Government of India	Ministry of Environment, Forests and Climate Change	India
20633	57	39	57	41	It could be specified here that, by construction, if the models are based on the initial assumption that national economies are on their production frontier, any change in the baseline necessarily entails a cost. This will be the case for mitigation, which can only lead to a loss of GDP in relation to the baseline. It could be also specified that most of the times, climate change impacts are not represented in these models. Such limits of modeling issues should be presented first before describing political issues.	Partially accepted -- the paragraph was adjusted to address this concern, noting that likely gains after 2050 are, by definition, not captured by these studies or addressed in this Chapter given the limited time frame (up to 2050). In general, given that they typically include distortionary taxes and, explicitly or implicitly, assume that labor and capital are not fully utilized, models do not assume that economies are on their production frontier. Furthermore, given time lags and the limited time period that is covered in these studies (not going beyond 2050), the gains from mitigation in the form of lower costs of climate change are not likely to be significant.	Government of France	Ministère de la Transition écologique et solidaire	France
55365	57	39	57	46	Do these findings (negative impacts on GDP) include estimates of the costs society will incur in the absence of mitigation the consequent and unavoidable costs of adaptation? This paragraph should explain that clearly one way or the other.	Partially accepted. During the time period under consideration (up to 2030 or 2050), mitigation is not expected to significantly reduce the need for adaptation. However, the paragraph was adjusted to note that likely gains after 2050 are, by definition, not captured by these studies.	Government of United States of America	U.S. Department of State	United States of America
64157	57	44	57	44	Silva Herran et al. (2019 Climate Policy) also report GDP as endogenous variable.	Noted. The observation is correct but adding it would not change the findings presented here.	Diego Silva Herran	National Institute for Environmental Studies	Japan
18147	58	1	58	1	Could the figure be re-plotted to indicate which lines represent which countries? Figure 4.4	Accepted. Figure 4.4 has been revised for FGD; however, not identifying individual countries	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
16309	58	4	58	8	Are the two panels in Figure 4.4 based on the same set of reviewed studies? I see that Figure 4.4b shows that GDP continues to grow even with mitigation between year 2030 and 2050. However, in Figure 4.4a most points in the graph indicate negative GDP growth. The two graphs seem to imply totally different findings. More detailed information and explanation for Figure 4.4 is needed for clarification.	Accepted. Figure 4.4 has been revised for FGD	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16311	58	4	59	3	Further information is needed on "which simulation or study" each point is from, and "what country" each point represents.	Accepted. Figure 4.4 has been revised for FGD; however, not identifying individual countries	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
45873	58	5	58	6	Fig. 4.4 b needs a legend to explain the colours. The provision of unfinished work prevents reviewing it.	Accepted. Figure 4.4 has been revised for FGD	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
66789	58	7	58	7	On Figure 4.4 the top panel the top panel is quite instructive but the bottom panel, with one model per country, does not really tell us much other than a range of possible outcomes are possible. One would expect this, given different country contexts. Not sure how much it adds, unless (and this is possible) I am missing something. I see it is to be further elaborated but even so, the exact point of the fig needs to be clearer.	Accepted. Figure 4.4 has been revised for FGD; however, not identifying individual countries. Text also revised	Navroz Dubash	Centre for Policy Research	India
72485	58	7	58	7	The quality of the figure being very low it seems that in panel a there are points of either different color or shape. What do they represent? Is it linked to the impact in 2030 and in 2050?	Accepted. Figure 4.4 has been revised for FGD (figure quality will be addressed in publication)	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
55367	58	7	59	3	In Figure 4.4b, what does "index 100 = model base year" mean? The meaning of emissions index on the y-axis also is not self-evident. Clarify in the legend what this plot means.	Accepted. Figure 4.4 has been revised for FGD, including legends	Government of United States of America	U.S. Department of State	United States of America
30681	59	26	59	28	Indirect CO2 emissions also need to be taken into account because of the increasing electrification of the industrial, building and transportation sectors. The final energy consumption and electrification rate of each sector also need to be presented for a better understanding.	Accepted. Figure 4.4 has been revised for FGD	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
55369	60	5	60	6	Risks and downsides associated with auctioning permits should be acknowledged explicitly. These include the use of derivatives, credit default swaps, collateralized debt obligations, the way betting exacerbates instabilities, lack of transparency, and the use (sometimes) of shell companies in tax havens. The advantages of taxes should be clarified, as well as how the success of tax plans hinges on how the income from taxes is used. Appropriately directed, tax revenue can increase equity.	Accepted. Text was adjusted to include a reference to the section in Ch 13 that discusses the auctioning of permits and other carbon pricing instruments.	Government of United States of America	U.S. Department of State	United States of America
20635	60	10	60	17	Such issue about the efficiency frontier could probably be discussed earlier: page 57, just after the paragraph beginning line 39 ("Most country level mitigation...") because the fact that mitigation leads to positive or negative impacts on GDP depends here on the economic modeling paradigm and not on policy design or implementation that are discussed afterwards.	Partially accepted. A typo was corrected and, for clarity, an observation was added at the end of the sentence. However, the issue is not related to the modeling paradigm so additional changes were not warranted.	Government of France	Ministère de la Transition écologique et solidaire	France
20637	60	18	60	22	The lack of consideration of the impacts of CC in economic modeling should also be addressed on page 57 after the paragraph beginning line 39: "Most country level mitigation..."	Accepted. The statements here and on p. 57 of SOD were adjusted, stating more clearly that the impacts of CC are not covered and the reasons for this.	Government of France	Ministère de la Transition écologique et solidaire	France

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
405	61	3	61	11	More discussion is needed on the effectiveness of carbon pricing on economic and social programs that address climate change initiatives in developing vs. developed countries.	Accepted. The discussion of employment and equity aspects of carbon pricing in Sections 4.3.3.3 and 4.3.3.4, respectively has been strengthened.	Michael Kennish	Rutgers University	United States of America
52087	61	3	61	32	The literature suggests that, employment effect of mitigation policies tend to be limited on aggregate, but can be significant at sectoral level is false. Mitigation measures can affect a country's economy negatively and affects its employment if the country is fossil fuel source reliant.	Accepted. The text was expanded to make the point that employment is found to decline in sectors and regions that are heavily dependent on fossil fuels.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
47363	61	3	61	42	Section 4.3.3.3: Suggest to add the following literature, which looked at the net employment impact of power sector decarbonisation in Japan: Kuriyama, A., and Abe, N. (2021). Decarbonisation of the power sector to engender a 'Just transition' in Japan: Quantifying local employment impacts. <i>Renew. Sustain. Energy Rev.</i> 137, 110610. doi:10.1016/j.rser.2020.110610.	Noted. The study largely confirmed and did not add to what is already stated in the section.	Takeshi Kuramochi	NewClimate Institute	Germany
48109	61	4	61	5	"Numerous studies have analysed the potential impact of carbon pricing on labour markets." Please also mention studies that have examined the job creation versus loss upon transitioning the world to 100% renewable energy: (1) Jacobson, M.Z., M.A. Delucchi, Z.A.F. Bauer, S.C. Goodman, W.E. Chapman, M.A. Cameron, Alphabetical: C. Bozonnat, L. Chobadi, H.A. Clonts, P. Enevoldsen, J.R. Erwin, S.N. Fobi, O.K. Goldstrom, E.M. Hennessy, J. Liu, J. Lo, C.B. Meyer, S.B. Morris, K.R. Moy, P.L. O'Neill, I. Petkov, S. Redfern, R. Schucker, M.A. Sontag, J. Wang, E. Weiner, A.S. Yachamin, 100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for 139 countries of the world, <i>Joule</i> , 1, 108-121, doi:10.1016/j.joule.2017.07.005, 2017; (2) Jacobson, M.Z., M.A. Delucchi, M.A. Cameron, S.J. Coughlin, C. Hay, I.P. Manogaran, Y. Shu, and A.-K. von Krauland, Impacts of Green New Deal energy plans on grid stability, costs, jobs, health, and climate in 143 countries, <i>One Earth</i> , 1, 449-463, doi:10.1016/j.oneear.2019.12.003, 2019.	Accepted. The text was adjusted and now refers to Jacobson et al. (2019), the more recent of these two studies.	Mark Jacobson	Stanford University	United States of America
50287	61	12	61	12	Vandyck et al. (2016, already in the literature list) also analyze labour market effects and show the concentration in sectors	Accepted. Reference added	Matthias Weitzel	European Commission, Joint Research Centre	Spain
12245	61	21	61	21	I think this is missing the really novel contribution of Castellanos and Heutel (2019) on modelling the impact of carbon pricing on the US labour market when there are frictions.	Noted. The paper is promising from a methodological perspective, but the findings that can be generated from comparative static simulations comparing zero and full labor mobility are too stylized to be relevant to this chapter.	Linus Mattauch	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
2473	61	21	61	42	It may be worthwhile mentioning that the (potential) impacts of mitigation on informal labour markets in developing economies have been relatively little explored to date. This is despite the fact that the impact on informal employment may be a key political economy factor for mitigation policy choices (think of the political power of the transport sector). The role of the self-employed should also not be ignored when thinking about the the equity implications of mitigation (see next point).	Accepted. The Ch. 4 section on research gaps (Section 4.6) now states that little literature has been done on the impact of mitigation on informal labor markets.	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
72487	61	31	61	33	"employment effect of mitigation policies tend to be limited on aggregate, but can be significant at sectoral level (limited evidence, medium agreement)" I understand that the "(limited evidence, medium agreement)" applies to "significant at sectoral level". If I am right, it would indeed be very interesting to provide a similar estimation (X evidence, Y agreement) for the first part of the sentence "employment effect of mitigation policies tend to be limited on aggregate".	Rejected. The confidence statement applies to preceding sentence as a whole.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
10587	61	31	61	36	As commented in the previous chapter, it seems that what the literature has to say about mitigation versus employment is weak. This issue might be identified as a gap of knowledge.	Noted. According to our assessment, the literature is not particularly weak in this area – the findings cited in this paragraph receive relatively strong support in the literature.	Philippe Waldteufel	CNRS	France
55371	61	32	61	32	Insert "the" after "at"	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
50289	61	43			This section is relatively silent on horizontal equity, i.e. the different implications for different groups within income groups (carbon pricing on transport fuels would potentially be more concentrated in rural households rather than in a specific income group). There is an emerging literature on this topic, e.g.: Douenne, T. (2020). The vertical and horizontal distributive effects of energy taxes: A case study of a French policy. <i>The Energy Journal</i> , 41(3). Cronin, J. A., Fullerton, D., & Sexton, S. (2019). Vertical and horizontal redistributions from a carbon tax and rebate. <i>Journal of the Association of Environmental and Resource Economists</i> , 6(S1), S169-S208. Fullerton, D., & Muehlegger, E. (2019). Who bears the economic burdens of environmental regulations?. <i>Review of Environmental Economics and Policy</i> , 13(1), 62-82. Pizer, W. A., & Sexton, S. (2019). The distributional impacts of energy taxes. <i>Review of Environmental Economics and Policy</i> , 13(1), 104-123.	Accepted. The text now discusses vertical and horizontal redistribution with reference to a subset of these references.	Matthias Weitzel	European Commission, Joint Research Centre	Spain
50291	61	43			Equity of carbon pricing was also assessed in EMF 36 in a number of models, the overview paper summarizes the findings (Christoph Böhlinger, Sonja Peterson, Jan Schneider and Malte Winkler: Carbon Pricing after Paris: Overview of Results from EMF 36 (submitted in line with IPCC AR6 submission deadlines).	Accepted. Text revised to refer to this reference and its findings related to recycling of revenues from carbon pricing.	Matthias Weitzel	European Commission, Joint Research Centre	Spain
20639	61	43	61	43	In section 4.3.3.4, fuel poverty is not really addressed. Specific policies (financing the thermal renovation of housing for the most vulnerable households living in very poorly insulated housing) must be implemented to help them and not just compensatory transfers. see for example: Charlier D., Legendre B., Risch A., 2019, "Fuel poverty in residential housing: Providing financial support vs. combatting substandard housing", <i>Applied Economics</i> , 51:49, pp. 5369-5387	Accepted. The text now refers to the main points made by this study.	Government of France	Ministère de la Transition écologique et solidaire	France
12237	61	44	62	32	The selection of studies referenced in this section seems not balanced to me. First, why are the distributional problems with standards referenced explicitly but not those with pricing? Second, on standards perhaps the papers by Levinson (2019), Fullerton and Muehlegger (2019) are more pertinent. Third, the section talks about France a lot, but I believe French climate policy is quite special. The reference to Combet and Combet and Hourcade seems oddly specific if a far broader range of similar analysis have been conducted (e.g. Gould et al. 2019, JPubE, Klenert et al. 2018, ERE). Finally, if France is prominently discussed, fine studies capturing some of the political problems around the Yellow Vest debates are Douenne and Fabre (2019,2020).	Accepted. The revised text refers to Levinson (2019), and Fullerton and Muehlegger (2019) in the discussion of standards, and to Douenne and Fabre (2020) in the discussion of the French carbon tax. The paper by Klenert et al. (2018) was not cited since it is less directly linked to the applied concerns of this section or chapter. Finally, contrary to what the reviewer says, this section also refers to pricing as a source of distributional problems.	Linus Mattauch	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
2475	62	7	62	13	Indeed are the distributional implications of mitigation context-specific. Yet, the underlying structural factors that condition heterogeneity are known and important factors include energy use and transport patterns. Take the example of the possession of "energy-processing durables" (mainly private transport). See Renner, S., Lay, J., & Schleicher, M. (2019). The effects of energy price changes: heterogeneous welfare impacts and energy poverty in Indonesia. <i>Environment and Development Economics</i> , 24(2), 180-200; a paper that shows that the possession of cars and motorbikes is a key source of welfare impact heterogeneity (here of energy prices increases partly driven by subsidy removals).	Accepted. The text now makes this point with reference to this paper.	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
2477	62	14	62	22	One additional point on social transfers: While they are indeed an appropriate instrument to cushion potentially adverse impacts on the poorest they may often not be an adequate instrument to compensate losers since these may not be program beneficiaries. In fact, a key policy question that successful mitigation policies will have to answer is how to compensate losers, including but not limited to the poorest.	Noted. It is not clear what should be changed in response to this comment since the discussion in this section does not assume that transfers only benefit the poorest or do not reach non-poor losers.	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
407	62	23	62	32	More assessment is necessary on countries willing to embrace carbon taxation to support climate change programs and those that do not. While France's yellow-vest movement is addressed in this section of the chapter, there is no other information provided on the responses of other countries to carbon taxation. If this information is available in the literature it should be included.	Noted. The topic is covered in this section.No specific change suggested.	Michael Kennish	Rutgers University	United States of America
5121	62	23	62	32	It might be worth including the Swiss model of carbon tax and redistribution in this section	Accepted. Text now refers to the Swiss case, drawing on Carattini et al. (2017)	Lina Hollender	n/a	Germany

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
12239	62	32	62	32	While a paper by Baranzini is mentioned, a substantial literature has been developed since AR5 about how the public support of policies such as pricing depends on a range of factors beyond inequality and efficiency, notably citizens ignoring that pricing pollution actually reduces pollution (Kallbekken et al. 2011, Carattini et al. 2017, Klenerer et al. 2018, Maestre-Andres et al. 2019). I wonder if that should at least be mentioned in passing -- after all the chapter puts much weight on how in the short-term public policy entry points must be found to deliver emission reductions that actually work with broad constituencies! I noted later 4-81 this literature is referenced, but not actually engaged with what it's main insights are.	Accepted. This paragraph now includes a reference to Section 4.4.1.8, which draws on some of the reference mentioned in this comment.	Linus Mattauch	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
55373	62	33	62	33	This subheading is hard to understand. What does "articulation" mean? Many readers will be confused. Can you find a different word? Does it just mean "relationship between"?	Accepted. Section 4.3.4 of SOD no longer exist in FGD, material on the relationship is treated in 4.2.7, and is indeed about the relationship between. However, we now refer to 'obstacles'. We think that is clear language	Government of United States of America	U.S. Department of State	United States of America
83125	62	33	68	33	This section sounds a little too 'comprehensive rationality'-like, where there is a clear-cut path from talk to decisions to actions (with some level of implementation failure to be accounted for). You might draw a little on ch 13.4.3. (Cultural understandings shaping climate governance") in recognizing that decisions about the long-term can sometimes even work as substitutes for actions. See also Dubash 2020 (https://onlinelibrary.wiley.com/doi/10.1002/wcc.622). Might also fit under 'risks' in 4.4.3	Noted.	Geden Oliver	German Institute for International and Security Affairs	Germany
55375	62	38	62	38	"shift" should be "shifting"	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
66791	62	40	62	46	This description of a continuum broadly maps to Figure 13.6, except Ch 13 uses the term 'multiple objectives' rather than development measures. But the spirit is very similar. It may make sense to cross reference.	Accepted, cross-reference added	Navroz Dubash	Centre for Policy Research	India
55377	62	41	63	16	This text begins in a very general way (then on page 63, lines 14-16, more specifically) to address confusion about what a mitigation policy even means divorced from a development pathway. It could at a minimum be cross-referenced when this idea first comes up in the chapter.	Accepted, cross-reference added	Government of United States of America	U.S. Department of State	United States of America
10589	63	8	63	24	The priority here is given to mitigation. Then, it appears the duty of IPCC to wonder: for every SDG in turn (excepting SDG 13 of course), analyse in depth - and quantitatively whenever possible - to which extent reaching the SDG and concerned targets will contribute to a more efficient mitigation. Hopefully some scholars are interested in these questions.	Taken into account. Chapter 17 has worked with several other chapters and produced a table across SDGs	Philippe Waldteufel	CNRS	France
409	63	9	63	10	Some statements in Chapter 4 are redundant. They are repeated on several pages. For example, "Mitigation conceived as incremental change is not enough..." is found on page 63, line 9. On page 71, line 11 the following statement is made, "Again incremental change is not enough..." Is it necessary to repeat statements on multiple pages in the chapter?	Accepted - redundancies to be eliminated, except where required for summarizing or emphasizing points	Michael Kennish	Rutgers University	United States of America
1943	64	2			Not immediately straightforward that there are no paths where emissions are somewhat higher and relatively many of the SDGs can be achieved. At least the figure seems to "hide" any tradeoffs	Accepted. Figure 4.6 (SOD, is 4.7 in FGD) has been significantly revised, based on several comments. There is a new figure on 'obstacles' has been added, Fig 4.6 in FGD	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71445	64	2			Not immediately straightforward that there are no paths where emissions are somewhat higher and relatively many of the SDGs can be achieved. At least the figure seems to "hide" any tradeoffs	Accepted. Figure 4.6 (SOD, is 4.7 in FGD) has been significantly revised, based on several comments. There is a new figure on 'obstacles' has been added, Fig 4.6 in FGD	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
55379	64	2	64	2	Delete "wide"	Accepted. Figure 4.6 (SOD, is 4.7 in FGD) revised	Government of United States of America	U.S. Department of State	United States of America
20641	64	14	64	15	This cross-chapter box 4 is very useful and relevant! But, there is a strong contradiction between the very relevant and fundamental message delivered in this box and the content of chapter 3, which produces scenarios using models that take into account structural changes only with difficulty or not at all, particularly on the demand side, and which calculate GDP losses compared to a reference scenario with mainly changes in the energy system only. I readily admit that all this is very difficult, but it is also not very coherent. Chapter 3 should really highlight the limits of the modeling and clearly display in the preamble- before going into the details of the description of the scenarios, costs, etc.- the assumptions in terms of the scope of costs considered and not considered, and the limits on structural changes poorly or not represented by these models.	Noted. This is a comment for Ch3.	Government of France	Ministère de la Transition écologique et solidaire	France
82279	64	14	68	33	Linking the energy needs for wellbeing, and thus energy use in the global north and global south, and development pathways to the current state of such multidimensional living standards, can be done usin a recent study which shows the marginal change in energy for decent living across the globe. This would support statements related to (in)equity and provide a direct reference to statements in this box decent living standards, transformative change (notably without assuming strong technological improvements), in the context of climate mitigation scenarios. https://doi.org/10.13140/RG.2.2.26909.23528	Noted. Reviewed the study, however the feasibility of achieving decent standard of living and mitigation at the same time (which is the point of Kikstra et al.) is more relevant in Chapter 5 than in the box.	Jarmo Kikstra	IIASA	Austria
20643	65	14	65	18	Please note that the provision of the underground with fossil fuels or minerals also drive development pathways and economic and industrial structure.	Noted. Endowments in natural resources matter for development pathways. This idea is already captured in the last clause of the definition: "In the present report, development pathways refer to patterns of development resulting from multiple decisions and choices made by many actors in the national and global contexts". The limited length of the Cross Chapter box does not allow for long discussions, which can be found in the relevant chapters (here in Chapter 4).	Government of France	Ministère de la Transition écologique et solidaire	France
71447	65	14	65	33	Re: our comment on page 51. Placing the box at the start of the development pathways section would be very helpful to readers.	Accepted. Section 4.3.4 restructured in FGD	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
18149	65	19	65	20	Strength of evidence, degree of confidence? Recommend including this here. A very important point that if not already included in the Exec Summary, should be.	Accepted; add statement of high confidence (high evidence, medium agreement), although implicit already in 'compelling evidence'	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
52089	65	23	65	32	Development pathways ignored clean fossil fuel technologies and imposed carbon tax. Should consider all options.	Noted. These two paragraphs are about 'conventional' mitigation policies, the following argues for broader policies to shift development pathways	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
49713	65	33	65	36	Good example, in this context I miss the concept of leapfrogging. Instead of shifting, developing countries can avoid to go through the same development and directly introduce CO2-free/more efficient approaches, such as electric mobility. Just an example that is related to it (but not 100% leapfrogging) are UN Environment's ambitions for electrified two- and three-wheelers: https://www.unep.org/explore-topics/transport/what-we-do/electric-mobility/electric-two-and-three-wheelers	Taken into account. A cross-chapter box on transitions dynamics is being developed, placed in chapter 16.	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
79453	65	33	65	36	Good example, in this context I miss the concept of leapfrogging. Instead of shifting, developing countries can avoid to go through the same development and directly introduce CO2-free/more efficient approaches, such as electric mobility. Just an example that is related to it (but not 100% leapfrogging) are UN Environment's ambitions for electrified two- and three-wheelers: https://www.unep.org/explore-topics/transport/what-we-do/electric-mobility/electric-two-and-three-wheelers	Taken into account. A cross-chapter box on transitions dynamics is being developed, placed in chapter 16.	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
49715	66	1	66	7	Achieving sustainable transport has great positive impact on SDGs and climate action, as discussed in this report: http://slocat.net/wp-content/uploads/2020/04/SLOCAT-ISDB_2020_Transport-Climate-Action-Sustainable-Development.pdf Transport touches on most of the SDGs: https://slocat.net/transport-sdgs/	Taken into account. Sustainable transport is mainly dealt with in chapter 10. This chapter (and others contributing to cross-chapter box 7) will be asked to indicate examples of SDPS, with cross-referencing	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
79455	66	1	66	7	Achieving sustainable transport has great positive impact on SDGs and climate action, as discussed in this report: http://slocat.net/wp-content/uploads/2020/04/SLOCAT-ISDB_2020_Transport-Climate-Action-Sustainable-Development.pdf Transport touches on most of the SDGs: https://slocat.net/transport-sdgs/	Taken into account. Sustainable transport is mainly dealt with in chapter 10. This chapter (and others contributing to cross-chapter box 7) will be asked to indicate examples of SDPS, with cross-referencing	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
52091	66	3	66	5	Development pathways calls for abandoning ICEs, ignoring the LCA of EV's and food security issues and biodiversity for biofuels. All of these should be included.	Noted. The statement does not call for abandoning any technology, but points to the mitigation potential and co-benefits of options. Literature on transport options is assessed in chapter 10.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
47443	66	11	66	19	There is evidence to the contrary on this - banning cars in urban environments and ensuring good public transport connections can enhance social interactions and does not necessarily affect small business income. Not limiting car access can restrict the freedom of those wishing to cycle, those with respiratory diseases, those for whom the noise and pollution is distressing. Please revise and provide a more nuanced assessment!	Taken into account. The sentence is necessarily brief in a box, and in our view balanced - pointing to two advantages and two disadvantages. For more detailed assessment of transport options, see chapter 10.	Government of Saint Lucia	Department of Sustainable Development - Ministry of Education, Innovation, Gender Relations and Sustainable Development	Saint Lucia
72773	66	11	66	19	There is evidence to the contrary on this - banning cars in cities and ensuring good public transport connections can enhance social interactions and does not necessarily affect small business income. Not limiting car access can restrict the freedom of those wishing to cycle, those with asthma, those for whom the noise and pollution is distressing. Please revise	Taken into account. The sentence is necessarily brief in a box, and in our view balanced - pointing to two advantages and two disadvantages. For more detailed assessment of transport options, see chapter 10.	Matthew Gidden	Climate Analytics	Germany
78155	66	11	66	19	There is evidence to the contrary on this - banning cars in cities and ensuring good public transport connections can enhance social interactions and does not necessarily affect small business income. Not limiting car access can restrict the freedom of those wishing to cycle, those with asthma, those for whom the noise and pollution is distressing. Please revise!	Taken into account. The sentence is necessarily brief in a box, and in our view balanced - pointing to two advantages and two disadvantages. For more detailed assessment of transport options, see chapter 10.	Charlotte Plinke	Climate Analytics	Germany
83127	66	44	66	44	I wonder whether "evidence-based policymaking" (before and after also "science-based") isn't a bit too idealistic, given how formal institutions work. "Evidence-informed policymaking" might be the more realistic expectation, see Cairney 2016 (https://www.palgrave.com/gp/book/9781137517807)	Rejected. The title of Cairney's book is "The politics of evidence BASED policy making" indicating that this is a term of art	Geden Oliver	German Institute for International and Security Affairs	Germany
77749	67	2	67	2	The reference cited is to Green and Dennis (2018) (one of my papers) but I think the reference is meant to be a different one of my papers, namely: Green, Fergus, 'Anti-Fossil Fuel Norms', <i>Climatic Change</i> , 150 (2018), 103–16	Rejected. We meant to cite the paper co-authored with Dennis. Green (2018) is focused on norms, the last clause in the sentence, but our assessment is that the other papers cover more of the whole sentence	Fergus Green	Utrecht University	Netherlands
20201	67	2	67	4	To underpin: Song, L., Lieu, J., Nikas, A., Arsenopoulos, A., Vasilioiu, G., & Doukas, H. (2020). Contested energy futures, conflicted rewards? Examining low-carbon transition risks and governance dynamics in China's built environment. <i>Energy Research & Social Science</i> , 59, 101306.	Rejected. Reference not completely relevant to the sentence.	Nikas Alexandros	National Technical University of Athens	Greece
27651	67	7	67	11	Delete "Overcoming inertia and locked-in practices may face considerable opposition (5.4.5) (Geels et al. 2017). The durability of carbon intensive transport modes and electricity generating infrastructures increase the risk of lock-in to high emissions pathways, as these comprise not just consumer practices, but sunk costs in infrastructure, supporting institutions and rules, as well as interest groups that benefit from and aim to protect the status-quo (Seto et al. 2016; Mattioli et al. 2020)."	Partly accepted. Statements are based on assessment of literature. Last clause will be deleted	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
46991	67	38	67	44	There is research that suggests, that moral arguments based on justice and harm prevention can also appeal to more conservative/right-wing groups (see Strimling et al. (2019). The connection between moral positions and moral arguments drives opinion change. <i>Nature Human Behaviour</i> , 3, 922-930, https://www.nature.com/articles/s41562-019-0647-x). This shows again the importance of moral normative change as suggested above (see again Otto et al. (2020), Social tipping dynamics for stabilizing Earth's climate by 2050, <i>PNAS</i> (https://www.pnas.org/content/117/5/2354 and Green (2018), Anti-fossil fuel norms, <i>Climatic Change</i> , 150, 103-116, https://link.springer.com/article/10.1007/s10584-017-2134-6).	Noted. We already cite Green and Dennis 2018 on norms to support moving away from fossil fuels. The reference to Strimling et al. and Otto et al. are directly relevant to the acceleration of mitigation discussed notably in Chapters 4 and 5.	Viktoria Spaier	University of Leeds	United Kingdom (of Great Britain and Northern Ireland)
52059	68	15	68	16	The appropriate set of policies to shift development pathways thus depends on national circumstances and capacities is important to emphasize in SPM.	Taken into account. This is a comment for the SPM.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
66793	68	35	69	2	The five policy instrument categories (as used in Ch 13) are used by Ch 13 very deliberately NOT only as mitigation policy instrument categories, but rather broad categories that encompass both mitigation specific or development focused/multiple objective policies. In other words, they are objective agnostic. For example from Table 4.9, tax as a market instrument could be a carbon tax (mitigation), but could also be ecological tax reform (development pathway). In another example, zoning laws are regulatory instruments aimed at urban development but which may have mitigation outcomes but are not mitigation centric. And indeed, packages are one way to hit multiple buttons. In our (Ch 13) reading, there isn't a 'broader range' of instruments (line 40-41) because this set is all-encompassing, as a taxonomy. Instead, it is the purpose toward which the instruments are designed, and the attention to the broader enabling conditions, that distinguish mitigation centric versus broader development pathway shifts, not the instruments themselves, which are just ingredients in the soup. If this is consistent with Ch 4's understanding, perhaps Ch 4 colleagues might consider re-writing this slightly to introduce the generic five categories, and noting they may be turned to either mitigation or broader outcomes, including shifting development pathways depending on how they are used, the purpose to which they are put, and how explicitly and intentionally they pay attention to enabling conditions.	Accepted. We now say "The literature identifies a broad set of enabling conditions that can both foster shifting development pathways and accelerated mitigation, along five categories", in our Exec Summary	Navroz Dubash	Centre for Policy Research	India
78415	69	18	69	18	This material and associated text has a lot of overlap with Chapter 13.	Accepted. Liaised with chapter 13 and improved consistency	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
85763	69	18	70	1	Table 4.9 lists "regulation of advertisement" as an example of a policy measure that can help shift development pathways. It would be useful if the table could provide more specific information about (or more specific examples of) the type of advertising regulation that is being referred to here as there is no other reference to this in the documents provided. For instance, is this referring to advertising bans or other content requirements/restrictions?	Rejected. Valid comments, but the table does not allow for detailed elaboration	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
55381	69	19	69	19	This should be a two-way exchange: Public money supports corporations, and one line of thinking argues corporations in turn should contribute to the public fund, e.g., via taxes.	Rejected. Comments seems to be on caption of Table 4.9	Government of United States of America	U.S. Department of State	United States of America
63589	69				Under Governance and institutions, recommend adding deployment (i.e. RD&D) to public investment	Noted.	Government of Canada	Environment and Climate Change Canada	Canada
18151	70	14	70	20	Could the authors consider mentioning corruption as a further limiting factor and that measures are needed to address this in order to ensure that policy measures detailed in table 4.9 can be properly executed?	Rejected. Other reviewers raised concerns about corruption, and it is a sensitive topic	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
66795	70	14	70	20	Ch 13 uses three categories to try and sum up governance tasks particularly salient to climate mitigation: coordination (making sure mitigation is mainstreamed into development and vice versa as the last line of chapter 4 ES says), mediating interests (making sure losers aren't unduly blocking), and strategic coordination (charting direction, reviewing, revising etc.).	Accepted, cross-reference added	Navroz Dubash	Centre for Policy Research	India
27653	70	16	70	20	Delete "A major socio-economic transformation, such as the shift away from fossil fuel-based energy economy, can be expected to significantly disrupt the status quo, leading to a stranding of financial and capital assets and shifting of political economic power. Ensuring the decision-making process is not unduly influenced by actors with much to lose is key to managing a transformation."	Rejected. No rationale provided for deletion	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
1945	71	1	71	1	Heading very similar to heading 4.3.4, which is confusing	Noted. 4.3.4 refers to why - combining shifting development pathways and accelerating mitigation - whereas 4.4.1 focus on how to do it.	Anne Othoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71449	71	1	71	1	Heading very similar to heading 4.3.4, which is confusing	Noted. 4.3.4 refers to why - combining shifting development pathways and accelerating mitigation - whereas 4.4.1 focus on how to do it.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
78417	71	1	84	0	Section 4.4.1 has a huge overlap with chapters 5, 13, 15 and 16. Overlap could be reduced, cross-referencing enhanced and consistency checked. It is in the chapter scope but its only one bullet point.	Partially accepted. 441 is core to the assessment in chapter 4, and as noted, in scope. We have worked to enhance consistency, cross-referencing - and reducing length	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
55383	71	1	84	33	This section, though interesting, does seem to go on at length often without appropriate citations. Suggest cutting this down by looking for points of repetition, ensuring all paragraphs are tied to specific articles/bodies of literature, and generally sharpening the language.	Partially accepted. 441 is core to the assessment in chapter 4, and as noted, in scope. We have worked to enhance consistency, cross-referencing - and reducing length	Government of United States of America	U.S. Department of State	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
86305	71	1	90	44	Climate changes do not have political borders. Therefore I would like to suggest that climate impacts be considered on basis of environmental and geographical boundaries rather than political boundaries. This can be certainly challenging from many aspects but it could be an experiment to try with neighbouring districts and provinces in the same country and politically friendly neighbouring countries that fall in the same or similar environmental envelope. A detailed review of a fast track approach would be required to identify and pursue easy tracks and successes. The success of initial experiment can be a motivator and forerunner for larger engagements between collaborating partners. This could be considered for integration in the trade policy of the region.	Noted.	RABIZ FODA	Hydro One Networks Inc.	Canada
2479	71	4	72	25	This section is very general and can probably be shortened considerably (for example p.71, 23-35 could be dropped without major substantive loss). In my view, the strongest part of 4.4.1 are the concrete examples of integrated policy packages (sections 4.4.1.8-4.4.1.10, not so sure about 4.4.1.7 that is much less concrete). I would therefore suggest to cut-down on all the fairly general discussions of policy-processes, governance, finance, behaviour and innovation. While these discussions are well grounded in the respective sub-disciplines/fields, they are not necessary to get the main messages across.	Noted. Specific and exhaustive examples of new technologies are not the scope of this section.	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
20645	71	18	71	19	Please not that this also include NGO's ability to involve non-state actors	Noted	Government of France	Ministère de la Transition écologique et solidaire	France
84549	71	22	71	23	Please add the following: "Moreover, identifying co-benefits, and considering these in climate policy decision-making, may help to further accelerate mitigation (Karlsson et al. 2020)", and please add the following in the reference list: "Karlsson, M., Ahfredsson E. & Westling N. (2020) Climate policy co-benefits: a review, Climate Policy 20, 292-316. DOI: 10.1080/14693062.2020.1724070"	Noted. Will review the suggested references.	Mikael Karlsson	KTH Royal Institute of Technology	Sweden
85159	72	1	72	3	Please provide a more balanced selection of examples of new technologies really entering the market and that will be most likely successful. Please add: airborne wind-energy, offshore wind-turbine floating concepts and smart rotors. REFERENCE: https://www.sciencedirect.com/science/article/pii/S1364032119304782 . Please consider: E-vehicles as such are not a new technology. CCS has major fundamental constraints and open issues, although not being new technology as well.	Noted. Specific and exhaustive examples of new technologies are not the scope of this section.	Jens Tambke	Umweltbundesamt	Germany
50449	72	8	72	12	This is an interesting diagram that illustrating the roles of the enabling conditions, authors may also consider adding facilitates line pointing towards the policy. Finance is so crucial that not only is an required condition but also can facilitate the policy-making, whereby with financial system that supports sustainability, policy-makers will be more confident to go for more ambitious commitments.	Noted. Thank you.	Hoy Yen Chan	ASEAN Centre for Energy	Malaysia
80563	72	9	72	10	It would be more intuitive for the readers if the 'Requires' arrows from required sources (inputs) towards beneficiaries (outputs). For instance, Finance 'is required' for Accelerating mitigation.	Accepted, figure revised, including arrows	Olga Savchuk	Instituto Superior Tecnico	Portugal
63591	72	10			Arrows on this diagram are a bit confusing. i.e. accelerating mitigation and shifting development pathways requires finance? Would suggest having arrows in opposite direction for that example	Accepted, figure revised, including arrows	Government of Canada	Environment and Climate Change Canada	Canada
20647	72	10	72	10	Please consider this alternative, if relevant: The main conditions for accelerating mitigation today are guided by policy acceptance, not policy construction. The role of civil society, its education, support for its actions, and its involvement in local governance, are guarantees of the success of mitigation policies. Technology could be considered a tool, rather than a condition?	Noted. But Technology innovation is part of the broad set of enablers and levers that are consistently assessed along the report.	Government of France	Ministère de la Transition écologique et solidaire	France
66797	72	10	72	10	Figure 4.7 is an improvement over the FOD. And It makes sense to stick to the 1.5 reports enabling conditions categories. Yet, there are some linkages that get a bit obscured. For example, institutions and governance is also important for finance and for behavioural change, for example. Policies can also help nudge behavioural change. Not sure what one does about this, as reflecting the actual complexity of linkages works against having a tractable figure.	Accepted, figure revised	Navroz Dubash	Centre for Policy Research	India
2481	72	26	73	47	This is an interesting review of some key aspects of "policy-making for sustainability". Yet, for the purposes of this report it could be shortened considerably. Further, it would be helpful to already make reference to the "integrated policy packages" that are presented later.	Noted.	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
16313	72	26	84	32	The titles of subsections 4.4.1.2 ~ 4.4.1.9 are not consistent in their form (sentence or phrase). Specifically, titles of 4.4.1.3 ~ 4.4.1.6 are phrases, and other titles are sentences.	Partially accepted. Have made clearer that 4.4.1.7 to 4.4.1.10 are examples, by adding that word	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
8255	72	27	73	1	Not only innovate technology has driven transitions in the past, so has also external factors such as war.	Noted	Frida Zahlander	DanChurchAid	Denmark
73041	73	5			Add another citation to the existing one: Edwards & Cox 2020. (See details in one of the comments above.)	Noted. Will review the suggested references.	Larry Edwards	Larry Edwards Environmental Consulting	United States of America
84551	73	23	73	24	Please add the following after "... et al. 2017"): "By analysing various delay mechanisms in science and policy, effectual strategies may be identified (Karlsson and Gilek, 2019), and please add the following in the reference list: "Karlsson, M., Gilek, M. (2019) Mind the gap: Coping with delay in environmental governance. Ambio 49, 1067-1075 (2020). https://doi.org/10.1007/s13280-019-01265-z "	Noted. Will review the suggested references.	Mikael Karlsson	KTH Royal Institute of Technology	Sweden
2483	73	29	73	47	The integrated development and climate policies should be much broader/comprehensive than the suggested mix of climate policy instruments (here (a) to (d)). In fact, this comes out very clearly in the later examples.	Taken into account. Text to be revised and edited as relevant.	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
9695	73	29	73	47	True but also take note that multiple policies or policy packages need to be inspected to avoid policy overlapping and policy conflicts.	Noted.	Mustafa Babiker	Saudi Aramco	Saudi Arabia
71451	73	29	73	47	A discussion and classification of policy instruments can also be found at:Paolo Bertoldi, Chapter 4.3 - Overview of the European Union policies to promote more sustainable behaviours in energy end-users, Editor(s): Marta Lopes, Carlos Henggeler Antunes, Kathryn B. Janda, Energy and Behaviour, Academic Press, 2020, Pages 451-477, ISBN 9780128185674, https://doi.org/10.1016/B978-0-12-818567-4.00018-1 . (https://www.sciencedirect.com/science/article/pii/B9780128185674000181)	Noted. Will review the suggested references.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72287	73	29	73	47	A discussion and classification of policy instruments can also be found at the following book chapter, which could be cited here: Paolo Bertoldi, Chapter 4.3 - Overview of the European Union policies to promote more sustainable behaviours in energy end-users, Editor(s): Marta Lopes, Carlos Henggeler Antunes, Kathryn B. Janda, Energy and Behaviour, Academic Press, 2020, Pages 451-477, ISBN 9780128185674, https://doi.org/10.1016/B978-0-12-818567-4.00018-1 . (https://www.sciencedirect.com/science/article/pii/B9780128185674000181).	Noted. Will review the suggested references.	bertoldi paolo	European commission	Italy
47201	73	30	73	31	IPCC reports must be policy relevant and but not policy prescriptive	Noted.	Stuart Minchin	The Pacific Community	Australia
73043	73	39			Add another citation to the existing one: Edwards & Cox 2020. (See details in one of the comments above.)	Noted. Will review the suggested references.	Larry Edwards	Larry Edwards Environmental Consulting	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
20649	74	1	74	1	Issues related to the need for policy makers to adopt a dynamic adaptive policy pathway for managing decarbonization over the period of implementation could also be addressed in this section on governance and institutional capacity. When choosing a pathway as the most desirable option, it is important to keep in mind that each decarbonization option relies on the implementation of specific policies and instruments. Given structural, effectiveness, and timing uncertainties specific to each policy option, they may fail in delivering the expected outcomes in time. The possibility of diverging from an initial decarbonization trajectory to another one without incurring excessive costs should therefore be a strategic element in the design of an appropriate decarbonization strategy. Reference: Mathy, S., Criqui, P., Knoop, K., Fischelick, M., & Samadi, S. (2016). Uncertainty management and the dynamic adjustment of deep decarbonization pathways. <i>Climate Policy</i> , 16(sup1), S47-S62.	Taken into account. The issues raised related to national policy, assessed in chapter 13, which we have cross-referenced	Government of France	Ministère de la Transition écologique et solidaire	France
71453	74	1	75	2	Multilevel Governance and Institutional Capacities were key enabler for strengthening and implementing the global response as indicated in Ch.4 of the IPCC special report, therefore you could cite it again. In addition, in addition to multilevel governance also the concept of polycentric governance could also be added in this section, see Carlisle, K. and Gruby, R.L. (2019), Polycentric Systems of Governance: A Theoretical Model for the Commons. <i>Policy Stud J</i> , 47: 927-952. https://doi.org/10.1111/psj.12212	Taken into account. Will review the suggested references.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72289	74	1	75	2	Multilevel Governance and Institutional Capacities were key enabler for strengthening and implementing the global response as indicated in Ch.4 of the IPCC special report, therefore you could cite it again. In addition to multilevel governance also the concept of polycentric governance should also be added in this section, see Carlisle, K. and Gruby, R.L. (2019), Polycentric Systems of Governance: A Theoretical Model for the Commons. <i>Policy Stud J</i> , 47: 927-952. https://doi.org/10.1111/psj.12212	Taken into account. Will review the suggested references.	bertoldi paolo	europaen commission	Italy
55385	74	37	74	37	Use semi colon after Nerrini et al. (2019) for consistency.	Accepted. Editorial.	Government of United States of America	U.S. Department of State	United States of America
55387	74	37	74	37	Why is Nerim's first name listed? Delete it.	Accepted. Editorial.	Government of United States of America	U.S. Department of State	United States of America
71455	74	39	74	41	The Global Covenant of Mayor is a successful example of a transnational climate governance initiatives with over 10000 cities in all continents. These two article could be cited here: Paolo Bertoldi, Albana Kona, Silvia Rivas, Jean François Dallemand, Towards a global comprehensive and transparent framework for cities and local governments enabling an effective contribution to the Paris climate agreement, <i>Current Opinion in Environmental Sustainability</i> , Volume 30, 2018, Pages 67-74, https://doi.org/10.1016/j.coesust.2018.03.009 . (https://www.sciencedirect.com/science/article/pii/S1877343517301288) Giulia Melica, Paolo Bertoldi, Albana Kona, Andreea Iancu, Silvia Rivas, Paolo Zancanella, Multilevel governance of sustainable energy policies: The role of regions and provinces to support the participation of small local authorities in the Covenant of Mayors, <i>Sustainable Cities and Society</i> , Volume 39, 2018, Pages 729-739, ISSN 2210-6707, https://doi.org/10.1016/j.scs.2018.01.013 . (https://www.sciencedirect.com/science/article/pii/S2210670717313471)	Noted. Will review the suggested references.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72291	74	39	74	41	The Global Covenant of Mayor is a major successful example of a transnational climate governance initiatives with over 10000 cities in all continents. These two article should be cited here: Paolo Bertoldi, Albana Kona, Silvia Rivas, Jean François Dallemand, Towards a global comprehensive and transparent framework for cities and local governments enabling an effective contribution to the Paris climate agreement, <i>Current Opinion in Environmental Sustainability</i> , Volume 30, 2018, Pages 67-74, https://doi.org/10.1016/j.coesust.2018.03.009 . (https://www.sciencedirect.com/science/article/pii/S1877343517301288) and Giulia Melica, Paolo Bertoldi, Albana Kona, Andreea Iancu, Silvia Rivas, Paolo Zancanella, Multilevel governance of sustainable energy policies: The role of regions and provinces to support the participation of small local authorities in the Covenant of Mayors, <i>Sustainable Cities and Society</i> , Volume 39, 2018, Pages 729-739, https://doi.org/10.1016/j.scs.2018.01.013 . (https://www.sciencedirect.com/science/article/pii/S2210670717313471)	Noted. Will review the suggested references.	bertoldi paolo	europaen commission	Italy
27657	75	3	76	40	Section 4.4.1.4 to also incorporate financing challenges as a result of the pandemic and increasing indebtedness.	Taken into account. Chapter 15 assesses literature, including in relation to COVID	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
82493	75	3	76	40	the role of financial regulators, supervisors and central banks should be highlighted. Chapter 15 makes a strong case on this, therefore a couple of lines in Chapter 4 would be relevant. Cf. Bolton et al 2020 and Chenet et al 2021 for overview and references (incl. to NGFS) Chenet, H., Ryan-Collins, J., van Lerven, F., 2021. Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy. <i>Ecol. Econ.</i> 183, 106957. https://doi.org/10.1016/j.ecolecon.2021.106957 Bolton, P., Despres, M., Pereira da Silva, L.A., Samama, F., Swartzman, R., 2020. The green swan: central banking and financial stability in the age of climate change. Banque de. ed. Bank for International Settlements (BIS). NGFS, 2019. NGFS First comprehensive report. A call for action: Climate change as a source of financial risk.	Noted. Ch15 will be cross-referenced for this matter.	Hugues CHENET	University College London	France
61733	75	4	75	8	"Accelerated mitigation and shifting development pathways necessitates both re-directing existing financial flows from high- to low-emissions technologies and systems and to provide additional resources (robust evidence, high agreement). An example are changes in investments from fossil fuels to renewable energy, with pressures to disinvest in the former and increasing levels of "green finance" (6, 15)." The latter part should be rephrased as "[...] from fossil fuels to renewable and nuclear energy [...]" for it to be more scientifically accurate and technology neutral.	Rejected. We meant to say "renewable energy" (as an example)	Rauli Partanen	Think Atom	Finland
65767	75	4	75	8	"Accelerated mitigation and shifting development pathways necessitates both re-directing existing financial flows from high- to low-emissions technologies and systems and to provide additional resources (robust evidence, high agreement). An example are changes in investments from fossil fuels to renewable energy, with pressures to disinvest in the former and increasing levels of "green finance" (6, 15)." The latter part should be rephrased as "[...] from fossil fuels to renewable and nuclear energy [...]". This is especially critical given the debate regarding the role of nuclear energy in the EU taxonomy. The IPCC should make a stance for a promoting policy support for all low-carbon energy sources not only for renewables. Revise accordingly.	Rejected. We meant to say "renewable energy" (as an example)	Eero Hirvijoki	Aalto University	Finland
55389	75	6	75	6	"are" should be "is"	Accepted. Editorial.	Government of United States of America	U.S. Department of State	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
27655	75	6	75	7	Delete "An example are changes in investments from fossil fuels to renewable energy, with pressures to disinvest in the former and increasing levels of "green finance".	Rejected. No rationale provided for deletion	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
55391	75	7	75	7	Insert "a" after "is"	Accepted. Editorial.	Government of United States of America	U.S. Department of State	United States of America
5279	75	7	75	8	Thermal renewables are competitive for some domestic or industrial use. Renewables (solar and wind) for electricity production are not competitive with hydro, nuclear or gas production and need public subsidies and public warranties to promote investment. In addition, don't forget the cost of storage or alternate supply when there is no wind or sun.	Taken into account. Chapter 6 assesses energy technologies	Michel SIMON	Retraité/ Pdt d'association	France
61735	75	8	75	10	"Some renewable energy technologies have become competitive (section 4.2, chapter 2), so that public support is needed [...]." Rephrase into "Where allowed and not discriminated against, nuclear energy already is and some renewable energy technologies have become competitive (section 4.2, chapter 2), so that public support is needed [...]."	Rejected. We meant to say "renewable energy"	Rauli Partanen	Think Atom	Finland
65769	75	8	75	10	"Some renewable energy technologies have become competitive (section 4.2, chapter 2), so that public support is needed [...]." Rephrase into "Nuclear energy already is and some renewable energy technologies have become competitive (section 4.2, chapter 2), so that public support is needed [...]."	Rejected. We meant to say "renewable energy"	Eero Hirvijoki	Aalto University	Finland
55393	75	9	75	9	Minor typo or word missing (needed the extent)	Accepted. Editorial.	Government of United States of America	U.S. Department of State	United States of America
82491	75	23			"explored" instead of "developed" ... as e.g. Basel rules are not currently modified, but some authors and institutions work on developing innovative approaches.	Accepted.	Hugues CHENET	University College London	France
39053	75				"Accelerated mitigation and shifting development pathways necessitates both re-directing existing financial flows from high- to low-emissions technologies and systems and to provide additional resources (robust evidence, high agreement). An example are changes in investments from fossil fuels to renewable energy, with pressures to disinvest in the former and increasing levels of "green finance" (6, 15)." This is a good sentence, because it embodies some of the dangers of discussing transition finance only in terms of GHG reduction. This problem also afflicts the discussions surrounding the adoption of the EU Green Taxonomy. What is left out of the equation, both here and in the EU's taxonomy, is any consideration of the costs of this transition in terms of managing the shift out of existing infrastructure. It's way more than just considering fossil-fuel-related stranded assets—it's a considerably higher percentage of the economy that can be expected to see material transition costs. We need a broader discussion of these, and how they are going to be financed, and by whom. Please don't replicate the EU's optimism on this point—that it's a simple matter of redirecting financial flows. It's not.	Taken into account. Mostly a comment, and thanks. We include just transitions in 4.5	Robert Buhr	Green Planet Consulting Ltd.	United Kingdom (of Great Britain and Northern Ireland)
12241	76	13	76	26	I think this is too loose drafting. Readers that deep in an IPCC chapter do not need to be told the vary basics of pricing (current best guess level and basic ways of implementing). Instead this should be more concrete for the main point here, the SDG agenda. For example, Franks et al. (2018), Nature Sustainability has interesting concrete numbers how much of development infrastructure needs can be financed by carbon pricing.	Rejected. We devote a paragraph to carbon pricing, and corridor is not 'basic', in our assessment	Linus Mattauch	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
55395	76	27	76	36	This paragraph described how reductions in military spending globally could free up funds to support adherence to the SDGs. Operating under the assumption that commitment to the SDGs is insufficient to influence countries' military spending, this section would benefit from a discussion on how military spending could be more climate conscious (e.g., renewable fuel investments) and examples of how this is already being done.	Rejected. Good point, but we did not find literature on 'greening' military spending	Government of United States of America	U.S. Department of State	United States of America
20651	76	37	76	38	The issues surrounding the elimination of fossil fuel subsidies are really only touched upon in this chapter. In the same way that the amount of military spending is given, it might be interesting to give the amount of fossil fuel subsidies compared to the amount of renewable energy subsidies.	Taken into account. Chapter 15 assesses literature on fossil fuel subsidies	Government of France	Ministère de la Transition écologique et solidaire	France
55397	77	4	77	6	This is another point in which the themes and arguments made in Section 4.3.2 are likely worth repeating. It is not all people/countries that need to make shifts, but those currently responsible for the majority of emissions – either directly or indirectly. This could be framed in terms of environmental justice.	Rejected. It is not for IPCC to indicate which countries take action, and these sentences refer to adaptation as well as mitigation	Government of United States of America	U.S. Department of State	United States of America
71457	77	7	77	29	Not only the principle of cognitive psychology are important but also the complementary policy approach based on social practices theories (social norms) shall be included to overcome the limitations of current policy approaches to energy conservation. It is recommended to cite for following article: Nicola Labanca, Paolo Bertoldi, Beyond energy efficiency and individual behaviours: policy insights from social practice theories, Energy Policy, Volume 115, 2018, Pages 494-502, https://doi.org/10.1016/j.enpol.2018.01.027. (https://www.sciencedirect.com/science/article/pii/S0301421518300363)	Noted. Social norms are already part of the enabling factors considered in the section. Will review the suggested references	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72283	77	7	77	29	Not only the principle of cognitive psychology are important but also the complementary policy approach based on social practices theories (social norms) shall be included to overcome the limitations of current policy approaches to energy conservation. It is recommended to cite for following article: Nicola Labanca, Paolo Bertoldi, Beyond energy efficiency and individual behaviours: policy insights from social practice theories, Energy Policy, Volume 115, 2018, Pages 494-502, https://doi.org/10.1016/j.enpol.2018.01.027. (https://www.sciencedirect.com/science/article/pii/S0301421518300363).	Noted. Social norms are already part of the enabling factors considered in the section. Will review the suggested references	Bertoldi Paolo	European Commission	Italy
55399	77	12	77	14	This indicates the limitations of mainstream economics and the need to make those assumptions transparent in this chapter. Many people act for reasons that appear to conflict with self-interest, either because institutions influence their choices (e.g., through advertising campaigns) or because they are in situations where they cannot choose freely (e.g., a soldier in the military).	Noted.	Government of United States of America	U.S. Department of State	United States of America
80565	78	4	78	10	Suggested paraphrasing: Targeting mitigation alone has less success than strategies which incorporate subjective life satisfaction and build societal support. Costs and immediate benefits significantly shape behaviour, therefore schemes that bring forward distant costs into the present or provide upfront incentives are more effective.	Taken into account. This is a key message, and has been revised based on multiple considerations. Thanks for the suggestion	Olga Savchuk	Instituto Superior Tecnico	Portugal
85365	78	17	78	17	This text seems to a political statement rather than based on data and analysis. A definition is needed for the "high emitting sector" phrase, since it is very unclear why the aviation sector with its share of 2% CO2 emissions and a forum (i.e. ICAO) on defining clear policies for decarbonisation is mentioned here, while for example, the fast-growing industries (such as textiles) are not referred to in this manner.	Accepted. Text to be edited and use the term "Hard to abate" sectors, according to the literature review.	Neil Dickson	ICAO	Canada
63593	78	18			Would include RD&D as "learning-by-doing" which can include through deployment, is often used throughout this chapter as a means to close technology gaps as well.	Taken into account. Refer to new technology deployment in 4.2.5.13 of FGD	Government of Canada	Environment and Climate Change Canada	Canada
66799	79	7	84	32	Secs 4.4.1.7 to 4.4.1.10 are sliced very differently from the sections that precede them. While the preceding sections are organised around enabling conditions, these are around particular examples. I like these sections - they bring the issues to life. But as an organisational device, please consider pulling them into a different sub-section. Putting the two bits together also results in a very long section (13 pages), which is hard to read.	Rejected. There were many considerations on structure, and the team chose to keep this as a single section, but signalling "examples" are in the latter half	Navroz Dubash	Centre for Policy Research	India
61737	79	36	79	37	"The future viability of sectors will depend on the extent to which they can remain profitable while relying on renewable energy." Rephrase into "The future viability of sectors will depend on the extent to which they can remain profitable while relying on low-carbon energy." To be more consistent, scientifically accurate and technology neutral.	Accepted. We meant to say "lower-carbon energy" (including inter alia nuclear see also chapter 6)	Rauli Partanen	Think Atom	Finland
65771	79	36	79	37	"The future viability of sectors will depend on the extent to which they can remain profitable while relying on renewable energy." Rephrase into "The future viability of sectors will depend on the extent to which they can remain profitable while relying on low-carbon energy."	Accepted. We meant to say "lower-carbon energy" (including inter alia nuclear see also chapter 6)	Eero Hirvijoki	Aalto University	Finland

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
74169	79	37			Strike "renewable energy" and insert carbon-free generation. A focus on only renewables is not appropriate as it shows a bias against other forms of clean energy generation.	Accepted. We meant to say "lower-carbon energy" (including inter alia nuclear see also chapter 6)	Jeffrey Merrifield	Pillsbury Law Firm	United States of America
50055	79	37	79	37	"relying on renewable energy" should be "relying on low-carbon energy such as renewables."	Accepted. We meant to say "lower-carbon energy" (including inter alia nuclear see also chapter 6)	Masahiro Sugiyama	University of Tokyo	Japan
31737	79	39	79	39	cross refer Gender CCB (P34L26-Cross-Chapter Box GENDER: Gender, Climate Justice and Transformative Pathways) from chapter 18 WG II	Noted.	Shreya Some	Ahmedabad University	India
10591	79	39	79	41	It is frustrating that SDG 5 ("Achieve gender equality and empower all women and girls") is only mentioned in this economic context. Indeed, target 5.6 reads "Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences" As demonstrated by Vollnet et al (https://doi.org/10.1016/S0140-6736(20)30677-2), the fulfillment of this target will contribute considerably to put an end to population growth. In other words, target 5.6 offers a powerful contribution for mitigating climate warming. The report of WG3 should mention this.	Taken into account. We made a special effort to bring in gender, among many considerations. It is also assessed in other chapters in the WGIII report	Philippe Waldteufel	CNRS	France
2485	80	10	82	13	Green fiscal reform can be a key "integrated policy package" - I am in much agreement with the authors here. It includes, but is not limited to carbon taxes (subsidy removal), green subsidies, public investment/infrastructure, redistribution, and social spending etc. Acceptance for carbon pricing is one aspect of such reform (which is probably over-emphasized a bit here), but in essence it is about a fiscal policy that heads for transformative change. Maybe this could be made more explicit. PS: I am not an expert on European climate policy, but I am surprised that the EU's "green deal" is not even mentioned here (is only mentioned later, see also my comment on the lack of cross-references between this section and the later section on "just transition").	Noted. And thanks. Afraid space does not allow EU Green Deal to be mentioned everywhere	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
71459	80	10	82	13	Carbon taxes are also discussed in Ch.9 section 9.9.3.1, it is suggested to cross reference the two sections (in your chapter section 4.4.1.8.)	Accepted. Will cross-reference.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72285	80	10	82	13	Carbon taxes are also discussed in Ch.9 section 9.9.3.1, it is strongly suggested to cross reference the two sections (in your chapter section 4.4.1.8.)	Accepted. Will cross-reference.	bertoldi paolo	europaen commission	Italy
5123	80	12	80	18	You mention fiscal systems "currently" being under stress. It would be good if you also explicitly referred to possible aspects of the economic recovery from the COVID-19 crisis	Taken into account. See more detailed treatment in 4.2.2.5 and other chapters, including a COVID cross-chapter box in chapter 1	Lina Hollender	n/a	Germany
66193	80	33	80	35	Text mentions the scope of fossil fuel subsidies and points out that the potential of for creating fiscal space varies strongly across countries. Several recent studies have estimated the impact of removing fossil fuel subsidies on emissions and potential of reaching NDC targets in selected countries by using this instrument. It is suggested to add a brief discussion of corresponding literature and results to the text. In particular Jewell et al. (2018) argue that fossil fuel subsidies removal would have a relatively limited impact of global CO2 emissions reduction (between 1% and 4%). Chepeliev and van der Mensbrugge (2020) show that, while scope for a global emissions reduction is limited, selected countries (9 out of 17 analyzed) can reach their NDC targets by fossil fuel subsidy reform only. References: 1. Jewell et al., 2018. Limited emission reductions from fuel subsidy removal except in energy exporting regions Nature DOI (2018), 10.1038/nature25467 2. Chepeliev and van der Mensbrugge. 2020. Global fossil-fuel subsidy reform and Paris Agreement. Energy Economics, Volume 85, January 2020, 104598, https://doi.org/10.1016/j.eneco.2019.104598	Noted. This paragraph does not discuss the impact of removing fossil fuel subsidies on emissions; it merely notes the global value of these subsidies.	Maksym Chepeliev	Purdue University	United States of America
9697	80	43	81	3	Discuss tax interaction effect and the implication of pre-existing distortions including both taxes and subsidies.	Accepted. Text amended to refer to interactions between different policies, not only taxes but more broadly, with a reference to Parry 2020.	Mustafa Babiker	Saudi Aramco	Saudi Arabia
15233	81	13	81	17	The statement of carbon leakage is inaccurate and incomplete, and it is suggested to make the following changes: 1. The word "confirm" in line 13 is too absolute, and it is suggested to change it to "finds". 2. There is also a lot of literature that suggests that using a border adjustment tax to correct carbon leakage would create new inequities. So, it is suggested to include the sentence "Additional researches suggest that using a border adjustment tax to correct carbon leakage would create new inequities." (Mckibbin 2008, xie 2010, MESSERLIN 2012, Ravikumar 2020) The supporting literature is as follows: Mckibbin W J, Wilcoxon P.J. "The Economic and Environmental Effects of Border Tax Adjustments for Climate Policy". Brookings Working Paper, 2008. Xie Laihui, Chen Ying: Is China Overly Concerned about Carbon Tariffs? International Economic Review, 2010 MESSERLIN, and A. Patrick. "Climate and trade policies: from mutual destruction to mutual support. " World Trade Review (2012). Ravikumar A. P., Carbon border taxes are unjust, MIT technology review, 2020. https://www.technologyreview.com/2020/07/27/1005641/carbon-border-taxes-eu-climate-change-opinion/	Partially accepted. While the initial statement was correct, it has been adjusted to be more nuanced and now refers the reader to other chapters that discuss this issue in more detail.	Government of China	China Meteorological Administration	China
61739	81	24	81	26	"As part of ongoing efforts to accelerate mitigation, such tax hikes may be crucial to avoid a slow-down in the shift to renewable energy sources." Substitute "renewable energy sources" with "low-carbon energy sources" to be both scientifically more accurate and technology neutral.	Accepted. We meant to say "lower-carbon energy" (including inter alia nuclear see also chapter 6)	Rauli Partanen	Think Atom	Finland
65773	81	24	81	26	"As part of ongoing efforts to accelerate mitigation, such tax hikes may be crucial to avoid a slow-down in the shift to renewable energy sources." Substitute "renewable energy sources" with "low-carbon energy sources".	Accepted. We meant to say "lower-carbon energy" (including inter alia nuclear see also chapter 6)	Eero Hirvijoki	Aalto University	Finland
5281	81	26	81	26	Replace Renewables by low carbon	Accepted. We meant to say "lower-carbon energy" (including inter alia nuclear see also chapter 6)	Michel SIMON	Retraité/ Pdt d'association	France
27659	81	26	81	27	Delete "In countries that exports carbon energy, carbon taxation may run into additional resistance from producers."	Noted. The paragraph already discusses the main insights from the literature. (The first sentence says that the literature exists; the following sentences discuss its main insights.)	Eleni Kadiri	Organization of the Petroleum Exporting Countries, OPEC	Austria
12243	81	28	81	31	I think it would be highly desirable to not just say that this literature exist, but to develop what it's main insights are to advance short-term mitigation! Choice of references odd, consider Kallbekken et al. 2011, 2017, Carattini et al. 2017, Klenert et al. 2018	Partially accepted. In fact, the paragraph already discusses the main insights from the literature. (The first sentence says that the literature exists; the following sentences discuss its main insights.) The text was amended to include pertinent findings in Carattini et al. (2017).	Ilmus Mattauch	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
63595	81	28	81	33	potential opportunity here to include Canadian carbon pricing system with being revenue neutral.	Accepted. Reference to carbon pricing in Canada has been added.	Government of Canada	Environment and Climate Change Canada	Canada
55401	83	2	83	2	"remain" should be "remains"	Accepted. Typo has been fixed.	Government of United States of America	U.S. Department of State	United States of America
55403	83	2	83	2	"is" should be "are"	Accepted. Typo has been fixed.	Government of United States of America	U.S. Department of State	United States of America
55405	83	5	83	5	Delete parentheses around the citation.	Accepted. Typo will be removed as part of editing.	Government of United States of America	U.S. Department of State	United States of America
84449	83	22	83	24	"Today's investments in electric vehicles in settings where electricity is produced with fossil fuels is an example of convertible investments – they will be decarbonised once electricity production has switched to renewable energies." Switch "renewable" to "non-fossil" or "renewable and nuclear".	Accepted. Text changed to "zero-carbon energies".	Mattias Lantz	Uppsala university	Sweden
5283	83	24	83	24	Replace Renewables by low carbon	Accepted. Text changed to "zero-carbon energies".	Michel SIMON	Retraité/ Pdt d'association	France

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84553	83	34	83	35	Please add the following reference in the parenthesis: "Karlsson, M., Alfreðsson E. & Westling N. (2020) Climate policy co-benefits: a review. <i>Climate Policy</i> 20, 292-316. DOI: 10.1080/14693062.2020.1724070".	Taken into account. A reference to this piece of research was not added here (given its limited focus on agriculture) but in the beginning in Section 4.3.3.1, where it is highly relevant.	Mikael Karlsson	KTH Royal Institute of Technology	Sweden
78419	83	38	84	32	This is a good case study which could be better in a box than in the text. There are other similar examples	Accepted. Thanks.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
24931	84	1	84	6	The first two sentences repeat too similar concepts.	Accepted. Text has been edited to remove redundancy.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
55123	84	15	84	26	The authors state that there was deregulation of land use in the Amazon, but it is not true. There were no changes in land regulations in Brazil and the country have maintained its Forest Code as it is. There is no mention in the document regarding where this information came from and it is important to check this fact before publication. Regarding monitoring enforcement, the Brazilian Government established the Amazon Council and an Environment Task Force to devise plans and actions for protecting, defending, and sustainably developing Brazilian forestry. These actions were not reflected in the text. The Council is coordinated by the Vice President, Hamilton Mourão. In the box, the authors missed to cite the recent the Floresta + Project, designed to align policies for social and economic development with climate change adaptation and mitigation, as well as biodiversity protection.	Noted. No specific textual change is proposed nor literature provided by the reviewer. The paragraph cite several references.	Government of Brazil	Ministry of Foreign Affairs of Brazil	Brazil
70155	84	21			2020 in FGD]. This 11,000 km ² rate of deforestation far exceeds the rate agreed upon by the National Policy on Climate Change in 2009. Current rates of deforestation are 182% higher than the established targets - representing a reduction of only 44% compared to the 80% established in law. The failure to meet these commitments lend increased weight to the need for strong actions aimed at reducing deforestation including deforestation moratoriums and a coherent plan for regularization and protection of public and indigenous lands (Silvia Junior et al. 2020). https://www.nature.com/articles/s41559-020-01368-x	Rejected. IPCC does not assess status of individual countries against targets, we assess the literature	Rayner Andersen	Department of Fisheries and Oceans	Canada
27661	84	24	84	26	Delete "Further, fossil fuel subsidies and other fiscal support of increased exploitation of oil resources may create carbon lock-ins that inhibit further low-carbon investments (LeVine et al. 2018)."	Rejected. No rationale provided for deletion	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
55407	84	33	88	38	Though the authors make some interesting points in this section, there is considerable overlap with past discussions on development pathways and also frames some actions – which primarily have mitigation outcomes – in the context of adaptation. Critically, the land-based and blue carbon arguments here ought to be more clearly highlighted in previous sections.	Noted. While this reviewer seeks mention earlier, that would lead to repetition, and generally chapters were asked to reduce word length or limit increase	Government of United States of America	U.S. Department of State	United States of America
16317	84	33	90	44	The contents and discussions in this part are often closely related with the discussions in other chapters in AR6. So, it will be very informative and helpful to readers if authors explicitly indicate related chapters in such cases.	Accepted. Will cross-reference.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
1947	84	34	84	39	It would be worth mentioning up front that mitigation efforts directly determine/influence climate impacts and thereby the need for adaptation. The last sentence is tricky to understand, but the intrinsic interrelationships between development and adaptation would also need to be brought out more clearly. Several studies find that development is the most important determinant of adaptive capacity.	Accepted, we will address this more clearly.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71461	84	34	84	39	It would be worth mentioning up front that mitigation efforts directly determine/influence climate impacts and thereby the need for adaptation. The last sentence is tricky to understand, but the intrinsic interrelationships between development and adaptation would also need to be brought out more clearly. Several studies find that development is the most important determinant of adaptive capacity.	Accepted, we will address this more clearly.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
20653	84	40	84	42	Could also add that PA recognises that mitigation co-benefits from adaptation actions can contribute to mitigation efforts under NDCs (article 4.7).	Taken into account. Article 4.7 is cited on p.87 of SOD	Government of France	Ministère de la Transition écologique et solidaire	France
10593	84	42	84	42	"The Agreement and recognizes?"	Accepted, text revised	Philippe Waldeufel	CNRS	France
1949	85	5	85	13	This is also the case with respect to the SDGs	Noted. However, inclusion of SDGs in this section not crucial to development of chapter, so omitting due to space constraints.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71463	85	5	85	13	This is also the case with respect to the SDGs	Noted. However, inclusion of SDGs in this section not crucial to development of chapter, so omitting due to space constraints.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
16315	85	20	84	32	I see that in SOD, Links to Adaptation section has moved to the end of Ch.4 as a separate section. However, reshaping or reorganizing the contents in subsection 4.4.2.1 will improve the structure of the section.	Noted. However, the structure of subsection 4.4.2.1 has been chosen to be parallel to table 4.9 which gives examples of policies that shift development pathways. We'll edit to explicitly call out policies and relate back to table 4.9.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
70159	85	34			adaptation goals. Risks remain concerning retrofitting adaptation into existing development agendas - potentially leading to maladaptation. Existing adaptation efforts may reinforce, redistribute or create new vulnerabilities in the face of climate change - addressing inefficiencies and oversights in existing adaptation policies is crucial in order to turn adaptation efforts from hindrance or irrelevance to helpful actions (Eriksen et al. 2021). https://www.sciencedirect.com/science/article/pii/S0305750X20305118	Noted.	Rayner Andersen	Department of Fisheries and Oceans	Canada
20671	85	37	85	39	"cities, governments": Please note that there are counterarguments both ways. Thomas Thaler , Marie-Sophie Attensa, Mathieu Bonnefond, Darren Clarke Amandine Gatien-Tournat , Mathilde Gralpeois , Marie Fournier , ConorMurphy , Magdalena Rauter, Maria Papatoma-Köhle , Sylvie Servain , Sven Fuchs : Drivers and barriers of adaptation initiatives - How societal transformation affects natural hazardmanagement and riskmitigation in Europe Science of the Total Environment 650 (2019) 1073–1082. Jennifer West (NO) and Elisabeth Worliczek (AT), Operationalising knowledge on and for societal transformations in the face of climate change : White Paper of JPI Climate. Edited by Dabo Guan, Zhifu Mi, Zhu Liu, Jingru Liu, Vincent Viguié, Neil Fromer: SI: Cities: the core of climate change mitigation Journal of Cleaner Production Volume 207, 10 January 2019, Pages 582-589	Noted	Government of France	Ministère de la Transition écologique et solidaire	France
63597	85	41			Would recommend explaining how so. Does the private sector invest in adaptation only offer means for adaptation under their CSR reporting? Thinking of insurance companies and flood insurance for example.	Noted. Text revised, but leaving detailed elaboration of private sector in adaptation to WGII	Government of Canada	Environment and Climate Change Canada	Canada
411	85	44	86	6	Mitigation pathways in line with the 1.5°C and 2°C temperature targets of the Paris Agreement will entail steep transformational changes if GHG emissions are to decline towards net zero by mid-century. The mitigation targets in NDC focus primarily on incremental and gradual changes rather than acute transformations. There is considerable uncertainty that people will be receptive to the behavioral changes necessary to implement these transformational changes. There needs to be an assessment of the views of people in different countries to determine how receptive they are to sweeping transformational changes necessary to mitigate climate change impacts.	Noted. Good points, but calls for an 'assessment of the views of people ...' - further research is needed	Michael Kennish	Rutgers University	United States of America
63599	86	2	86	4	Would reframe sentence to indicate that these authors came to these findings.	Accepted, text revised	Government of Canada	Environment and Climate Change Canada	Canada
413	86	7	86	14	The paragraph on Finance provides little in-depth assessment. The first order draft on Financial Systems was far superior in content, focus, and recommendations. The shifting interests of developed nations can significantly affect policy efforts to direct financial resources to developing nations for dealing with climate change problems. Government reduction in climate financing due to shifting political platforms means that global public and private investment will take on an increasingly important financial resource to deal with climate change. It is becoming clear that increased public and private investment will be necessary to achieve near- and mid-term goals of global emissions reduction. New investment strategies must be pursued to increase effective financing of climate change.	Taken into account. We refer the reviewer and all readers to chapter 15 for more in-depth discussion relating investment in funding mitigation and adaptation actions.	Michael Kennish	Rutgers University	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
61279	86	7	86	14	The A6 WGIII report has great potential to influence the policies of the UN Convention to Combat Desertification the achievement of SDG Target 15.3 on land degradation neutrality (LDN), but only if there are sufficient entry points in the text. This chapter may offer an excellent opportunity, perhaps in this section, if a sentence were to be added such as follows in red: "… may best be achieved through integrated actions that comprise policies, both fiscal and other, in support of the broader SDG agenda (13.8, 13.9). For example, policies that promote land degradation neutrality, which is integral to SDG target 15.3, can also enhance food security, human wellbeing and climate change adaptation and mitigation. [1] [1] See key messages B.1.3, B.4.4, C.1.1, C.1.3 in the IPCC SRCL and Land https://www.ipcc.ch/srcl/ Also see AR6 WG II Chapter 12, pages 76-78.	Partially accepted. The WGIII report cannot cover in detail other conventions, CCD, CBD, POPs and others. We do refer to land degradation citing IPBES 2019, and link that to our assessment on shifting development pathways to sustainability. We have also revised, so that there is specific assessment of 'Farming system approaches can benefit mitigation and adaptation'	Graham von Maltitz	UNIVERSITY OF STELLENBOSCH, UNCCD SCIENCE POLICY INTERFACE	South Africa
8257	86	8	86	14	Only 20% of global climate finance goes to adaptation, despite UN secretary general's call for the increase to 50% (Climate Adoption Summit, Jan 2021)	Noted	Frida Zahlander	DanChurchAid	Denmark
1489	86	11	86	11	Add Kongsager et al. 2016 to the cited reference: "limited (Kongsager et al. 2016; Locatelli et al. 2016) There" *Kongsager, R., Locatelli, B. & Chazarin, F. (2016). Addressing climate change mitigation and adaptation together: a global assessment of agriculture and forestry projects. <i>Journal: Environmental Management</i> 57 (2), pp 271-282. http://dx.doi.org/10.1007/s00267-015-0605-y	Rejected. Reviewer requests added reference without any rationale	RICO KONGSAGER	University College Copenhagen	Denmark
1491	86	13	86	13	Add Kongsager et al. 2016 to the cited reference: "(Kongsager et al. 2016; Locatelli et al. 2016)." *Kongsager, R., Locatelli, B. & Chazarin, F. (2016). Addressing climate change mitigation and adaptation together: a global assessment of agriculture and forestry projects. <i>Journal: Environmental Management</i> 57 (2), pp 271-282. http://dx.doi.org/10.1007/s00267-015-0605-y	Rejected. Reviewer requests added reference without any rationale	RICO KONGSAGER	University College Copenhagen	Denmark
415	86	15	86	25	Same comment here as that for Finance above.	Noted	Michael Kenish	Rutgers University	United States of America
63601	86	23			Does "north to south technology transfers" imply developed to developing country technology transfers?	Noted (and yes, that is the understanding)	Government of Canada	Environment and Climate Change Canada	Canada
45875	86	33	88	37	It could be useful for the reader to hint to the concept of nature-based solutions in chapter 4.4.2.2, as it has great potential for the development of systems beneficial for adaptation and mitigation, e.g. by strengthening systems like agroforestry, which also provide biodiversity benefits and further co-benefits (see Cohen-Shacham et al. 2016, Seddon et al. 2021).	Accepted, text revised	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
20655	86	34	86	36	This chapter includes no explicit analysis of the synergies/conflicts between near-/mid-term climate pathways and protecting biodiversity - although the topic is treated directly in other chapters (cf. 3.7.5). Several of the paragraphs that follow do, however, address these issues. It might therefore be helpful to add in this covering paragraph something along lines: "Actions in these areas may be particularly relevant in seeking to reconcile policies to address climate mitigation, adaptation and the protection of biodiversity."	Taken into account. We refer to land degradation citing IPBES 2019, and link that to our assessment on shifting development pathways to sustainability. We have also revised, so that there is specific assessment of 'Farming system approaches can benefit mitigation and adaptation'	Government of France	Ministère de la Transition écologique et solidaire	France
20657	86	37	86	42	Could this information be summarized in a dedicated figure/table, to better highlight for policymakers the trade-offs and synergies between adaptation and mitigation, sensitivity to biophysical coupling and linkages to development pathways?	Rejected. Added text, in response to previous figure, but not a dedicated figure	Government of France	Ministère de la Transition écologique et solidaire	France
12013	87	4	87	10	To add weight to the point that coastal ecosystems may have limited mitigation impact, it would be useful to note that recent assessments suggest that coastal wetlands can sequester 0.2 GtCO ₂ per annum globally, storing between 50 – 90% of this carbon over the long term - HOWARD, J., SUTTON-GRIER, A., HERR, D., KLEYPAS, J., LANDIS, E., MCLEOD, E., PIDGEON, E. & SIMPSON, S. 2017. Clarifying the role of coastal and marine systems in climate mitigation. <i>Frontiers in Ecology and the Environment</i> , 15, 42-50.	Accepted. Text revised and reference added	Paul Rouse	Carnegie Climate Governance Initiative (C2G) - The Carnegie Council for Ethics and International Affairs	United Kingdom (of Great Britain and Northern Ireland)
12015	87	4	87	10	Restoration of coastal ecosystems would give rise to governance issues - i.e. land use change, monitoring, verification and reporting and, potential transboundary issues. These could usefully be referenced - see the 'Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat 2016-2024 Strategic Plan https://www.ramsar.org/sites/default/files/documents/library/4th_strategic_plan_2016_2024_e.pdf	Rejected. Good point, but we cannot fully explore links this RAMSAR and many other conventions	Paul Rouse	Carnegie Climate Governance Initiative (C2G) - The Carnegie Council for Ethics and International Affairs	United Kingdom (of Great Britain and Northern Ireland)
70007	87	12	87	13	In parenthesis, add the following reference: "Cordova et al. 2019"	Rejected. Reviewer requests added reference without any rationale	Markku Kanninen	University of Helsinki	Finland
71465	87	33	87	34	Blue carbon refers to carbon stored in vegetated coastal ecosystems such as seagrasses, salt marshes, and mangroves." Please note that the glossary - Annex A states the following for Blue carbon: "All biologically-driven carbon fluxes and storage in marine systems that are amenable to management can be considered as blue carbon. Coastal blue carbon focuses on rooted vegetation in the coastal zone, such as tidal marshes, mangroves and seagrasses. These ecosystems have high carbon burial rates on a per unit area basis and accumulate carbon in their soils and sediments. They provide many non-climatic benefits and can contribute to ecosystem-based adaptation. If degraded or lost, coastal blue carbon ecosystems are likely to release most of their carbon back to the atmosphere. There is current debate regarding the application of the blue carbon concept to other coastal and non-coastal processes and ecosystems, including the open ocean. Please consider expanding to fit with the more comprehensive definition from the glossary. For example, in the case of the whale pump, ending overfishing and restoring whale populations could be considered an ocean mitigation action via NBS.	Accepted, we will update the definition to be consistent with the glossary.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
10595	87	40	87	42	This sentence is lame.	Accepted. Text revised (though 'lame' is harsh)	Philippe Waldteufel	CNRS	France
45877	87	40	87	45	It should be explained why the restoration/protection of coastal ecosystems has limited potential as a global-scale mitigation measure, although it has been advocated as a climate solution at national and global scales. This seems not clear from this paragraph but would be highly policy relevant.	Accepted, we will quantify the potential mitigation in this sector.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
20659	87	44	88	3	"relative...salinity" is unclear. The previous sentence was asserting that "Restoration and protection of coastal ecosystems has been advocated as a climate solution at [...] global scales". This sentence contradicts this statement, thus making it unclear whether it can be considered as a solution at global scales.	Accepted, text revised	Government of France	Ministère de la Transition écologique et solidaire	France
9891	87		88		• Blue carbon and mitigation co-benefits of adaptation actions The Paris Agreement recognised that mitigation co-benefits resulting from Parties' adaptation actions and/or economic diversification plans can contribute to mitigation outcomes. Blue carbon refers to carbon stored in vegetated coastal ecosystems such as seagrasses, salt marshes, and mangroves. • Restoring or protecting such coastal ecosystems increases carbon sinks, reduces coastal erosion and protects from storm surges, and otherwise mitigates impacts of sea level rise and extreme weather along the coast line	noted.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
10597	88	2	88	2	"of" seems missing	accepted.	Philippe Waldteufel	CNRS	France
20661	88	8	88	9	"habitat preservation": Some examples would be of great interest. E.g.: water filtering, biodiversity hotspots...	accepted. From the examples in the comment - ecosystem services is perhaps a more useful framework; we will articulate ecosystem service examples.	Government of France	Ministère de la Transition écologique et solidaire	France
20663	88	11	88	12	This statement might seem confusing. Ending this part on such a conclusion can be dangerous for the conclusion readers would make. Indeed, it suggests that coastal ecosystem-based adaptation is no longer interesting at higher levels of climate change, when this adaptation is crucial for millions of people living by the coast. Indeed, when coastal ecosystem-based adaptation is important for local and national societies, ending with this statement can lead to dangerous interpretation. E.g. - If coastal ecosystem-based adaptation suffers from the vulnerability that it may no longer be effective at higher levels of climate change, then it is not a priority compared to better solutions.	Accepted. Text revised, sections now ends differently	Government of France	Ministère de la Transition écologique et solidaire	France
55409	88	18	88	19	Landscape restoration can take place in landscapes that aren't productive or directly associated with agriculture. The sentence should specify that the benefits to farmers are in the context of agricultural landscapes.	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
72775	88	19	88	21	Success here is conditional on the types of trees that are planted, whether participation of people that live / use the land is ensured, and other factors such as water availability. If well implemented, there are potential positive biophysical impacts associated with tree planting (e.g. local cooling). Please expand	accepted	Matthew Gidden	Climate Analytics	Germany
78157	88	19	88	21	Success here is conditional on the types of trees that are planted, whether participation of people that live / use the land is ensured, and other factors such as water availability. If well implemented, there are potential positive biophysical impacts associated with tree planting (e.g. local cooling). Please expand!	accepted.	Charlotte Plinke	Climate Analytics	Germany
683	88	24	88	37	Aforestation and reforestation do not always improve water filtration and flood control under all circumstances. Soils can become hydrophobic after wildfires. Flash flooding and erosion are concerns after natural or prescribed-burn fires, especially in mountainous or sloped areas. The impacts to the vegetation and natural hydrology can last for several years after the fire.	Accepted, text revised	Bekki Harjo	NOAA/National Weather Service	United States of America
55411	88	36	88	37	This point should be elaborated to provide nuance and detail to the finding asserted, i.e., under what conditions landscape restorations fail.	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
417	88	38	89	46	Accurate quantitative analysis and assessment of the literature is critical to reduce the risks and uncertainties of the global level of GHG emissions projected for 2030 and 2050. The accuracy will increase with the collection and analysis of new data and information on emissions. This is particularly important because of uncertainties involving accelerating mitigation and development pathways and variable financing that will unfold in future years.	Noted.	Michael Kennish	Rutgers University	United States of America
20203	88	41	88	42	You may want to consider the EIST special issue on mixed methods approaches to framing, identifying, and understanding risks and uncertainties: - Antosiewicz, M., Nikas, A., Szpor, A., Witajewski-Balviks, J., & Doukas, H. (2020). Pathways for the transition of the Polish power sector and associated risks. <i>Environmental Innovation and Societal Transitions</i> , 35, 271-291. - Arning, K., Offermann-van Heek, J., Sternberg, A., Bardow, A., & Ziefle, M. (2020). Risk-benefit perceptions and public acceptance of Carbon Capture and Utilization. <i>Environmental Innovation and Societal Transitions</i> , 35, 292-308. - Bachner, G., Wolking, B., Mayer, J., Turk, A., & Steininger, K. W. (2018). Risk assessment of the low-carbon transition of Austria's steel and electricity sectors. <i>Environmental Innovation and Societal Transitions</i> . - Mayer, J., van der Gast, W., Bachner, G., & Spijker, E. (2020). Qualitative and quantitative risk assessment of expanding photovoltaics in the Netherlands. <i>Environmental Innovation and Societal Transitions</i> , 35, 357-368. - Nikas, A., Stavrakas, V., Arsenopoulos, A., Doukas, H., Antosiewicz, M., Witajewski-Balviks, J., & Famos, A. (2020). Barriers to and consequences of a solar-based energy transition in Greece. <i>Environmental Innovation and Societal Transitions</i> 35, 383-399. - van Vliet, O., Hanger-Kopp, S., Nikas, A., Spijker, E., Carlsen, H., Doukas, H., & Lieu, J. (2020). The importance of stakeholders in scoping risk assessments—Lessons from low-carbon transitions. <i>Environmental Innovation and Societal Transitions</i> , 35, 400-413. - Skoczowski, T., Bielecki, S., Kochanski, M., & Korczak, K. (2020). Climate-change induced uncertainties, risks and opportunities for the coal-based region of Silesia: Stakeholders' perspectives. <i>Environmental Innovation and Societal Transitions</i> , 35, 460-481. As well as others, like: - Song, L., Lieu, J., Nikas, A., Arsenopoulos, A., Vasileiou, G., & Doukas, H. (2020). Contested energy futures, conflicted rewards? Examining low-carbon transition risks and governance dynamics in China's built environment. <i>Energy Research & Social Science</i> , 59, 101306. - Blynn, K., & Attanucci, J. (2019). Accelerating bus electrification: A mixed methods analysis of barriers and drivers to scaling transit fleet electrification. <i>Transportation Research Record</i> , 2673(8), 577-587. - Labella, A., Koasidis, K., Nikas, A., Arsenopoulos, A., & Doukas, H. (2020). APOLLO: A Fuzzy Multi-criteria Group Decision-Making Tool in Support of Climate Policy. <i>International Journal of Computational Intelligence Systems</i> , 13(1), 1539-1553.	Noted. Reviewed suggested references, though chapter not primarily focused on methods	Nikas Alexandros	National Technical University of Athens	Greece
55413	89	4	89	4	"actor" should be "actors"	Accepted. Text revised	Government of United States of America	U.S. Department of State	United States of America
83129	89	40	89	40	An additional reference on how to deal with uncertainties in carbon budget estimates in climate policy analyses is Peters 2018 (https://www.nature.com/articles/s41561-018-0142-4)	Noted. Reviewed suggested references	Geden Oliver	German Institute for International and Security Affairs	Germany
48399	90	1	90	6	Recently national scenario papers also assessed stranded asset due to rapid energy system changes. For example, Oshiro et al. (2020) indicated that energy investment in energy demand sectors can be stranded as well as energy supply infrastructure, while the risk of stranded investment can be reduced by sectoral policies such as subsidy for electrified equipment. * Oshiro, K., Fujimori, S. (2020). Stranded investment associated with rapid energy system changes under the mid-century strategy in Japan. <i>Sustainability Science</i> , in press. doi:10.1007/s11625-020-00862-2	Noted. Reviewed suggested references	Ken Oshiro	Kyoto University	Japan
1951	90	19	90	30	This subsection can be substantially strengthened drawing on the most recent literature, which supports some points but contradict others.	Noted.	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
18153	90	19	90	30	Could be worth mentioning the 'green recovery' post Covid-19 movement here that has been promoted by state/multi-state (e.g. UK, EU) and non-state actors alike	Taken into account. See cross-chapter box 1 on COVID, in chapter 1	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
71467	90	19	90	30	This subsection can be substantially strengthened drawing on the most recent literature, which supports some points but contradict others.	Noted	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
83583	90	19	90	30	One additional way of dealing with this and at least reduce the number of potential black swans is by more actively trying to scope extremes and explore unlikely scenarios. McCollum, D.L., Gambhir, A., Rogelj, J., Wilson, C., 2020. Energy modellers should explore extremes more systematically in scenarios. <i>Nature Energy</i> . https://doi.org/10.1038/s41560-020-0555-3	Noted. Reviewed suggested references	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
82275	90	20	90	20	Here, recent new literature could be mentioned, like Hepburn 2020 on investment options (perhaps in combination with Andrijevic et al 2020 on the size for energy transition investment versus total fiscal stimuli), and can be combined with Kikstra et al. 2021 (in review; https://doi.org/10.21203/rs.3.rs-155224/v1) and other studies which show the potential of learning from activities observed during the pandemic.	Noted. Reviewed suggested references	Jarmo Kikstra	IIASA	Austria
8259	90	32	90	43	The political aspect is also a risk if the social aspect is not taken into account in change of development pathways, as this might fuel the political opposition and hence a political swift which might degrade the sustainable achievements can occur. E.g. Brazil and USA	Accepted. Text to be revised for FGD.	Frida Zahlander	DanChurchAid	Denmark
73045	90	38			Add a sentence after the period: "Once in place, a suite of national policies that demonstrably provide a high level of fairness will present resistance to attempts to weaken or remove them. (Edwards & oc 2020)	Taken into account. Have revised, linking assessment in 4.5 to 4.2.2.7	Larry Edwards	Larry Edwards Environmental Consulting	United States of America
19905	91	1	91	24	Section 4.2.2.6 and section 4.5 do not engage in any depth with the "extensive literature on equity frameworks of national emission allocations" (4-91 line 12). At 4-18 line 16, it is mentioned that the equity literature "including quantification of national emission allocations" is assessed in section 4.5. This assessment is however not provided in the current version of section 4.5. As outlined in the previous comments, it is crucial that the report includes this assessment.	Taken into account. See response to (identical) comment 19903.	Dennis van Berkel	Urgenda Foundation	Netherlands

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
83585	91	1	91	24	Maybe the following study on equity and fairness implications of new ways of aggregating greenhouse gas emissions can provide useful additional evidence for the assessment in this paragraph. It shows that applying some of the novel greenhouse gas emissions metrics can imply that historical emissions of short-lived forcers are grandfathered into the future emissions allocations of countries. Rogelj, J., Schlessner, C.-F., 2019. Unintentional unfairness when applying new greenhouse gas emissions metrics at country level. Environmental Research Letters 14, 114039. https://doi.org/10.1088/1748-9326/ab4928	Accepted. Text revised and reference added	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
2487	91	1	95	10	I agree with the importance of a "just transition". Yet, I find this section not well integrated with the remainder of this chapter. At least, some cross-references in/to the preceding chapter (on how to shift development pathways) would have helped. One could think of equity as a key dimension - as both enabler and lever - of a different development pathway. I don't think this comes out clearly (except in the executive summary).	Accepted. For the FGD, we have improved integration across 4.5 and 4.2.2.7, and introduced a 'roadmap' paragraph on how equity is treated in 4.1	Jann Lay	German Institute for Global and Area Studies (GIGA)	Germany
16319	91	1	95	10	In section 4.5 as well, the contents and discussions in this chapter are closely related with the discussions in other chapters in AR6. So, it will be very informative and helpful to readers if authors explicitly indicate related chapters in such cases.	Accepted. For the FGD, we have improved integration across 4.5 and 4.2.2.7, and introduced a 'roadmap' paragraph on how equity is treated in 4.1, and included cross-references to other chapters	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
72169	91	1	95	10	While the report improved in mentioning available scientific literature that provides assessments of equity and fairness for countries, it does not provide any details for these results. Overall the equity chapter lacks quantification and level of details. Fair share ranges should be provided both for well below 2° and 1.5°C either in a table or as an annex. This information is of critical importance for some assessments (including legal ones).	Noted. This is a comment on the report as a whole (and there is no 'equity chapter', presumably the reviewer might mean section 4.5). The matter of 'fair shares' of mitigation is contested, including in courts, and including by the reviewer's organisation. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant but not policy-prescriptive. The CLAs of chapter 4, together with others, sought advice from the co-chairs on this matter. Based on this advice, the chapter continues the approach of outlining frameworks, but not presenting results for individual countries. See response to comments 19903; and we also point to the treatment of fair shares in the chapter on national policy, 13.4.2 on 'shaping climate governance through litigation', and internationally, including 14.3.2 on elements of the Paris Agreement relevant to mitigation and 14.5.3 on civil society and social movements, and their involvement in litigation	Carl Schlessner	Climate Analytics	Germany
72171	91	1	95	10	Rajamani et al (forthcoming) should be added to the equity section. The forthcoming literature can add value to the international law principles.	Accepted. Text revised and reference added	Carl Schlessner	Climate Analytics	Germany
72173	91	1	95	10	A specific subsection on equity and CDR should be included. Both questions of intergenerational and international equity should be assessed. Given the prominence of CDR in this assessment report, this would be a very important addition. And, arguably, CDR is a true burden sharing problem. No co-benefits in sight there. See e.g. Fyson et al. (2020) for emerging concepts.	Partially accepted. CDR more generally is assessed in chapter 12.3, in which there is a cross-chapter box. We have added the reference in chapter 4	Carl Schlessner	Climate Analytics	Germany
77743	91	1	95	10	This section is very well done. I have one significant and one small suggestion for improvement. The more significant suggestion is to consider the risk that processes established in the name of "just transition" become co-opted by powerful/wealthy agents who the notion of just transition was not intended to benefit and who do not require (and arguably have no normative entitlement to) transitional assistance. Of particular importance here is distinguishing the interest of individual natural persons (e.g. workers) in a just transition from the business firms that employ those workers. Thus Green and Gambhir (2020) in section 2.2 (pp. 907-908) of their paper in Climate Policy highlights: "an important distinction between losses arising at the level of a group agent and losses experienced by real human beings as a consequence of group agent-level losses. Strategic group agents like corporations and (in an international policy context) states may incur financial losses, but such losses have no independent moral value – they are mere 'paper losses' that only have moral significance insofar as they flow through to the wellbeing or interests of real persons. Of course, group-level losses do flow through to real persons. But, crucially, the causal chain that links losses at the group agent (corporate or state) level with effects on the wellbeing of real persons is mediated by choices – by boards and managers, or by governments – about how group agent-level losses are to be distributed among the group's members and stakeholders. Some members and stakeholders, such as shareholders of corporations and wealthy citizens of states, will be better placed to absorb and adapt to those losses (and will often have greater causal and moral responsibility for failing to mitigate the group-level losses in the first place) than others, such as lower-level workers and poorer citizens. Targeting transitional assistance at group agents leaves these important secondary distributional decisions to group-level governing bodies" (and should arguably therefore be avoided or subject to strict and enforceable conditionality). This danger is a real one: witness the large "compensation" payments being made to German lignite firms pursuant to the German Coal Commission recommendation and associated legislation, which is now the subject of an investigation by the European Commission for a suspected violation of EU state aid rules: < https://ec.europa.eu/commission/presscorner/detail/en/ipg_21_972 >. A similar phenomenon has arisen in regard to COVID relief: corporate bailouts purportedly intended to keep workers employed have instead been used by firms to pay dividends to shareholders or other purposes. This is both unjust and entirely predictable, and deserves no part in a just transition process. See, e.g., Stokes, Leah C., and Matteo Mildenberger, 'Green Stimulus, Not Dirty Bailouts. Is the Smart Investment Strategy during the Coronavirus Recession', Washington Center for Equitable Growth, May 2020 < https://equitablegrowth.org/green-stimulus-not-dirty-bailouts-is-the-smart-investment-strategy-during-the-coronavirus-recession/ >. The minor suggestion is to rephrase the awkward term "regulating prosperity" on p 92 (line 18)—it is not clear what this is intended to mean, so a clearer term should be used.	Accepted. Text revised. We agree the phrase "regulation of prosperity" is not clear, and added text related to good comments, and some new references (Green and Gambhir was already cited)	Fergus Green	Utrecht University	Netherlands
84843	91	10	91	10	Robiou du Pont et al. 2018 (https://www.nature.com/articles/s41467-018-07223-9) is more recent, and combines equity concepts in a bottom-up manner arguably reflective of the Paris-Agreement, consistent with differentiated potentially self-interested sovereign approaches. It is also in line with litigation cases, such as Urgenda where the judge can only rule for the least stringent of multiple equity allocation, while ensuring a top-down consistency with global warming thresholds.	Taken into account. Robiou du Pont and Meinshausen (2018) is cited	Yann Robiou du Pont	Climate Analytics	France
66801	91	12	91	12	For this discussion, it may be of interest to look for a paper under review with Nature Climate Change Budolfson et al, which asks what an allocation would look like if global welfare were maximised (instead of costs minimized) and allowed for different C prices across regions (which is the reality at the moment). This explicitly benchmarks NDC outcomes against the outcome from maximizing global welfare. (full disclosure, I am a co-author).	Noted. Reviewed reference, but did not add citation	Navroz Dubash	Centre for Policy Research	India
60333	91	12	91	24	The text could be significantly enhanced by describing the literature's result of national emission allocations, not only stating that it exists. The literature is rich on such quantitative results, relevant studies are already quoted, but they are not quantitatively summarised. I assume the readers of the IPCC report would expect such an analysis.	Noted. This is a comment on the chapter. The matter of 'fair shares' of mitigation is contested, including in courts, and including by the reviewer's organisation. The IPCC is an Intergovernmental Panel, and the published procedure of the IPCC includes chapters being presented to governments for acceptance. The IPCC's core task is to assess literature, in which it aims to be policy-relevant, but not policy-prescriptive. The CLAs of chapter 4, together with others, sought advice from the co-chairs on this matter. Based on this advice, the chapter continues the approach of outlining frameworks, but not presenting results for individual countries. See response to comments 19903; and we also point to the treatment of fair shares in the chapter on national policy, 13.4.2 on 'shaping climate governance through litigation', and internationally, including 14.3.2 on elements of the Paris Agreement relevant to mitigation and 14.5.3 on civil society and social movements, and their involvement in litigation	Niklas Höhne	NewClimate Institute	Germany
84845	91	13	91	13	I am not sure to see what the Climate Action Tracker 2017 refers too, is there a peer-reviewed study for it?	See reference in text.	Yann Robiou du Pont	Climate Analytics	France
84847	91	18	91	18	Only part of equity is about sharing costs and benefits. Some equity approaches are just seeking corrective justice (historical responsibility) and are not built using cost metrics at all. Please revise to broaden the scope of interpretations. It is a classic misunderstanding, beneficial to historical polluters, to omit past pollution and focus on equity as a tool to derive acceptable future emissions targets. It can be that tool, but it's not limited to it and was not designed necessarily to serve that purpose.	Accepted, text revised	Yann Robiou du Pont	Climate Analytics	France
28891	91	25	91	31	Please see Chapter 18 WGII	Noted	Nathalie Hilmi	Centre Scientifique de Monaco	France

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
55415	91	25	91	31	This discussion of equity is very good but misses a key point that Klinky and Wheeler (2018) -- the final citation in this paragraph -- make: "We then assess the ability of current modelling practices to address each element [of equity], focusing on global integrated assessment models augmented by national modelling and scenarios. We find current practices face serious limitations across all six dimensions although the severity of these varies." Making the limitations and implications of IAMs transparent in this chapter is very important, and this may be the place to make a clear statement about their limitations in treatment of equity. "Most IAMs were designed to provide globally aggregate analyses for a single, infinitely lived social planner, a task epistemologically at odds with the rainbow of human heterogeneity." Link to Klinky and Wheeler here for easy reference: https://royalsocietypublishing.org/doi/10.1098/rsta.2016.0461	Taken into account. We cite Klinky and Winkler (2018) earlier	Government of United States of America	U.S. Department of State	United States of America
82273	91	25	91	31	Open suggestion: when talking about energy justice in the context of pathways and transitions, it might be worthwhile considering a mention of literature that operationalises such a notion (e.g. based on the decent living standards framework, such as Rao et al. 2019, Millward-Hopkins 2020, Kikstra et al. 2021 in review: https://doi.org/10.13140/RG.2.2.26909.23528)	Noted	Jarmo Kikstra	IIASA	Austria
63603	91	28	91	30	Research also shows economic impacts and imperatives for addressing issues of equity	Accepted, text revised	Government of Canada	Environment and Climate Change Canada	Canada
86505	91	32	91	35	As discussed on a Comment for Chapter 1, I believe that the mention to the "No one left behind" phrase is not to be given lightly in an IPCC Report and I believe it should not be included in a scientifically rigorous and comprehensive discussion of Just Transition, if not when citing a specific literature source that mentions it, and promptly analyzing its context and feasibility within that context. I believe that the "No one left behind" phrase associated to an overall Just Transition discourse is inappropriate: 1) Because it is often reported on discussions with a national or subnational focus 2) Because it almost never refers to frameworks including future generations 3) Because it is often used to justify the preservation of existing carbon-intensive sectors and the delay of timely climate action 4) Because it is practically impossible to be achieved in a transition, such as the climate transition, which is forcibly no longer incremental, gradual, or perfectly smoothable, given the carbon budget constraints to meet temperature goals starting from current emissions levels - while obviously every effort compatible with temperature targets should be taken to reduce unevenness in the distribution of the burden of the transition, across national population demographics, across all countries and across generations, in due proportion. In summary, I believe that any reference to the phrase "Leaving no-one behind" should be either removed or should be deeply and adequately contextualised and its limitations clearly identified and reported.	Partially accepted. The phrase is widely cited in the literature, which we assess. We have added text on future generations. Thank you for thought-provoking comments	Lorenzo Campus	Ca' Foscari University of Venice, Italy	United States of America
74171	91	32	92	2	This section could be dropped. It does not further the overall concept of reducing carbon emissions. Frankly, the number of long term jobs created by renewables (after wind and solar generation is erected) is very small. In comparison, a significantly higher number of long-term, high paying jobs are created through the establishment of nuclear generation - which is not referenced in the paragraph. While it has a significant amount of colorful language about job creation, it contain no statistical data to back up the claims made therein.	Rejected. Employment is policy-relevant and we have assessed literature that argues that address equity enables ambition mitigation	Jeffrey Merrifield	Pillsbury Law Firm	United States of America
15067	92	3	92	16	Necessary and adequate training should also be included into the core elements or to be addressed in item (4)	Accepted, text revised	Guoquan HU	National Climate Center of China Meteorological Administration	China
86507	92	3	92	5	The approach here summarized from selected literature has a national and subnational focus and does not take into consideration equitable transition across space, i.e. Across countries, and across time, i.e across generations. Analyzing equitable in-country transition dynamics is per se very valuable and (up to a certain extent) instrumental to smoothen climate transition as described in literature; but this analysis must readily include 1) A study of the consequences of a national focus on "global" transition dynamics, including a shift to unilateralism; 2) A study on the consequences over more vulnerable countries that this approach originated in developed countries and it has originally been tailored to economic dynamics specific to developed countries 3) A study of the NET consequences of such national focus (characterized by heavy politicization and polarization of the transition discourse) on the probabilities of a "timely" success of meeting mitigation targets, including studies of how such approach and definition of Just Transition is taken as justification for - and a driver of - delay of climate action and reduced ambition, including NDC ambition. In addition to this, it is important to distinguish between the validity of such approach and the abuse and monopolization of the term "Just Transition" (especially serious within IPCC language) to refer "only" to nationally-centered and politically charged discourse, instead of including all dimensions of the word "JUST", i.e. including transition burden and capabilities across countries and generations.	Accepted, text revised. We have added in intergenerational equity. Thank you for thought-provoking comments	Lorenzo Campus	Ca' Foscari University of Venice, Italy	United States of America
63605	92	13			Should "politics" read "policies"?	Taken into account. Reviewed literature again, and both politics and policies are referred to	Government of Canada	Environment and Climate Change Canada	Canada
28893	92	17	92	17	Just transition here and Just Transition in Chapter 15	Noted	Nathalie Hilmi	Centre Scientifique de Monaco	France
83907	92	17	92	23	The discussion about measures for a just transition could also cite the paper about combining carbon taxes with a right access to energy for India by Azad and Chakraborty (2020). Azad, R. and Chakraborty, S. (2020) 'Green Growth and the Right to Energy in India', Energy Policy, 141, p. 111456. doi: https://doi.org/10.1016/j.enpol.2020.111456 .	Noted	Gregor Semieniuk	University of Massachusetts Amherst	United States of America
74173	92	17	95	10	This section is a political treatise, not a solid argument. If the IPCC report is to gain more widespread traction amongst a diversity of groups, including climate change deniers, this language runs contrary to that goal. We should be increasing and building support for concrete action on climate change. This type of language only will provide fodder to those who oppose the overall recommendations of the report and makes it look unbalanced. Additionally, there are groups out there which espouse a more balanced approach to reducing carbon emissions which should be referenced.	Taken into account. We have reviewed language to be policy-relevant, but not policy-prescriptive	Jeffrey Merrifield	Pillsbury Law Firm	United States of America
27663	92	19	92	22	Delete "and that governments, polluting industries, corporations and those more able to pay higher associated taxes pay for transition costs, provide a welfare safety net and adequate compensation for people, communities, and regions that have been impacted by pollution, marginalised or negatively impacted by a transition from a high to low carbon economy and society"	Rejected. No rationale provided for deletion	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
55417	92	24	92	26	The reference does not support the assertion. The reference is only about the United States, not about the just transition being an "international focal point tying together social movements, trade unions..." Find references that actually support the powerful assertion or else change the text.	Partially accepted. The reference was indeed specific to the US, but have retained the broader point. Added new references in other parts of the section, that support the point	Government of United States of America	U.S. Department of State	United States of America
86509	92	24	92	26	Same here: The approach here summarized from selected literature has a national and subnational focus and does not take into consideration equitable transition across space, i.e. Across countries, and across time, i.e across generations. Analyzing equitable in-country transition dynamics is per se very valuable and (up to a certain extent) instrumental to smoothen climate transition as described in literature; but this analysis must readily include 1) A study of the consequences of a national focus on "global" transition dynamics, including a shift to unilateralism; 2) A study on the consequences over more vulnerable countries that this approach originated in developed countries and it has originally been tailored to economic dynamics specific to developed countries 3) A study of the NET consequences of such national focus (characterized by heavy politicization and polarization of the transition discourse) on the probabilities of a "timely" success of meeting mitigation targets, including studies of how such approach and definition of Just Transition is taken as justification for - and a driver of - delay of climate action and reduced ambition, including NDC ambition. In addition to this, it is important to distinguish between the validity of such approach and the abuse and monopolization of the term "Just Transition" (especially serious within IPCC language) to refer "only" to nationally-centered and politically charged discourse, instead of including all dimensions of the word "JUST", i.e. including transition burden and capabilities across countries and generations.	See response to 86507	Lorenzo Campus	Ca' Foscari University of Venice, Italy	United States of America

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
85161	92	31	92	34	The Just Transition Mechanism has been augmented to mobilise at least €150 billion. Please check. And please consider that the currency is EUR. https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_931	Accepted. Checked numbers, budgets and what is being mobilised. To the best of our knowledge, the information in FGD is accurate, at the time of literature cut-off	Jens Tambke	Umweltbundesamt	Germany
83131	92	32	92	32	The "100 billion" number is outdated. It was always only part of an EU Commission proposal, the numbers agreed by the co-legislators (Council of Member States and European Parliament) are much lower (as an entry point: https://ec.europa.eu/commission/presscorner/detail/en/IP_20_2354).	see response to 85161	Geden Oliver	German Institute for International and Security Affairs	Germany
55419	93	2	93	5	The UNHCR report does not address decarbonization. Maybe add a second reference here to support more strongly the link between just transition and decarbonization.	Rejected. UNHCR report does address decarbonisation; asked CA to check and this was confirmed	Government of United States of America	U.S. Department of State	United States of America
16939	93	11	93	11	Updated information can be found in "The Just Transition Strategy within the Strategic Energy and Climate Framework" (https://www.miteco.gob.es/en/prensa/etj-english-interactive_tcm38-505653.pdf) The National Just Transition Strategy is based on the recognition that, in Spain, it is particularly important to optimize the outcomes of the Ecological Transition where jobs are concerned.	Accepted. Text revised and reference added	Government of Spain	Área de Estrategias de Adaptación - Oficina de Cambio Climático - Ministerio de la Transición Ecológica	Spain
20665	93	13	93	13	It is suggested to refer to reports and initiatives at the European (C.Lohan, Climate justice, European Commission 2017, NAT/712-EESC-2017) and french levels (Jouzel, J., & Michelot, A. (2016). Climate justice: Challenges and prospects for France ESEC opinion)	Taken into account. We have added further initiatives, though not cited these particular reports	Government of France	Ministère de la Transition écologique et solidaire	France
47373	93		93		Box 4.4: It is not clear at all on what criteria the listed organisations are selected. It's particularly strange that the European Union is listed here.	Accepted, box revised	Takeshi Kuramochi	NewClimate Institute	Germany
47333	94	1	94	10	figure 4.8 needs to be more illustrated because all contents are not readable	Accepted, figure revised	Khaled Mohamed Madkour	Ain Shams University, Cairo, Egypt	Egypt
8171	94	1	95	3	Figure 4.8: Please revise panel c, there is no coal region in Ireland, but in Great Britain.	Accepted, figure revised	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
55421	94	1	95	3	Figure 4.8b shows the funds related to the "Just Transition within the European Union Green Deal"... but the entire panel seems to be a single color (blue) and there's no legend, so it's hard to know what information the figure is actually supposed to convey.	Rejected. Looked at in the context of the other two panels, the single colour makes sense, in that it signals the EU JT fund (not in individual member states)	Government of United States of America	U.S. Department of State	United States of America
83133	94	1	95	3	What is the rationale for panel B? It simply shows almost all countries of the European Union (those eligible for money from the Just Transition Fund based on the first EU Commission proposal. Please reconsider using this. But if you do, check again if the countries eligible under the initial Green Deal proposal are still the same after final agreement of the Just Transition Fund and its rules	Rejected. Looked at in the context of the other two panels, the single colour makes sense, in that it signals the EU JT fund (not in individual member states)	Geden Oliver	German Institute for International and Security Affairs	Germany
10599	94	2	95	3	Panel B in figure 4.8 cannot be said to show the funds related to the Just Transition within the European Union Green Deal!	Accepted. The caption is 'just transitions', and the EU panel includes a JT Fund	Philippe Waldteufel	CNRS	France
20677	94				The legend of the Figure 4.8 has to be completed with more detailed elements from the figure. We also suggest mentioning the Convention Citoyenne sur le Climat for France (L-G Giraudet 2021, "Deliberating on Climate Action: Insights from the French Citizens' Convention for Climate" https://ideas.repec.org/p/hal/wpaper/hal-03119539.html)	Taken into account. Reasonable point, but space does not allow city level initiatives to be shown in Figure. We assess non-state actor in 4.2.3	Government of France	Ministère de la Transition écologique et solidaire	France
1421	94		94		figure 4.8 has low quality	Accepted. Figure quality will be improved for final publication	Hamideh Dalaei	climatologist at Islamic Republic of IRAN Meteorological Organisation	Iran
3179	94		94		figure 4.8 has low quality. It should be noted that there are low quality figures in the IPCC Chapters as usual.	Accepted. Figure quality will be improved for final publication	Hamideh Dalaei	climatologist at Islamic Republic of IRAN Meteorological Organisation	Iran
43417	94		94		figure 4.8 has low quality. It should be noted that there are low quality figures in the IPCC Chapters as usual.	Accepted. Figure quality will be improved for final publication	sadegh zeyaeayan	Head of national center for forecasting and weather hazards management of Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
50323	94		94		figure 4.8 has low quality. It should be noted that there are low quality figures in the IPCC Chapters as usual.	Accepted. Figure quality will be improved for final publication	Government of Iran	Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
1953	95	12			Will this section be expanded/revised to become more coherent? It provides an excellent summary of major gaps on the basis of the chapter, but would probably benefit from a bit of further work.	Accepted, text revised	Anne Olhoff	UNEP DTU Partnership, Technical University of Denmark	Denmark
71471	95	12			Will this section be expanded/revised to become more coherent? It provides an excellent summary of major gaps on the basis of the chapter, but would probably benefit from a bit of further work.	Accepted, text revised	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
71469	95	12	95	39	4.6 research gaps - include the open ocean and blue carbon? How about quantification of the blue carbon stocks? Research into what happens if the sequestration capacity of the ocean and marine ecosystems is damaged by CC and tipping point until the sink becomes an emitter?	Accepted, text revised - include blue carbon	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
84849	95	13	95	13	Additional research gaps suggestion: 1) quantification of equity frameworks to quantify subnational (regions, city) level action (see my point above), 2) linking equity frameworks on mitigation with adaptation and most importantly with loss and damage, 3) extending equity frameworks to quantify equitable international support, as the difference between equity-based national emissions scenarios and national domestic emissions scenarios.	Accepted, text revised	Yann Robiou du Pont	Climate Analytics	France
60755	95	13	95	39	It is suggested that there search gaps be summarized, not just enumerated.	Noted	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
84555	95	20	95	21	Please insert the following point: "Knowledge is missing on co-benefits, concerning quantitative and monetized data, which would benefit from commonly agreed methods for categorizing, measuring and presenting co-benefits, as well as knowledge on how best to integrate co-benefit data into policy making, including on how to describe the total value of different categories of co-benefits that in parallel may follow climate policy measures (Karlsson et al. 2020)."	Rejected. This and previous IPCC assessments have reviewed literature on co-benefits	Mikael Karlsson	KTH Royal Institute of Technology	Sweden
55423	95	22	95	23	This is an example of a "finding" that is so intuitively obvious that it's unclear what the value is of having it in an IPCC report. Establishing theoretical targets is much, much easier than developing a practical roadmap for policy implementation. Recommend looking at this list of research gaps and other high-level findings with that view in mind. Identify which ones are insights or rest on research where the finding would not have been self-evident.	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
20667	95	30	95	38	Regarding research gaps. Issues related to the need for policy makers to adopt a dynamic adaptive policy pathway for managing decarbonization over the period of implementation should be addressed here. When choosing a pathway as the most desirable option, it is important to keep in mind that each decarbonization option relies on the implementation of specific policies and instruments. Given structural, effectiveness, and timing uncertainties specific to each policy option, they may fail in delivering the expected outcomes in time. The possibility of diverging from an initial decarbonization trajectory to another one without incurring excessive costs should therefore be a strategic element in the design of an appropriate decarbonization strategy. Example of reference: Mathy, S., Criqui, P., Knoop, K., Fischeidick, M., & Samadi, S. (2016). Uncertainty management and the dynamic adjustment of deep decarbonization pathways. Climate Policy, 16(sup1), S47-S62.	Rejected. Highly specific gap, related more to implementation than knowledge	Government of France	Ministère de la Transition écologique et solidaire	France
55425	95	37	95	38	It is not clear what the "research gap" actually is. Research on how frequently these robust strategies exist? What is required to develop one? Whether they should be expected to arise?	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
63607	95	39			What does this mean exactly? Not clear.	Accepted, text revised	Government of Canada	Environment and Climate Change Canada	Canada

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
47335	96	1	96	1	add Box 4.5 about "Create a new or a unified platform for trading voluntary carbon credits and create or developed one standard for calculating, accrediting and documenting all voluntary credits under the UN or IPCC with a compiles with the Paris agreement to take more control of the carbon market and facilitating procedures for verifying and issuing carbon credits and for the compliance carbon credits market". as one of the mitigation and development pathways in the near- to the midterm	Rejected. Highly specific gap	Khaled Mohamed Madkour	Ain Shams University, Cairo, Egypt	Egypt
14965	96	1	96	33	The FAQ status presented here is not acceptable and does not meet the IPCC FAQ standards as they appear completely unfinished without informing the reviewers as part of a PLACEHOLDER. Above all, the questions are phrased in a policy-prescriptive way. This is grave concern and must be changed. The answers provided are unreadable, nowhere near comprehensive and have to be fully rewritten. Please provide at least a one-page response to every question that clearly sets the scene, establishes all relevant contexts for a lay readership and provides answers in a non-policy prescriptive way.	Accepted, text revised (including checks for policy-prescriptive language)	Government of Saint Kitts and Nevis	Department of Environment - Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlements	Saint Kitts and Nevis
50451	96	1	96	33	Suggest reformulating the FAQs to questions what could be the highlights of the chapter. E.g. relate the FAQs to the enabling conditions and just transition	Rejected. Stylistic	Hoy Yen Chan	ASEAN Centre for Energy	Malaysia
9301	96	2	96	33	These FAQs sound rather prescriptive to me, and I wonder how much specific information non-specialists are able to gather from the current formulations. For example, what exactly is the difference between "accelerating mitigation" and "deep and rapid transformations" or "transformative changes"? These are probably draft versions that still need to become more concrete and tangible? My suggestion would be to "zoom in" on key aspects, for example the benefits of certain actions (taken by individuals or societal groups or institutions/governance/policy) that illustrate a "shift in development pathways" or "increased sustainability" and/or would help to stay below the limits of warming defined in the Paris Agreement.	Accepted, text revised (including checks for policy-prescriptive language)	Maïke Nicolai	Helmholtz Centre Geesthacht	Germany
55427	96	2	96	9	Throughout this chapter authors make the point that incremental change is not enough, and FAQ 4.1 speaks to this point. Refreshingly, this FAQ also explicitly recognizes the need to improve underlying enabling conditions for climate change mitigation. The question this begets is: Are there examples of transformative, rapid improvements in enabling conditions? How did those occur? How likely is it that it can be replicated? If that problem cannot be solved, then it is very unclear how these transformative pathways will be achieved. It's also unclear whether the models that underly some of the findings in this chapter (and many other WGIII chapters) realistically describe the barriers to effecting that rapid shift.	Taken into account. And thank you. We have worked further on examples, in section 4.4.1.7-10, the SDPS cross-chapter box, summarised in our Executive Summary	Government of United States of America	U.S. Department of State	United States of America
60757	96	2	96	9	FAQ 4.1 needs an improved framing of the answer. This is a question which is the gist of the Paris Agreement.	Accepted, text revised (including checks for policy-prescriptive language)	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
46487	96	2	96	9	FAQ 4.1: this FAQ is phrased in a policy-prescriptive manner. Please avoid phrases like "to be done", "are needed". Text is to be elaborated (only key terms listed in the current version).	Accepted, text revised (including checks for policy-prescriptive language)	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
55429	96	10	96	18	Isn't this what international aid agencies and practitioners and researchers have been trying to figure out for decades: how to shift development pathways? It's effectively saying that, to accelerate mitigation in the near term, one must understand how to shift development pathways which does not bode well for the possibility of success.	Rejected. The assessment in this chapter throughout is that both accelerating mitigation and shifting development pathway are needed. Not that one is a precondition of the other. And enabling conditions for both can be put in place now - though some large changes take time, others can happen rapidly	Government of United States of America	U.S. Department of State	United States of America
60759	96	10	96	18	FAQ 4.2 is a corollary to FAQ 4.1, thus the answer should be very clear.	Noted	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
46489	96	10	96	18	FAQ 4.2: this FAQ is phrased in a policy-prescriptive manner. Please avoid phrases like "to be done". Text is to be elaborated (only key terms listed in the current version).	Accepted, text revised (including checks for policy-prescriptive language)	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
55431	96	22	96	23	Give an example of what such a policy "grafted on" looks like. It is hard to envision what this means.	Rejected. We think grafted is quite visual, and could not find a better term, none was suggested	Government of United States of America	U.S. Department of State	United States of America
85625	97	46	146	46	First author name is missing. There are many other references missing the first author.	Accepted, editorial	San Win	Environmental Conservation Department, Ministry of Natural Resources and Environmental Conservation	Myanmar
82489	105	11			Chenet et al 2019 should be dated 2017 instead	Accepted, editorial	Hugues CHENET	University College London	France
70009	107	3	107	3	Add: Córdova, R., Hogarth, N., Kaminen, M. 2019. Mountain farming systems' exposure and sensitivity to climate change and variability: Agroforestry and conventional agriculture systems compared in Ecuador's indigenous territory of Kayamb people. Sustainability 11(9) 2623. https://doi.org/10.3390/su11092623 .	Rejected. Not linked to any specific section.	Markku Kaminen	University of Helsinki	Finland
84557	120	11	120	12	Please add: "Karlsson, M., Alfredsson E. & Westling N. (2020) Climate policy co-benefits: a review. Climate Policy 20, 292-316. DOI: 10.1080/14693062.2020.1724070".	Rejected. Not linked to any specific section.	Mikael Karlsson	KTH Royal Institute of Technology	Sweden
84559	120	13	123	14	Please add: "Karlsson, M., Gilek, M. (2019) Mind the gap: Coping with delay in environmental governance. Ambio 49, 1067-1075 (2020). https://doi.org/10.1007/s13280-019-01265-z ."	Rejected. Not linked to any specific section.	Mikael Karlsson	KTH Royal Institute of Technology	Sweden
47359	149		149		The information provided in the "Policies" column is somewhat inconsistent. I am happy to clarify the information for studies I am involved in (Climate Action Tracker, Kuramochi et al. 2020) but it was not clear to me which exact wording I should use. Both studies, they cover NDC and a subset of implemented and adopted policies to quantify current policy projections. Even though it is a 'subset' of policies, the policy coverage is often more comprehensive for most countries than several of the modelling studies in the Table that reports to be "comprehensive".	Accepted, careful checks of supplementary information undertaken for FGD, including 'policies' column	Takeshi Kuramochi	NewClimate Institute	Germany

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
15069	149		157		<p>Table s4.1 of this chapter (the number here is s4.10 in the report, which is incorrect) summarizes the relevant global studies used to predict greenhouse gas emissions under NDC and / or current policies, but does not fully reflect the relevant studies of China's comprehensive assessment model of climate change (c3iam).</p> <p>Wei et al (2018) adopted China's first comprehensive assessment model of climate change with independent intellectual property rights (c3iam), based on the scenario of shared socio-economic path, evaluated the future global and regional emission paths, temperature rise and energy supply changes under the existing NDC goals, and provided corresponding policy suggestions for Global Climate Governance. Compared with other models mentioned in the table, this model embeds China energy technology model (net) and China Provincial computable general equilibrium model (CGE) into global lam, which can reflect not only the regional characteristics (especially China's), but also the global characteristics. Compared with other studies mentioned in the table, this study considers the uncertainty of NDC target calculation and proposes criteria based on emission intensity and emission structure. Based on these criteria, the national NDC emission targets are divided. At the same time, all scenarios of shared socio-economic path (ssp1-ssp5) are selected in this study. Based on these scenarios, not only the global and regional future emission (CO2 and other Kyoto greenhouse gases) paths under the NDC target are discussed, but also whether the global temperature control target of degree 2 can be achieved under different scenarios. In addition, the study also shows the changes of energy supply, land use change, energy and carbon intensity under different scenarios.</p> <p>In view of the above characteristics of Wei et al. (2018), and taking into account table s4.1,</p> <ol style="list-style-type: none"> 1. There is a lack of lam research that can not only describe China's region, but also reflect the world. 2. There is a lack of research that can reflect the comprehensive analysis under five ssp5 scenarios. 3. There is a lack of research on temperature control target and emission gap under NDC target. <p>It is suggested to add a line in this table, which is as follows: Study: (Wei et al. 2018); Regions: Global, with regional detail (Chinese detail); Sectors: Energy, Land use change; Emissions: Kyoto gases/IPCC AR4; Scenarios: NDC for SSP1-SSP5; Policies: NDC: GHG targets, Global temperature targets; Methods: National Energy technology model (NET) and National Computational General Equilibrium model (CGE) embed in global LAM (C3IAM); References: (Wei et al.2018) Supporting literature : Wei, Y. M. et al. An integrated assessment of INDCs under Shared Socioeconomic Pathways: an implementation of C3IAM. Nat. Hazards 92, 585–618 (2018).</p>	Accepted, careful checks of supplementary information undertaken for FGD. Table is correctly captioned "Table SM4.1". Wei et al (2018) is cited	Guoquan HU	National Climate Center of China Meteorological Administration	China
37515	158	41	158	41	Supplementary info box 4.1: China is clearly in a different league (also indicated by a different colour); text should be changed to clarify US is next, followed by India and the EU. As of now it seems India is more than the US.	Noted. Supplementary Material Box S4.1 in SOD was not included in the FGD	Government of India	Ministry of Environment, Forests and Climate Change	India
47361	158		158		Table S4.2: This is nearly entirely taken from Table 2.5 of the UNEP Emissions Gap Report 2020 Chapter 2. Please clearly provide reference that this is an adaptation of Kuramochi et al. (2020a).	Accepted. Table 4.2 of SOD not included in FGD	Takeshi Kuramochi	NewClimate Institute	Germany
43349	161				Kuramochi, T., M. den Elzen, G. P. Peters, C. Bergh, M. Crippa, A. Geiges, ..., and Y. G. Kim, 2020a: Global Emissions Trends and G20 Status and Outlook - Emissions Gap Report 2020, Chapter 2. UNEP, Nairobi. This concerns references which are not coherent. I suggest they follow a particular referencing style throughout. This reference has the name of all the authors but there is no date of publication. Koberke, A. C., P. Rochedo, A. F. P. Lucena, A. Szklo, and R. Schaeffer, Brazil emissions trajectories in a well-below 2oC world: the role of disruptive technologies versus land based mitigation in an already low-emission energy system. Clim. Change.	Accepted, references checked (year 2020 added)	Henry Tantoh	University of South Africa	South Africa
43351	161				The referencing style of this is different from the one above. Only the first author is included followed with and coauthors. Example, Krieglter, E., and Coauthors, 2018: Short term policies to keep the door open for Paris climate goals. Environ. Res. Lett., 13, 074022, https://doi.org/10.1088/1748-9326/aac4f1 .	Accepted, checked references, and TSU will apply IPCC style	Henry Tantoh	University of South Africa	South Africa
43353	161				In this citation, and et al., comes after the first author. For example, - Kuramochi, T., and et al., 2019: Greenhouse gas mitigation scenarios for major emitting countries. Analysis of current climate policies and mitigation commitments: 2019 update. https://www.pbl.nl/en/publications/greenhouse-gas-mitigation-scenarios-for-major-emitting-countries-2019-update . I think these references should follow appropriate referencing styles throughout	Accepted, checked references, and TSU will apply IPCC style	Henry Tantoh	University of South Africa	South Africa
7523					<p>INTRODUCTION</p> <p>Most climate change mitigation plans are very lengthy documents such that very few people actually read them. They also have many different approaches to mitigating climate change depending on the region of the world for which they are designed. They are also usually not very comprehensive in that they do not discuss how the CO2 emissions from each sector of the economy can be completely eliminated by a given year, because they assume that residual CO2 emissions in each sector will somehow be dealt with in the more distant future. For example, the fairly good climate change mitigation plan for Boston, Massachusetts, which has many strong points, is like this, leaving about 10 percent of CO2 emissions to be dealt with after the end date of the plan in 2050. Similarly, the very important climate change mitigation reports issued by the IPCC roughly every seven years, the Working Group III reports, are not at all clear nor comprehensive, and tend to be very diffusely and incompletely described in their thousand page reports. Even the much shorter and somewhat clearer outline of major options for climate change mitigation planning as presented in section C.2 of the Summary for Policy Makers of the October 2018 IPCC Special Report on 1.5 degree Celsius Scenarios was quite incomplete and far too brief (being only 2.5 pages). The mitigation scenarios in this report also left significant amounts of CO2 emissions to be eliminated after 2050 in each of four "illustrative model pathways" presented.</p> <p>Thus, the world seems to need a description of what a generic and fairly comprehensive climate change mitigation plan would consist of that is also brief enough so that interested members of the public and policy makers could easily read it in one sitting. This article tries to fulfill that need by describing the gist of what the IPCC should say in their upcoming Working Group III report for the 6th assessment due to be published in the fall of 2021. Furthermore, given that the pace of actual climate change always seems to get worse faster than most climate scientists anticipate, the generic plan described in this perspective is designed to eliminate all CO2 emissions from fossil fuels and industrial activity by 2045 at the latest. Unfortunately, achieving zero CO2 emissions by 2045 now appears to be necessary in order that the global average mean temperature increase since the mid-19th century not exceed 1.5 degree Celsius. In fact, evolving assessments of climate change science by 2030 may turn out to require achieving zero CO2 emissions by 2040, given that it will be even more difficult to eliminate other greenhouse gas (GHG) emissions by then that will probably lead to further average warming after 2040. Finally, a generic climate change plan for the world must also be shaped by considerations of what a "fair transition" would consist of so that the citizens of rich countries do not benefit disproportionately.</p> <p>II.DO WE HAVE MUCH CHOICE IN THE COMPOSITION OF A COMPREHENSIVE MITIGATION PLAN FOR CLIMATE CHANGE?</p>	Noted.	Richard Rosen	Tellus Institute 'retired	United States of America
27641					NDC estimates presented in the Chapter to be updated considering the most recent 2019/2020 NDC submissions.	Accepted, assessment of updated NDCs in 4.2.2	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
30511					The impacts of short-term goals in Chapters 3 and 4 are similar, and repetitions should be avoided in relevant chapters.	Rejected, comment unclear	Lingna Liu	China University of Geosciences (Beijing)	China

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country	
55433					Something needs to be said here about carbon dioxide removal (CDR), which is necessary to achieve 1.5°C. Although not considered as needed until the second half of the century and often dismissed as too expensive, CDR needs considerable research now. Lab and field studies show considerable potential for marine and terrestrial systems in removing CO2 and accelerating those processes. There is a need for research and for demonstration projects and other tests now so that it can be determined which approaches are most likely to succeed and which are likely to be least costly. Implementation could be initiated well before 2050 if the research is started now.	Taken into account. CDR is assessed in cross-chapter box 11, in chapter 12.3	Government of United States of America	U.S. Department of State	United States of America	
55435					Be sure that acronyms and other abbreviations are defined at their first appearance.	Accepted, editorial	Government of United States of America	U.S. Department of State	United States of America	
55437					Not many references to Chapter 4 in the SPM until the reader gets to "mitigation, adaptation, and sustainable development", but it seems like there are many opportunities to insert such references in material preceding that section.	Taken into account. This is a comment for the SPM.	Government of United States of America	U.S. Department of State	United States of America	
55439					The chapter falls short of addressing major uncertainties related to NDC targets and recommending concrete steps to contain them. Only two short paragraphs on pages 18-19 are devoted to the problems; much of it is focused on land use, which obscures the big picture uncertainties. Land use is a smaller fraction of the total budget. Uncertainties from it can be contained and improved by using remote sensing. Uncertainties from national policies have a much greater impact on climate mitigation. IPCC should lead on this by devoting space to discuss what they are, how they can affect the mitigation outcome, and how to contain them.	Taken into account. We point out uncertainties, information on assessment of NDCs is also in supplementary information, and we have word limits	Government of United States of America	U.S. Department of State	United States of America	
55441					As the chapter is about near and mid-term mitigation, it needs to explicitly clarify the implications for projections of using values for GWP other than 100 (much lower and much higher). It also needs to explain whether using only a value of GWP=100 is a constraint of the IAMs, a choice made by this author team or the IPCC, or a reflection of a bias in the literature. (i) On the shorter end (e.g., GWP 20), short-lived climate pollutants such as methane – a dominant GHG whose emissions respond to land and food system management – can have an outsized influence on peak atmospheric radiative forcing. (2) On the longer end, it is well known that CO2 emissions will partially transfer to the oceans and to the terrestrial biosphere, but they can, and do, come back to the atmosphere. The carbon does not disappear. When the full oceans have chemically equilibrated with the CO2 added to the atmosphere, there is still a portion (one sixth) that remains in the atmosphere. Using 100-year GWP values seriously underestimates the long-range consequences of CO2 emissions, but that nevertheless built into most (all?) integrated assessments and perhaps also into comprehensive modeling frameworks.	Taken into account. GWP values are used across WGI and WGIII, and the treatment is not only in this chapter. GHG metrics and GWP in particular are discussed in Cross-chapter Box 2.2 in chapter 2, and in more detail in Annex B.10. Box 2.2 finds that a GWP time horizon of 100 years corresponds for methane emissions to a discount rate of about 3% from a cost-benefit perspective, whereas a time horizon of 20 years corresponds to a discount rate of > ~11%. Accepting that climate change is a long-term problem, even if it requires rapid action, the question that policy-makers will need to address is whether discounting at more than 10% is justified in economic terms, in their context. GWP100 (which recognises the very long lifetime of CO2) corresponds to a discount rate of 1% or less, so GWP100 matches quite well the discount rate(s) chosen in long-term emission pathways to achieve Paris temperature goal and is thus internally consistent. As to bias in the literature, almost all 'standard' global IAM runs use GWP100, but pathways based on cost-minimisation (that don't use any exchange rate between gases) don't look too different for a temperature goal of well-below 2 degrees (see Box 2.2 and Annex B.10). There is much focus on just transitions to net zero. For the FGD, there are plans for a new box on net zero, addressing technical and policy issues. There are glossary entries to define net zero CO2 and net zero GHG emissions. The need to get to net-zero CO2 (or more generally, net-zero long-lived gases) globally is a fundamental physical constraint – choosing alternative metrics can offer some variations around the timing of global net-zero CO2/long-lived gases but cannot fundamentally remove this requirement – so focusing only on CH4 in the near term at the expense of CO2 mitigation would be counterproductive. Reducing CH4 in addition to CO2 is policy-relevant advice (and hopefully reviewers will agree, not policy-prescriptive). Policy options to mitigate CH4 in the near-term are less well described in the literature, suggesting limited options to get to zero, and the implications for livelihoods, notably of poor communities. Last but not least, the glossary entry on CO2 equivalent (CO2-eq) emission reads as follows: "The amount of carbon dioxide (CO2) emission that would have an equivalent effect on a specified key measure of climate change, over a specified time horizon, as an emitted amount of another greenhouse gas (GHG) or a mixture of other GHGs. For a mix of GHGs it is obtained by summing the CO2 -equivalent emissions of each gas. There are various ways and time horizons to compute such equivalent emissions (see GHG emission metric). CO2 -equivalent emissions are commonly used to compare emissions of different GHGs, but should not be taken to imply that these emissions have an equivalent effect across all key measures of climate change. Note. Under the Paris Rulebook [Decision 18/CMA.1, annex, paragraph 37], parties have agreed to use GWP100 values from the IPCC AR5 or GWP100 values from a subsequent IPCC Assessment Report to report aggregate emissions and removals." (emphasis added)		Government of United States of America	U.S. Department of State	United States of America
55443					When discussing mitigation options, including Carbon Dioxide Removal, it might be helpful to say something about the longevity of sinks because they are actually transfers rather than sinks. Especially biological storage will require management in perpetuity. Fires or, for example, changing soil moisture conditions could undo them.	Taken into account. CDR is assessed in cross-chapter box 11, in chapter 12.3	Government of United States of America	U.S. Department of State	United States of America	
55445					Economic comparisons of different pathways choose a future discount value. This value dictates how immediate costs and benefits compare to costs and benefits decades into the future and beyond. If the discount value is 5% per year (effectively a 20-year time horizon) the optimal strategy will very likely be to postpone serious mitigation policies, whereas 1% would favor immediate action. Chapter 4 appears to have taken all studies at face value. It could be illuminating if studies were sorted by discount factor.	Noted. However, (i) Ch4 does not deal with benefits from mitigation (which is addressed in Ch3, section 3.6). (ii) Ch4 deals with country specific studies. Since discount rates are country specific (because of different growth patterns and of different preferences), it is unavoidable to take discount rates at face value.	Government of United States of America	U.S. Department of State	United States of America	
55447					Chapter 4 should assert that claims need to be verified with external monitoring of some type to enable stakeholders to know objectively that the mitigation actually works as intended. For fossil fuel emissions there is an objective and transparent method, namely precise measurements of the carbon-14 content of atmospheric CO2 (Basu, www.pnas.org/cgi/doi/10.1073/pnas.1919032117). For many other mitigation methods the atmospheric signatures will be very small and diffuse, while non-atmospheric methods have to cope with large heterogeneity on small scales. It is likely that global atmospheric measurements reveal that the sum total of mitigation measures is less than claimed. Monitoring of the appropriate type and at the appropriate scale is necessary to explain such gaps and understand why they arise and what aspects of the overall mitigation landscape need to be managed more effectively.	Rejected. Policy prescriptive	Government of United States of America	U.S. Department of State	United States of America	
55449					Could this chapter include specific findings about the downsides of no guardrails while accelerating action, if you leave out SDGs or equity considerations? Could it also include associated recommendations?	Taken into account. We had not seen literature on inequitable or exclusive pathways, i.e. do not know of literature directly on this topic, i.e. acceleration of mitigation without considerations of equity and SD. Most of the literature has the opposite focus, connections, synergies, and some tradeoffs, but nothing on "no guardrails" or "planetary boundaries of decarbonization." We make no change in chapter 4, but would point the reviewers to chapter 3, and results relating to SSP (inequality).	Government of United States of America	U.S. Department of State	United States of America	
55451					Putting equity considerations at the end is a long haul for the reader. Many readers may never get to them. There are opportunities throughout the chapter to weave equity in – a sentence here or there with references pulled from that section at the end. For example, when discussing downsides of massive BECCS deployment, the text mentions cost and a couple of other things but did not mention biodiversity or cultural heritage loss associated with potential land use that has significance for livelihoods. Similarly, what are sources of biofuels and what consequences do biofuel production have if the SDGs ignored?	Accepted. Have sought to weave equity into chapter. We include a paragraph in the Exec Summary on equity - p 5, 13 to 15; have added a paragraph 'mapping' where equity is assessed in ch chapter, at the end of 4.1 Introduction; assess literature on NDCs as 'fair shares' in 4.2. We have added on potential adverse side-effects of large-scale BECCS in 4.2.5.4. We have left 4.5 as a final, stand-alone section	Government of United States of America	U.S. Department of State	United States of America	
55453					Throughout this chapter the text contains quantitative estimates related to mitigation, and they require some context for the reader to understand them. The text needs to weave throughout the chapter comparisons to how much mitigation is needed by a certain year from all sectors, comparisons of current amounts in NDC pledges, and comparisons to current annual emissions or changes per year in annual emissions (or sequestration).	Taken into account. See crosschapter box 6 (written by authors from chapters 3 and 4)	Government of United States of America	U.S. Department of State	United States of America	
55455					Language about mitigation's impacts on GDP needs to be carefully reviewed. While there are no concerns about the accuracy of the analysis, these statements will tend to be plucked out and repeated. They need to include appropriate caveats to say what the scope of modeling does and does not consider.	Noted. The paragraph to which the reviewer refers is focused on what the reviewed studies cover and do not cover.	Government of United States of America	U.S. Department of State	United States of America	

Comment id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
55457					The distinction between "mitigation pathways" and "development pathways" is sometimes very fuzzy. The concepts are central to this chapter and need more clear definition up front. There is a cross-reference to Chapters 2 and 3 near the beginning of the chapter, but this asks too much of the reader. Chapters need to be standalone because no one will read the entire WGIII AR6. Are shifting development pathways new and unique or a new name for a similar set of concepts that have been used in these types of assessments for decades? For example, would a carbon tax fall squarely in a mitigation pathway or a development pathway, or could it fall equally well in either?	Taken into account. We developed a new glossary entry on 'development pathways' (in title of our chapter, new in AR6) and 'mitigation pathways' are also defined there. The interaction is complex, and assessed across the chapter	Government of United States of America	U.S. Department of State	United States of America
55459					In a number of places, the text asserts that incremental change is not enough. This statement is foundational and needs to be substantiated better. Where is the wealth of evidence that tells the reader that this is true? Suggest drawing heavily on AR5 and SR1.5, particularly the transformative pathways in SR1.5.	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
55461					The treatment of uncertainties in policy goals expressed by different countries needs much more serious attention. It receives 1.5 pages and most of that is devoted to land use uncertainties, which only accounts for a small fraction of the total GHG budgets and can be monitored from space. The chapter should devote more space to recommending ways to improve transparency and uncertainties related to national policy objectives.	Taken into account. We point out uncertainties, information on assessment of current policies is also in supplementary information, and we have word limits	Government of United States of America	U.S. Department of State	United States of America
55463					Figures and text need to be checked to make sure that comparisons of different targets are apples-to-apples. In some cases the text or figures compare a 2°C target (chance of reaching it 67%) to a 1.5°C target (chance of reaching it 50%). See, e.g. Cross-Chapter Box 3, page 21, lines 7-8. All comparisons should be apples-to-apples.	Accepted. Checked text and figures for consistency.	Government of United States of America	U.S. Department of State	United States of America
55465					Chapter 4 often glosses over the costs associated with having to adapt if no mitigation. See, e.g., page 22. The numbers require context. Refer back to prior IPCC reports such as SR1.5 and AR5 which, for example, consider "If we were to go with a higher emissions pathway, the costs would be ..."	Accepted, text revised	Government of United States of America	U.S. Department of State	United States of America
55467					Reserve the word "significant" for statistical contexts, and replace it throughout with the word "substantial". To most scientists, something can be a significant effect even if it is insubstantial. A significant amount could be a tiny amount, whereas a substantial amount makes a material difference.	Accepted, text revised. Good point, thanks	Government of United States of America	U.S. Department of State	United States of America
55469					Throughout the chapter, there are NUMEROUS instances (in the text and tables) where an abbreviation is used but it is either never spelled out or is spelled out after it has been used previously. It is safe to assume some (most?) readers are only looking at chapters they are interested in. Hence, it would be helpful if chapter authors spelled out abbreviations when they first use them. Even if there is a list of abbreviations somewhere in the document or a given abbreviation may have been defined in a previous chapter, it would still be good not to ask readers of a chapter to go looking for the meaning of an abbreviation. Similarly, tables and figures should stand alone, so abbreviations should be spelled out in the table or figure or in a footnote.	Accepted, editorial	Government of United States of America	U.S. Department of State	United States of America
55471					Elevate what is new, not only highlights but also structure the chapter around those new findings. State the problem up front but don't dwell on it; get quickly to what is new.	Noted	Government of United States of America	U.S. Department of State	United States of America
55473					There is a strong need for much greater clarity in the text to distinguish findings supported by a single study from consensus findings that the writing team considers to be essentially facts (which then need to be supported by strong and usually multiple references). The chapter contains many prescriptive statements and statements with a citation but written as though it is a statement of IPCC.	Noted. However, this is a general comment without reference to individual instances of such issue.	Government of United States of America	U.S. Department of State	United States of America
55475					The chapter is supposed to be about near- and mid-term mitigation targets and pathways, which should include all sectors but is heavily oriented towards energy, with very little on land despite considerable progress in recent years on the role that the land sector needs to play (critically) to achieve 1.5 or 2°C targets. A distillation of recent literature and findings is needed. If it can be found in Chapter 7, that would be fine but text also needs to be included in this chapter. To the extent that land does appear now, it occurs mainly at the end rather than up front or dispersed.	Taken into account. Have improved treatment of land, and pointed to chapter 7, which indeed is where there full assessment of AFOLU is found	Government of United States of America	U.S. Department of State	United States of America
55477					Past IPCC reports have done a good job explaining what goes into and out of IAMs, and what expectations are channeled through those. This chapter lacks that treatment and information. Readers need to understand how to use the information from such models.	Taken into account. See Annex C	Government of United States of America	U.S. Department of State	United States of America
55479					The discussion of equity/inequality seems to focus strongly on economics and ignore many other dimensions of inequality with implications for emissions. There are strong links between gender and mitigation, for example, and these warrant inclusion. Gender inequity has implications for mitigation pathways.	Accepted, added more on literature on gender	Government of United States of America	U.S. Department of State	United States of America
83069					Since "net zero" announcements and national targets became quite popular in recent years, but can mean many different things in terms of coverage (all GHGs, or CO2 only, or long-lived gases only) please make sure that you highlight the differences and don't treat "net zero" as a uniform thing. I highlighted several instances (but not all) in detailed comments throughout the chapter. In general, PA (Art. 4) is about net zero GHG, not the geophysically more relevant CO2 only concept. Most (but not all: US & China) national targets are on GHG, not CO2 only (which makes them more ambitious). New Zealand's net-zero target is only on long-lived gases. You could refer to the discussion in ch3 (a new box) or Fuglestedt et al 2018 (https://royalsocietypublishing.org/doi/full/10.1098/rsta.2016.0445) and/or Rogelj et al. 2021 (Nature 591, "Three ways to improve net zero emissions targets"). See also the glossary entries on net zero and neutrality concepts	Taken into account. Box on net zero has been added in WGIII report	Geden Oliver	German Institute for International and Security Affairs	Germany
86071					Rather limited coverage of carbon pricing. Design of carbon taxes and public acceptability are covered in Chapter 5, but global carbon pricing (e.g. Weitzman JAERE 2014; Nordhaus AER 2015; Stiglitz et al. 2019; Carattini, Kallbekken, Orlov Nature 2019; IMF 2019) does not receive much attention unfortunately. That also implies that ideas such as a system of harmonized carbon taxes or international carbon dividends (see Carattini, Kallbekken, Orlov Nature 2019) are not really covered by the report.	Taken into account. Chapter 13 assess national policies, including carbon pricing, in more detail	Carattini Stefano	Georgia State University	United States of America