Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
78297	0	0	0	0	This is a well presented chapter with a wider scope than in the analogous chapter in AR5.	Thanks.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
15201	0				It is suggested that the countries be regrouped in accordance with the UNFCCC classification or and the World Bank country classification approach.	As in other chapters, we have followed the region categorisation provided by the Working Group III Technical Support Unit and Bureau	Government of China	China Meteorological Administration	China
15203	0				The concept of "Committed emission" is relatively new. It is suggested to add an explanation of it in Annex A (Glossary).	Considered	Government of China	China Meteorological Administration	China
24885	0				The chapter flows well and includes a lot of useful information - well done. A gap is that it does not mention country GHG inventories (GHGI). GHGI are the foundation of any climate policy and the basis for assessing compliance toward the PA's targets. The AR6 is expected to provide a key input to the GST. While providing independent assessements from GHGI is fundamental, ignoring totally GHGI is surprising ,because policy makers will be among the key readers of this chapter. This comment applies mainly to CO2 AFOLU estimates. For non-AFOLU, databases (EDGAR, PRIMAP) match quite well with GHGI. For CO2 AFOLU, however, estimates provided here are not comparable with GHGI's LULUCF, i.e. a > 5GtCo2/yr gap exists. This is not a criticism to global models or to GHG inventories, but just a factual and policy-relevant observation. This is ackowledged in Ch 7 and in the Glossary of this AR6 report, in the SPM of IPCC SRCCL and in the SPM of SR 1.5C. This should be noted very clearly also in this chapter: in the executive summary, in chapter 2.4.2.5 (AFOLU) and if possible in all the figure / table legends where AFOLU estimates are shown. A standard sentence can be be used is "AFOLU CO2 estimates included in this chapter are not necessarily comparable with country GHG inventories, due to different approaches to estimate the 'anthropogenic' CO2 sink (see Chapter 7.2.2.5)"	Need some form of comparison - maybe at the global and regional level.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
31045	0				Military contributions to greenhouse gas emissions are missing from Chapter 2: Emission Trends and Drivers.	Rejected. This has not been requested by governments and is not a major topics in the scientific literature. Partially, GHG emissions from military activities are implicit in our data (manufacturing, distribution), but it is not possible for us to identify those in the dataset.	Daniel Helman	College of Micronesia-FSM	Micronesia, Federated States of
37397	0				Rewrite chapter to give adequate consideration to different emission accounting methods and not just accounting mesaures associated with emissions embodied in trade.Using production-based and consumption-based emissions from a range of emission accounting measures is cherry-picking. The existence of other methods such as historical cumulative emissions are just acknowledged as other ways of emission accounting in passing and then completely ignored. The production and consumption based emissions is being used to clearly advance the agenda of carbon taxes and border tax adjustments and does not reflect global consensus on this issue.	Noted. Production and consumption-based emission accounting approaches are methodologically two polar cornerstones. Deep historical emission accounts are also usually "production-based" or territorial. We acknowledge the importance of reporting GHG emissions from different perspectives. For example, we report deep historical emissions, per capita emissions,emissions per GDP etc.. We added another figure to the chapter that juxtaposes these different viewpoints. We do not feel that this requires a complete re-write of the chapter. Note that most of the scientific literature reports on relatively recent territorial emissions and consumption-based emissions. We further added clear definitions to different ways of emissions accounting.	Government of India	Ministry of Environment, Forests and Climate Change	India

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
61609	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	Noted. We refer to both low-carbon and renewable energy technologies depending on context	Rauli Partanen	Think Atom	Finland
66765	0		0		Ch 2 uses the terminology 'climate and non-climate' policy. Other chapters have shifted away from this language reflecting the fact that a lot of climate mitigation happens through taxes and subsidies for purposes such as RE promotion, urban devleopment, public transport etc. And so, it is increasingly not useful to call these non-climate policies. A usage more consistent with other chapters is policies pursued for multiple objectives, including but not limited to mitigation - multiple objective poliices, in short. I suggest Ch 2 consider adopting similar usage.	Rejected. The outline prescribed by the Plenary explicitly calls for assessing climate and non-climate policies.	Navroz Dubash	Centre for Policy Research	India
66767	0		0		The chapter explores linkage between economic growth and emissions is dealt with in the chapter, particularly in Sec 2.4. But nothing in this discussion indicates attention to discussing trends in a way that shines a spotlight on ethical or equity considerations, which AR6 aspires to integrate through the report. For example, from Ch 1, asymmetry in contributoin, impacts and capacity are salient 1.6.3.2. Or governance models that prioritise the impact on the poor (1.6.3.1). Section 2.4.3 does discussion how distribution within countries is related to emissions. But the main discussion of emissions trends across regions is devoid of contextual differences. For example, 2.4.1, the Kaya decomposition of CO2, suggests that increased consumption and production in developing regions is a substantial driver. Indeed it is. But is it not salient to explore how this data could inform an equity discussion? For example, what are the trends in terms of reductions in rates of people below the poverty line associated with this rise in emissions? This might be useful data to present. An equity lens would perhaps suggest that scarce carbon should be allocated to regions where it delivers the highest welfare. Is this happening? It would be worth trying to understand the link between emissions and welfare outcomes (even in simple GDP/cap or HDI/PQLI) across regions. The language instead is curious on 2:54 lines 6-7: "Despite having lower per-capita emissions, developing countries remained major accelerators of global CO2 emissions growth since 2010, mostly driven by increased consumption and production..." Surely it is BECAUSE per capita emissions are lower that poorer countries have higher growth rates and higher emissions. Ths chapter needs to take on the burden of projecting trend data in ways that inform a conversation around ethics and equity, if the AR6 as a whole is to be seen as taking this seriously. Nothing about the representation of these Kaya figures (or others that I spotted but apologies if I missed them since I only gave a very quick read) gives any indication that countries are starting at very different economic starting points, and that this may be salient to how one interprets faster or slower rates of emissions growth. Failing this, the current presentation simply invites a simplistic policy relevant conclusion: pay more attention to emissions in regions where emissions	Accepted - We have included more information on the issue of equity in several places: included a figure and discussion, presented absolute emission levels and discussed regional differences in Section 2.4.x, revised Section 2.4.3	Navroz Dubash	Centre for Policy Research	India
75939	0				The defintion of GHG comes very late, and should be given early in the chapter. Could be a footnote.	The GHG definition in now in Section 1 line 2.	Jan Fuglestvedt	CICERO	Norway

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
75941	0				For Aviation you give GHG, but this is a bit probelmatic since the impact of aviation of from CO2 and various SLCFs such as ozone and contrail cirrus.	Noted. This is a general limitation of our assessment that also holds true for other forms of transport (e.g. marine shipping, heavy dury transport etc.) with relevant co-emissions that influence warming impacts. We added a caveat and added importance for more comprehensive assessments in the future in the knowledge gaps section.	Jan Fuglestvedt	CICERO	Norway
75943	0				You refer to remaining carbon budgets results from WGI. Please update according to WGI FGD.	Done, thanks.	Jan Fuglestvedt	CICERO	Norway
75945	0				For metric values from WGI, please update according to WGI FGD	Done, thanks.	Jan Fuglestvedt	CICERO	Norway
75961	0				On emissions of CO2, CH4, N2O: Please check updates and consistency with WGI Ch5	Done, thanks.	Jan Fuglestvedt	CICERO	Norway
75963	0				On emissions of SLCF: Please check updates and consistency with WGI Ch6	Done, thanks.	Jan Fuglestvedt	CICERO	Norway
4933	1	1	90	1	Altogether the style of Chapter 2 results quite unusual as in some points results too informal. I would suggest to make it more formal and consistent with previous IPCC reports	Thanks. We have given the chapter a thorough proofread and edit. The copyeditors will also have another chance to improve the language and style.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
9019	1	1	1	1	The CO2 issue by each country must be evaluated with its evaluation manner and apply for control of annual CO2 issue.	We do not understand the comment and have taken no actions.	Behzad Layeghi	IRIMO	Iran
9021	1	1	1	1	]	We do not understand the comment and have taken no actions.	Behzad Layeghi	IRIMO	Iran
36987	1	1	107	41	A general point is the lack of coordination between chapter 2 on long run trends and chapter 5 on the 'demand, services and social aspects of mitigation', which is a new chapter for IPCC WG3. In particular, chapter 2 fails (apart from a small mention at 2-70-38) to consider the fundamental role of the long run demand for energy services on the trends in CO2 emissions. The two central drivers for long run trends are the demands for energy services (discussed in chapter 5) and the energy sources used to meet those demands (discussed more in chapter 2). The fact that chapter 2 does not take account of the perspective developed in chapter 5 is a concern.	Noted. Long-term trends are considered to the extent space constraints allow.	Roger Fouquet	LSE	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
36993	1	1	107	41	Chapter 2 needs to consider the long run trends in income elasticities of demand for energy services [1]. Fouquet (2014) shows that the income elasticities of demand for energy services have tended to follow an inverse-U shape curve – that is, the income elasticities of demand rise at low levels of economic development, peaking at mid-levels of income and then declining to one and below. Thus, at low levels of economic development, energy service consumption tends to be quite responsive to per capita income changes; at mid-levels, consumption tends to be very responsive to changes in income per capita; and, at high levels, consumption is less responsive to income changes (Fouquet 2016). The income elasticities of demand for energy services are essential to understanding the long run trends in carbon dioxide emissions (while fossil fuels remain in the energy mix) and a discussion of how income elasticities of demand for energy services change as economies develop need to be included in chapter 2 and chapter 5. [1] As a reminder, the income elasticity of demand for an energy service indicates the percentage change in the consumption of the energy service for a one percent change in income. For example, an income elasticity of 0.5 (or 1.5) implies that, if income rises by 10%, consumption will increase by 5% (or 15%, respectively). Fouquet, R. (2014) 'Long run demand for energy services: income and price elasticities over 200 years.' Review of Environmental Economics and Policy 8(2) 186-207. Fouquet, R. (2016) 'Lessons from Energy History for Climate Policy: Technological Change, Demand and Economic Development.' Energy Research & Social Science 22 79-93. Fouquet, R. (2017) 'Make low-carbon energy an integral part of the knowledge economy.' Nature 551(7682) S141.	Noted. Long-term trends are considered to the extent space constraints allow.	Roger Fouquet	LSE	United Kingdom (of Great Britain and Northern Ireland)
61243	1	1	158	21	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	Noted. We refer to both low-carbon and renewable energy technologies depending on context	Janne M. Korhonen	Lappeenranta University of Technology	Finland
72559	1	1	158	1	I think chapter 2 is very thoughtful. Th only main concern that I have is to add a subchapter about COVID-19 and GHG emissions.	Thanks for this. We have extended the analysis of the impact of COVID-19 on emissions including a comparison of all avialble data sources. We do not devote an own section to it.	Yun Hang	Emory University	United States of America
75177	1	1	158	4	This is a chapter highlights for issues that arise from policy chocies. Further development and inclusion of material from the chapter in the SPM may be useful including on metrics.	Noted, thanks.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75179	1	1	158	4	Differences from WGI on carbon budgets, warming due to atmopsheric GHG, shouldbe reviewed, harmonised or clearly explained.	Our carbon budgets (historical and remaining) are consistent with those in WG1.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
75453	1	1	158	12	This an important chapter and thanks to all the authors for their work	Thank you.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75455	1	1	158	12	The attention given to link with WGI material is very welcome. Clarity on these is very important and some further development of these may be needed to harmonise or clarify differences.	Noted. We will take care of this.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75457	1	1	158	12	The use of AR6 GWP100 values may lead to some confusion with data and anlaysis which uses AR6 or other values. Where possibe include the actual mass of emissions in Tonne along with the CO2e estimates.	Rejected. We discussed this with the entire author team, WGIII leadership and Bureau. A decision has been taken to use GWP100 values from AR6 to reflect the most recent science. Differences to AR5 values with climate feedbacks are relatively small.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75459	1	1	158	12	It is noted that the AR6 provides a GWP100 value for fossil methane which is significantly higher than that for methane from other sources. It is assumed that this multiplier is applied to these methane sources. If not then a reason for this should be clear.	Yes. Wed apply different GWP100 values for biogenic and fossil methane.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75461	1	1	158	12	A clear distinction is made between CO2 from energy/industry and CO2 from land. A similar distinction should be provided for fossil and non-fossil methane in tables and figures. This is important for policies and measures which differ significantly for these important sources.	Rejected. We cannot add more and more detail to tabels and figures. CO2 from LULUCF is important to distinguish, because it a) comes from a different data source (modelling approach); b) the flux is large; and c) uncertainties are particularly high in the LULUCF flux	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
76383	1	1	158	21	The overall structure is stressful for a reader which have not an ndex of abbreviation in hand as many abbreviation or acronyms are not extended while should be clearly put in brackets the very first time they are cited. It is a wrong habit to suppose a reader is a well learnt and not a newbie.	Accepted. We write out terminology fully with abbreviation in brackets upon first appearance in text. Abbreviations are used only afterwards on their own.	Emilio Sessa	Carbon Credits Consulting	Italy
3981	1		158		The text is very clear, complete and objective. It brings, in my understanding, fundamentally all the information pertinent to the treated subject. The section is very well written and the authors were very responsible and assertive in dealing with the subject in question. For these reasons I have nothing significant to add as I understand that the topic is being treated very clearly and completely. The authors are to be congratulated for the excellent work.	Thank you.	FABIO RUBENS SOARES	USP - Universidade de São Paulo	Brazil
43253	2	1	2	47	COVID 19 will lead many economies to open their markets with great intensity to recover their economies. How does the document address health crises caused by pandemics?	This chapter is concerned with emission trends and drivers. We cover the COVID-19 pandemic to the extent covered by public datasources and the peer-reviewed scientific literature	Government of Chile	Ministry of Environment	Chile
6093	2	22	2	27	one ‘blindspot’: CO2 emission from mask industry (and also hygienic products) is not yet quantified	Rejected. We have no explicit information on that in our dataset. Moreover, we are not aware of a prominent literature on this issue - and a substantial impacts on global emission levels and trends	Liwah Wong	EIT Climate KIC, EIT RawMaterials	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
73933	2	23	12	21	Neither the EDGAR database nor the emissions not quoted in Edgar include the GHG emissions from production, operation and disposal of military equipement. Nor are the CO2 emissions considered due to the resconstruction of buildings etc. destroyed by warlike actions. There is an emerging literature on the hidden carbon costs from the US, Germany and other countries. E.g the estimates of CO2 emissions from the 10 countries whith the highest expenditures for military equipment amount to 0.9 Gt CO2, certainly a very conservative estimate. See: Neta C. Crawford, Boston University. Pentagon Fuel Use, Climate Change, and the Costs of War June 12, 2019. https://watson.brown.edu/costsofwar/files/cow/imce/papers/2019/Pentagon%20Fuel%20Use%2C%20Climate%20Change%20and%20the%20Costs%20of%20War%20Final.pdf. Belcher et al., 2019. Hidden carbon costs of the “everywhere war”: Logistics, geopolitical ecology, and the carbon boot-print of the US military. https://doi.org/10.1111/tran.12319. Seemoz Kilmakiller Militär 10 December 2019. https://www.seemoz.de/oekomix/klimakiller-militaer-2/. These publications indicate that current GHG estimates are serious underestimations, a fact, that in my opinion leads to much larger estimates of uncertainties and has consequences for at least some other chapters of AR 6.	Rejected. We need to build on what we get from inventories. It is not true that inventories such as EDGAR would not cover some of these emissions. For example, emissions from reconstruction buildings that have been destroyed in wars would be covered, for example, as cement emissions, manufacturing emissions, and emissions in the transport sector etc.. But you would not able to isolate them and reporting would be year-by-year. Given the page constraints we do not think that this literature on the emissions of military/wars should be the focus of this chapter.	Dietrich Schwela	Stockholm Environment Institute at University of York	Germany
73935	2	23	11	21	Similarly, the EDGAR data base appears to be incomplete with respect to life cycle GHG emissions of tobacco production, consumption, and disposal. See e.g. Zafeiridou et al., 2018. Cigarette Smoking: An Assessment of Tobacco’s Global Environmental Footprint Across Its Entire Supply Chain. https://doi.org/10.1021/acs.est.8b01533.	Rejected. It is a matter of accounting methodology. In EDGAR, emissions from different LC stages appear as part of different accounts (e.g. AFOLU, industry, transportation). In section 2.3 we cover consumption-based emissions, but cannot cover individual products here.	Dietrich Schwela	Stockholm Environment Institute at University of York	Germany
74691	2	31	2	34	I believe these numbers are budgets to 2100 that account for CO2 released by 2100 due to Earth System Feedbacks and to warming due to non-CO2 drivers after the date the budgets are exhausted, so do not imply we will reach 1.5C by these dates. Budgets to peak warming would be much more informative and consistent with all the literature on carbon budgets up to the past couple of years.	Rejected. No - these are budgets that have been drawn from WG1 Second Order Draft, i.e. until peak warming. We are now using the numbers from the published version.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
469	2				PG Subchapter 2.2 and 2.3 need (to some extent) to be wirtten in parallel construct. The title needs to be coordinated. This comment will be applied to the whole table of contents. Some chapters have introduction but others do not. The chapter needs to have consistency. The sub chapter titles should be more informative rather than 'the introduction' or 'conclusion' or 'synthesis'. Also, The titles of 2.5 is very different from other chapters, combined with some sentence. Sub chapter 2.6. needs to be modified as well. The factors should be explained first, Then, the readers want to know how much emissions/reduced emissions could be attributed to individual factor. It will be linked to the citizens' participation	Noted. This contains a variety of suggestions that we have considered. But note that there are no formal requirements on how the sub-section structure or their titles are designed. We will do this with consideration of the reader perspective.	Kim Hana	KAIST	Republic of Korea
16069	2				PG Subchapter 2.2 and 2.3 need (to some extent) to be wirtten in parallel construct. The title needs to be coordinated. This comment will be applied to the whole table of contents. Some chapters have introduction but others do not. The chapter needs to have consistency. The sub chapter titles should be more informative rather than 'the introduction' or 'conclusion' or 'synthesis'. Also, The titles of 2.5 is very different from other chapters, combined with some sentence. Sub chapter 2.6. needs to be modified as well. The factors should be explained first, Then, the readers want to know how much emissions/reduced emissions could be attributed to individual factor. It will be linked to the citizens' participation	Noted. This contains a variety of suggestions that we have considered. But note that there are no formal requirements on how the sub-section structure or their titles are designed. We will do this with consideration of the reader perspective.	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
76355	4	0	4	46	The high confidence and medium confidence should be provided with a scale min/max, as there is not a clear reference to the boundaries of this.	The IPCC uncertainty assessment described: https://www.ipcc.ch/site/assets/uploads/2017/08/AR5_Uncertainty_Guidance_Note.pdf	Emilio Sessa	Carbon Credits Consulting	Italy
65263	4	1	9	20	These summaries are clear, specific and very helpful.	Thank you.	Lindsey Cook	Quaker United Nations Office / Friends World Committee for Consultation	Germany
72441	4	1			In the executive summary, there are sometimes references to the emissions in 2018 and others to 2019 (e.g. when refering to the COVID pandemic effects). If the numbers for 2019 are available why not use these latter. If they are not fully available, then refer all to 2018. A common reference date should be taken in order to be able to draw comparisons.	In the final government draft we have updated all numbers to 2019, apart from a finding on 2020 emissions and COVID.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
77099	4	1	4	4	The statement that GHG emissions are “higher than in any point in history” is true but irrelevant in that anthropogenic emissions represent are almost insignificant in the context of natural carbon cycle sources and sinks, as also in the context that global CO2 concentrations have been up to ~10 times higher in the paleoclimate.	Rejected. Note that "anthropogenic" is in the title of this ES statement. It should therefore be clear that this is our reference point. Further, we are not sure why anthropogenic emissions are irrelevant, since they drive observed warming trends, per AR6	Jim O'Brien	Expert Reviewer AR6 SOD WG1	Ireland
86089	4	1			Fantastic chapter – but too much (6 pages) in Exec Sum ..	Accepted. We have trimmed down both the ES and the chapter. We added an online supplementary material.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
11405	4	2	4	2	The global GHG emissions in 2018 reported here in Ch. 2 (59±5.9 GtCO2eq) is different from the figure reported by UN Emissions Gap Report 2019 (55.3 GtCO2eq) (https://www.unenvironment.org/resources/emissions-gap-report-2019). Also, UN Emissions Gap Report 2020 (https://www.unep.org/emissions-gap-report-2020) has already published the figure of global GHG emissions in 2019 while the latest emissions figure reported by WGIII AR6 is still that of 2018. Since both WGIII AR6 and UN Emissions Gap Report are authoritative UN publications, suggest including 2019 data and giving a brief explanation of the disparity in the main text.	Noted. Data is continuously evoloving and updated. However, the biggest descrepancy is caused by the Global Warming Potentials used to convert the individual GHG emissions into a common unit. While UN Emissions Gap uses GWPs from AR4, we use GWPs from AR6 here.	SAI MING LEE	Hong Kong Observatory	China
17969	4	2	4	2	The rate of growth of global GHG emissions has slowed with respect to the percentage change but it has not done so with respect to the absolute values. The change from 1990-1999 to 2000-2009 was 7 Gt. The change from 2000-2009 to 2009-2018 was 9 Gt. Therefore in absolute terms the rate of growth has increased from 7Gt in a decade to 9Gt in a decade. To say that the rate has slowed could be misleading and overly positive.	Accepted. We have highlighted that the growth in average annual GHG emissions decade-by-decade has been unprecendeted. However, note that coneptually these are two different things. In one case compare the average annual growth within a decade, in the other case we compare the growth in average annual	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
17971	4	2	2	4	There are three very important points in this paragraph - what current emissions are, that emissions are higher than ever been, but that rate of increase has reduced - and would be clearer if they reordered and split. Preferably split into three separate paragraphs in order I give above, but otherwise three separate sentences.	Rejected. While we appreciate that this is a lot of information in one paragraph, this also contributes to the synthetic nature of the findings. As the ES was over-length, we had to cut the statements significantly leaving no space for further separations as well.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
17973	4	2	2	4	Confusing that high confidence on actual emissions and rate of growth, but only medium confidence that emissions are higher than ever. Surely it would follow that this should also be high confidence, or is there a reason we think emissions may have historically have been higher?	Accepted. We made this distinction, because of the uncertainties around the levels. We focus therefore now on the increase in average decadal emissions, where we can assign high confidence.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
61545	4	2	4	13	latest data includes IEA GER data on energy CO2 for 2020 of 31.5Gt	Accepted. We include IEA data in the later finding on CO2-FFI emissions in 2020 "under COVID-19".	tom howes	International Energy Agency	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
78831	4	2	4	13	It would be useful to single out CO2 here rather than aggregate everying into CO2-eq. Separate information on CH4 and N2O would be valuable.	Rejected. It is useful to report aggregate GHG emissions in CO2eq units - as also done in UNFCCC reporting by Parties and wide parts of the relevant literature in WG3. We report developments in individual gases in the next finding - highlighting that all gases reached the highest decadal average for 2010-2019. Note that cited Figure 2.5 also show trends in individual gases.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
80587	4	2	4	7	Do these emissions and trends include CFC/HCFC/halons and non-methane tropospheric ozone emissions due to e.g. anthropogenic NMVOC and CO emissions? As shown in Figure 2 of Velders et al. (2007), emissions of CFCs and other ozone depleting substances in between 1970 and 1990 reached over 9 GtCO2e in GWP100 terms. Including CFC/HCFC/halons in the average annual GHG emissions from 1990–1999 would increase from 40±4.0 to approximately 44.8 GtCO2eq (GWP-100), based on calculations using NOAA and AGAGE data in addition to EDGAR v5. Citation: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Velders G.J.M., Andersen S.O., Daniel J.S., Fahey D.W., & McFarland M. (2007) The importance of the Montreal Protocol in protecting climate, Proceedings of the National Academy of Sciences 104(12): 4814–4819. Accessed at	No, We make now explicit, which F-gases are included. We also highlight that even today there is a significant contribution of CFCs and HCFCs. We highlight this in the underlying chapter and note it in another ES finding,	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
80731	4	2	4	7	Do these emissions and trends include CFC/HCFC/halons and non-methane tropospheric ozone emissions due to e.g. anthropogenic NMVOC and CO emissions? As shown in Figure 2 of Velders et al. (2007), emissions of CFCs and other ozone depleting substances in between 1970 and 1990 reached over 9 GtCO2e in GWP100 terms. Including CFC/HCFC/halons in the average annual GHG emissions from 1990–1999 would increase from 40±4.0 to approximately 44.8 GtCO2eq (GWP-100), based on calculations using NOAA and AGAGE data in addition to EDGAR v5. Citation: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Velders G.J.M., Andersen S.O., Daniel J.S., Fahey D.W., & McFarland M. (2007) The importance of the Montreal Protocol in protecting climate, Proceedings of the National Academy of Sciences 104(12): 4814–4819. Accessed at http://www.pnas.org/cgi/doi/10.1073/pnas.0610328104	No, We make now explicit, which F-gases are included. We also highlight that even today there is a significant contribution of CFCs and HCFCs. We highlight this in the underlying chapter and note it in another ES finding,	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
83363	4	2	4	13	The choice in this ES statement to report total aggregated GHG emissions with updated GWP-100 values is excellent, and it supports the most policy relevant quantity for aggregated GHG emissions. I would strongly support it remaining like this in the FGD as well.	accepted. Thank you.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
64441	4	3	4	4	In this frase: -(2018) emissions were higher than at any point in human history before (medium confidence)-, I think that here the confidence is high because in the Technical Summary (Page 14, line 3) said in 2018 measured at 59±5.9 GtCO2eq (high confidence), measure higher than at any previous point in human history.	Accepted. We made this distinction, because of the uncertainties around the levels. However, we agree that this is confusing. We therefore focus now on average decadal emissions 2010-2019, where we can assign high confidence.	Adriana Silva	Venezuelan Institute for Scientific Research (IVIC)	Venezuela
83457	4	3	4	4	Why only medium confidence? If emissions in a single year are too uncertian, maybe find a statement that you can say with high confidence?	Accepted. We made this distinction, because of the uncertainties around the levels. However, we agree that this is confusing. We therefore focus now on average decadal emissions 2010-2019, where we can assign high confidence.	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
7815	4	4	4	5	Here the text says that emissions in 2018 were 11% (5.9Gt GtCO2eq) higher than in 2010. In line 2, it says that global GHG emissoins measured at 59+-5.9Gt CO2eq in 2018. These descriptions mean that emissions in 2010 were 53.1+-5.9GtCO2eq. This figure seems to be calculated by using the difference of figures based on new Global Warming Potentials in AR6.. However, for policymakers or negotiators on climate change, 49Gt in 2010 was the figure they used in any occasion and they may be puzzled to find the figures (for them if increase between 2010 and 2018 is 5.9 Gt, then figure in 2018 should be 54.9Gt Though we can guess the reason of difference in 2010 emission figures come from new GWPs, it might be better to explain what are GWPs and explain briefly why the figures were altered, by inseting a box. For the authors'a reference, in the Committee on Climate Change's advice to the UK Government on 6th carbon budget in December 2020, CCC explained the reason of increase of UK emission figures due to the change of GWP in IPCC 6th Assessment Report.	Rejected. We highlight that GWP-100 values come from AR6. There is no space in the ES to say why, but we do this in the chapter (Section 2.2.2) and even have a cross-chapter box on emission metrics as well as additional information in the supplementary material.	Mitsutsune Yamaguchi	Research Institute for the Innovative Technology for the Earth (RITE)	Japan
61087	4	7	4	8	"GHG emissions growth slowed since 2010: while average annual GHG emissions growth was 2.3% between 2000 and 2010, it was 1.3% for 2010-2018." The periods 2000-2010 and 2010-18 are not comparable as the duration differs for the two years.	Accepted. We have 2000-2009 and 2010-2019 now.	LOKESH CHANDRA DUBE	TERI School of Advanced Studies	India
3219	4	8	4	8	usage of % might be misleading as absolute amount of annual GHG emissions is rising, so decreasing % is artificial result. Actually annual GHG emissions is increasing by the same absolute amounts per year -between 0.8-0.9 Gt per year	Rejected. It is a relevant finding that rel. Growth has slowed considerably. We are not reporting negative percentages, which would be an emission reduction, but decreases in the rate of growth. Further note that we equally say that emissions for the most recent decade 2010-2019 are higher than ever before. So overall we think that the finding is balanced.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
75947	4	9	4	10	Good that you make it clear how you calculate CO2-eq.	Thanks. We have this in a footnote now.	Jan Fuglestvedt	CICERO	Norway
20509	4	11	4	11	Is a word misssing? Suggestion to replace by "emissions reporting and accounting purposes"	Accepted. This is now part of a footnote.	Government of France	Ministère de la Transition écologique et solidaire	France
75949	4	11	4	11	Not sure if "required for emissions" is the right wording here. I think "reporting of" is missing.	Accepted. This is now part of a footnote.	Jan Fuglestvedt	CICERO	Norway
17967	4	12	4	12	"all metrics…": This sentence seems out of place here. The paragraph is stating facts about what is used under UNFCCC regarding a specific metric. Not sure why it ends with a reference to "all metrics".	Rejected. It is still important to say that GWP-100 is one specific metric. They are all imperfect and respond to different questions.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
8059	4	14	4	17	Please delete "change", AFOLU is not LULUCF and agriculture and forestry do not constitute land-use change.	In line with Working Group I we use now CO2-LULUCF to refer to CO2 emissions from land use, land-use change and forestry as reported in bookkeeping models.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
54581	4	14	4	21	Bullet is on emissions growth, but absolute emission growth values are not supplied. Instead of or in addition to listing 2018 emissions, list emission changes. Furthermore, to provide appropriate context and avoid misleading the reader, emission changes need to be supplied primarily in Gt CO2eq/yr throughout the bullet for all gases that are mentioned. Statements of relative increases are not as necessary but could be retained. The statement that "fluorinated gases have jointly grown much faster than all other GHGs" is misleading without inserting "on a relative basis". Also, the last two sentences include a comment on warming, which doesn't fit with this bullet since warming today isn't directly related to emissions. Instead it is related to cumulative emissions minus cumulative loss or, more precisely, the radiative forcing from atmospheric concentrations today relative to 1750. Consider rephrasing these sentences, cutting them, or moving them to a location that is more appropriate.	Accepted. We have added the levels and re-structured the narrative around it. This makes clear that the main contributions to growth in CO2eq emissions and warming come from CO2 and CH4. We still highlight the f-gas issue as well though, because it is important - particularly in the light of the neglect of important groups of species such as CFCs and HCFCs,	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
71131	4	14	4	14	Emission growth has been varied, but persistent across different gases. Varied across what? Unclear.	GHG emissions growth has been varied across different gases, i.e. they have all grown, but the pace of growth has been different. We try to make this clearer now.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
78833	4	14	4	21	This point would be a lot more informative if the numbers were presented as emissions of CH4 or N2O respectively. Converting these to CO2eq hides useful information.	Rejected. We want to make clear how increases in individual gases have contributed to overall GHG emissions changes - something that is done in UNFCCC country reporting frequently.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
76357	4	16	4	16	It is not clear from the sentence, if the CH4 here is referred to AFOLU or to FFI.	Rejected. This would be too much detail here.	Emilio Sessa	Carbon Credits Consulting	Italy
76359	4	17	4	17	The F-gas should be written always capitalized given it refers to a nomenclature, here is not.	Accepted. Done	Emilio Sessa	Carbon Credits Consulting	Italy
78835	4	17	4	17	F-gases is not a very comprehensive definition. WG I uses "Halogenated compounds" and the same terminology should be maintained in WG III for consistency. Not all halogenated compounds contain fluorine - does this definition exclude these?	For WG3 the main reference points are the global inventories, which today usually report HFCs, PFCs, SF6 and NF3. We made transparent what we include and highlight that this neglects important other F-gases.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
80589	4	17	4	21	Do these emissions and trends include CFC/HCFC/halons and non-methane tropospheric ozone emissions due to e.g. anthropogenic NMVOC and CO emissions? As shown in Figure 2 of Velders et al. (2007), emissions of CFCs and other ozone depleting substances in between 1970 and 1990 reached over 9 GtCO2e in GWP100 terms. Including CFC/HCFC/halons in the average annual GHG emissions from 1990–1999 would increase from 40±4.0 to approximately 44.8 GtCO2eq (GWP-100), based on calculations using NOAA and AGAGE data in addition to EDGAR v5. Citation: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Velders G.J.M., Andersen S.O., Daniel J.S., Fahey D.W., & McFarland M. (2007) The importance of the Montreal Protocol in protecting climate, Proceedings of the National Academy of Sciences 104(12): 4814–4819. Accessed at	For WG3 the main reference points are the global inventories, which today usually report HFCs, PFCs, SF6 and NF3. We made transparent what we include and highlight that this neglects important other F-gases. We further quantify the size of important F-gas emissions not considered here - such as CFCs and HCFCs.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
80733	4	17	4	21	Do these emissions and trends include CFC/HCFC/halons and non-methane tropospheric ozone emissions due to e.g. anthropogenic NMVOC and CO emissions? As shown in Figure 2 of Velders et al. (2007), emissions of CFCs and other ozone depleting substances in between 1970 and 1990 reached over 9 GtCO2e in GWP100 terms. Including CFC/HCFC/halons in the average annual GHG emissions from 1990–1999 would increase from 40±4.0 to approximately 44.8 GtCO2eq (GWP-100), based on calculations using NOAA and AGAGE data in addition to EDGAR v5. Citation: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Velders G.J.M., Andersen S.O., Daniel J.S., Fahey D.W., & McFarland M. (2007) The importance of the Montreal Protocol in protecting climate, Proceedings of the National Academy of Sciences 104(12): 4814–4819. Accessed at	For WG3 the main reference points are the global inventories, which today usually report HFCs, PFCs, SF6 and NF3. We made transparent what we include and highlight that this neglects important other F-gases. We further quantify the size of important F-gas emissions not considered here - such as CFCs and HCFCs.	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
9845	4	22		27	Please see comment on Chapter 1 page 1-17	Rejected. I cannot track-back comments in other chapters. Sorry.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
17975	4	22	4	25	Suggest adding " but emission growth has picked up with economic activity again since April 2020 after lock-down measures have been lifted or relaxed" to the main headline in bold. Alternatively please give a confidence level for this statement (if not also medium confidence). 25 economic activity again since April 2020 after lock-down measures have been lifted or relaxed	Noted. The offered language is very precide, but we need to keep statements very short. We tried to be brief and precise.	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
30629	4	22	4	27	Add the additional note that the quantitative impact of COVID19 on emissions and energy will be unclear. The described data and results of the analysis will be very limited because of the very recent event of COVID19.	Noted. We make very prominent that the effect seems to be of temporary nature as emissions have already rebounded.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
72525	4	22	4	27	It is so exciting to see COVID-19 is discussed in this chapter. I would suggest to generally mention emission declines in several individual countries/regions after introducing global trend in Executive Summary.	Noted. Thanks. No changes requested here.	Yun Hang	Emory University	United States of America
83025	4	22	4	27	It would be informative to add an indication about nonCO2 emissions during COVID, even if only in qualitative language. There might not be reliable numbers yet, but probably there arent't stark COVID-related changes, which means the temporary decline was even smaller	We hoped to get preliminary 2020 estimates for non-CO2 GHGs, but did not. Based on the available evidence, we decided to focus on CO2-FFI - which provides the only robust evidence base.	Geden Oliver	German Institute for International and Security Affairs	Germany
30631	4	24	4	24	The meaning of "7% (2.7-13%)" is not clear. It would be better to explain values in the parenthesis.	Accepted. We made it clear that this is the % reduction in 2020 emission relative to 2019. We also provide the absolute magnitude of this change. The entire finding got updates with 2020 estimates from IEA/BP and EDGAR.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
61529	4	24	4	24	Please correct ambiguous expressions. What do you mean the description of "7% (2.7-13%)"? More explanations on the parenthesis are needed.	Accepted. We made it clear that this is the % reduction in 2020 emission relative to 2019. We also provide the absolute magnitude of this change. The entire finding got updates with 2020 estimates from IEA/BP and EDGAR.	Takashi Homma	Research Institute of Innovative Technology for the Earth (RITE)	Japan
51959	4	25	4	25	"Emissions growth picking up in April" is a general, vague statement. This statement is not necessarily true in all regions. Show more specific cases on emissions growth.	Noted. We use more precise language now and say that global emissions have rebounded by the end of 2020.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
4901	4	28	4	38	The presentation of the results should be simplified to make the paragraph more easily readable	Accepted. We have shortened the paragraph and focussed on one simple comparison between emissions over the last decade (2010-2019) and the remaining 1.5°C budget.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
7817	4	28	4	38	The message here, I think, is the most important information for all parties concerned with Climate Change Issue, including policymakers and negotiator. Please put this message into SPM (page17, lines 1-33..	Thank you. It is not in our power to put this into the SPM, but we have proposed it to the editors leading the SPM writing process.	Mitsutsune Yamaguchi	Research Institute for the Innovative Technology for the Earth (RITE)	Japan
29825	4	28	4	38	In this para and in several other places throughout the report (e.g. in the SPM and the TS) you are currently using the formulation "keeping global warming below 1.5C", in some instances the formulation "well-below 1.5C" is also used (see eg. ch. 2 p. 8 l. 33). Please consider to rather formulate finding with respect to 1.5C too e.g. "stabilizing global temperature at 1.5C with or without overshoot" or "keeping global warming to 1.5C". We believe this is closer to the formulations in Art. 2 of the Paris Agreement. With respect to 2C the formulation below or well-below is more appropriate.	Accepted. We use this formulation and check other instances in the chapter.	Government of Norway	Norwegian Environment Agency	Norway
30633	4	28	4	29	It would be better to explain the specific period of "current rates".	Noted. We have redeveloped this finding. It no longer refers to "current rates". We compare the CO2 emissions of the last decade with the remaining carbon budget. This should be clear and clean.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
45757	4	28	4	38	It is stated here that the global carbon budget remaining for 1.5°C warming is depleted before 2030, both for CO2 emissions at the current rate as well as for annual CO2 reduction rates at 2 or 5%. This does not seem very plausible. Please provide more precise information when the budget is depleted for different CO2 growth/reduction rates.	Noted, We shortened and simplified the finding focussing now on a simple comparison between historic emissions 2010-2019 and the remaining 1.5°C budget. This makes the main point without any false precision. We decided against a langauge of "budget depletion" and therefore no longer do this for different hypothetical emissions reductions rates.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
61531	4	28	4	29	Please correct ambiguous expressions. More explanations on the specific period of "current rates" are needed.	Noted. We have redeveloped this finding. It no longer refers to "current rates". We compare the CO2 emissions of the last decade with the remaining carbon budget. This should be clear and clean.	Takashi Homma	Research Institute of Innovative Technology for the Earth (RITE)	Japan
64915	4	28	4	38	I would mention non CO2 GHGs at least to avoid unit confusion for non specilists when comparing to lines 2-13	Rejected. Carbon budgets are reported for CO2 emissions only. However, the uncertainties relfect scenario uncertainty that reflect a wide range of patterns of non-CO2 climate forcers.To that extent this is captured here. However, we cannot explain all this in the ES.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
66183	4	28	4	38	Statements linking degrees of warming to a carbon budget need to recognise that there is much uncertainty associated with such a relationship or climate sensitivity estimate (in several dimensions including the uncertainty in global energy imbalance of atmosphere/ocean, choice of dataset, measured parameters, year-to-year variance, regional variance, methods of model fitting, and allowances for climate influences other than GHGs). The methodology behind those statements, with accompanying uncertainty budget, ought to be a component of this report.	Rejected. This is the job of Working Group 1. We therefore refer the reader to WG1 chapter 5 for reference. We further report at least the scenario uncertainty.	Donal OCallaghan	Teagasc (retired member)	Ireland
75951	4	28	4	29	Important to avoid any confusing of these numbers vs the numbers for cumulative CO2 to net zero used in Ch3.	Accepted. We make a concious decision to refer to WG1 carbon budgets when referring to evidence that talks about the long-term historical carbon budget. Elsewhere we use WG3 net cumulative emissions until net-zero CO2 from emission reduction pathways as captured by chapter 3.	Jan Fuglestvedt	CICERO	Norway
77101	4	28	4	29	The statement that “the remaining carbon budget will be used by 2030” is scientifically inappropriate and inconsistent with observations.	Noted. We agree that our previous language could be seen to imply a false precision. We have simplified the finding and focus now on a simple comparison between historic emissions of the last decade and the remaining 1.5°C budget.	Jim O'Brien	Expert Reviewer AR6 SOD WG1	Ireland
83023	4	28	4	38	The enormous uncertainties in the WG1 carbon budget calculations and the many substantial changes in the WG1 methodology (between SR1.5 and AR6) might warrant to avoid the countdown language used here	Noted. We acknowledge some of these uncertainties and have simplified the finding to provide a simple comparison bezween historic emissions of the last decade and the remaining 1.5°C carbon budget.	Geden Oliver	German Institute for International and Security Affairs	Germany
83459	4	28	4	38	Please update with latest WG1 Ch5 numbers. Based on the latest WG1 numbers, this statement cannot be supported. The remaining carbon budget for 1.5°C is 500 GtCO2 (50%). Compared to current emissions of about 40 to 42 GtCO2/yr, this is definitely not exhausted before 2030.	Accepted. We agree that our previous language could also be seen as implying a false precision. We have simplified the finding and focus now on a simple comparison between historic emissions of the last decade and the remaining 1.5°C budget.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern
17977	4	29	4	29	I’d re-word to change ‘before 2030’ to a variant of seven years’ time (i.e. ‘is projected to be exhausted by 2028, based on current CO2 emissions’). This brings the deadline closer and more in line with the actual analysis.	Rejected. We believe that the previous finding implied a false precision. We have generalised the headline finding and simplified the body based on a simple comparison between historic emissions of the last decade and the remaining carbon budget for keeping warming below 1.5°C.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
29533	4	30	4	30	Please consider underlining that this is the most recent data for these calculations, so as to remove any doubt that data could be more recent.	Accepted. We have updated with the final WG1 numbers and use our extended data to 2019.	Government of Norway	Norwegian Environment Agency	Norway
11407	4	31	4	31	Re: "AR5 (2010)". AR5 reports, including WGI, WGII, WGIII and Synthesis Report, were published in 2013-2014, not 2010. Please revise.	Rejected. The most recent year reporting emissions in AR5 WG3 was 2010.	SAI MING LEE	Hong Kong Observatory	China
54583	4	31	4	36	The use of "respectively" here is not at all clear. Also, consider on line 35: "(43+/-4.1 Gt CO2/yr including both FFI and AFOLU)" to avoid confusion.	Noted, This language is no longer there. We streamlined this finding a lot.	Government of United States of America	U.S. Department of State	United States of America
54585	4	32			The numbers used in the brackets, example 310±250 (390, 500), are not explained. What are they?	Noted. The nubers are explained - they refer to carbon budget with different threshold probabilities. We tried to make this clearer by rewording.	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
71133	4	32	4	33	What do the parentheses (390,500) and (1140,1390) refer to? Is it the range for 2 standard deviations?	These are budget numbers for different threshold probabilities as indicated in the draft. We tried to make this clearer by rewording.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
76361	4	32	4	35	Here, it is not clear the number in brackets to which value refer to. It should be stated more explicitly.	We tried to clarify this by re-arranging the sentence.	Emilio Sessa	Carbon Credits Consulting	Italy
45759	4	34			Probability for "likely" is indicated as "of 67%" in this paragraph (see also page 2-30, line 25), while sometimes being expressed as "66% probability" (e.g. page 2-8, line 33). It would be very helpful if the likelihood is used consistently across the report.	Accepted. We made sure that this is the case troughout the chapter,	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
43049	4	35		37	CDR will probably be required: “Even if global CO2 emissions decrease at 2% or 5% per year, the 1.5°C budget will be exhausted before 2030 highlighting the dependence of 1.5°C pathways on the availability of substantial CO2 removal capacities.”	We mention this briefly in the chapter, but leave the assessment of CDR to other chapters. We have removed the language from the ES.	Graeme Taylor	BEST Futures	Australia
43471	4	35	4	38	Given current trends and technologies, a continuous annual reduction in greenhouse emissions of more than 5% between 2021 and 2030 is highly unlikely. Even developed countries have not been able to continuously reduce emissions to this level yet. Therefore, it seems that the goal of limiting the temperature increase to 2 degrees should be pursued instead of the 1.5 degrees goal (As agreed in the Paris Agreement).	Noted. We have streamlined the paragraph. This part is no longer there.	sadegh zeyaeyan	Head of national center for forecasting and weather hazards management of Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
50377	4	35	4	38	Given current trends and technologies, a continuous annual reduction in greenhouse emissions of more than 5% between 2021 and 2030 is highly unlikely. Even developed countries have not been able to continuously reduce emissions to this level yet. Therefore, it seems that the goal of limiting the temperature increase to 2 degrees should be pursued instead of the 1.5 degrees goal (As agreed in the Paris Agreement).	Noted. We have streamlined the paragraph. This part is no longer there.	Government of Iran	Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
20511	4	36	4	36	Please specify during which time frame (e.g. "from 2020 onwards")	Noted. We have streamlined the paragraph. This part is no longer there.	Government of France	Ministère de la Transition écologique et solidaire	France
30635	4	36	4	37	The results would be completely different for 2% and 5%. Please check the statement "Even if global CO2 emission decrease at 2% or 5% per year, the 1.5°C budget will be exhausted before 2030" is correct.	Noted. We have streamlined the paragraph. This part is no longer there.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
61517	4	36	4	37	Is "or" right?	Noted. We have streamlined the paragraph. This part is no longer there.	Takashi Homma	Research Institute of Innovative Technology for the Earth (RITE)	Japan
63457	4	37	4	38	Suggest changing the use of the term dependence with language consistent with that in Chapter 3. This is because the word dependence implies that 1.5C cannot be achieved without CO2 removal, which is not true (it is only unlikely/very unlikely). Examples of suggestions: -" the vast majority of scenarios include...". - "highlighting the importance/role of substantial CO2 removal capabilities on 1.5C pathways". - “highlighting the dependence of these 1.5C pathways on the availability of substantial CO2 removal capacities” - “highlighting the dependence of many/most 1.5C pathways on the availability of substantial CO2 removal capacities” - “highlighting the importance of CO2 removal capacities on 1.5C pathways”	We have removed this language in an effort to streamline this finding.	Government of Canada	Environment and Climate Change Canada	Canada
8227	4	39	5	2	"Individual countries have cut their emissions by 50%.." - I would suggest for you to mention whether this is consumption or production based measures	Noted. We have cut this part as we had to streamline this finding.	Frida Zahlander	DanChurchAid	Denmark

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
12665	4	39	4	39	Simplify heading to: "A growing number of countries have achieved…" Likewise in line 41 eliminate "There are" and say more directly "At least 35 countries…"	Accepted. Done	Donald Falk	University of Arizona	United States of America
54587	4	39	4	46	On line 40, the dash and text "--individual countries" seem out of place and should be cut. On line 40-41 adjust to "at rates that are broadly consistent ... well below 2°C if they were achieved by all countries". On line 44, do authors mean "by as much as 50% from peak levels"?	Accepted. We added a more precise language here around the achieved reducrions: "Reduction rates in a few countries have reached 4% in some years, in line with rates observed in pathways that likely limit warming to 2°C." We no longer have the drop from peak emissions here as we streamlined and merged with another ES finding.	Government of United States of America	U.S. Department of State	United States of America
17979	4	40	4	46	"individual countries at rates that are broadly consistent with climate change" - can you give a figure for the number of countries in this category?	Rejected. We simply say "a few" now - the number is very limited, but we do not want to draw rather subjective boundaries.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
29535	4	42	4	42	Please explain 'territorial-based'	We avoid this term now, but still use it where we compare with consumption-based emissions.	Government of Norway	Norwegian Environment Agency	Norway
4903	4	44	5	1	The sentence is too vague. I would suggest to delete it or to add more details. As it is, it does not provide a meaningful indormation	Noted. We have streamlined the sentence and a more concise language now.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
54589	4	44	4	44	The bullet text poorly represents what is in the chapter on page 35, line 32, which indicates "up to 50%". Hence, bullet point needs insertion of "up to" to retain accuracy. This correction, if adopted, also needs to be reflected in the SPM.	It would have been better to put "up to" or "about" there. We streamlined the finding as ES was too long. Sentence is gone now.	Government of United States of America	U.S. Department of State	United States of America
1659	4		9		The summary remains too vague, does not put a finger in the wound and makes it clear what the current status is and uses a deeply diplomatic language that prevents clear insight. At the end of the day, the reader automatically asks himself what came out in concrete terms, or what is now being proposed as a specific guiding principle. Any statements or advice based on the motto: who does what, by when, with what result, at what cost, are completely missing. The paper clearly fails to make any statements here. A really great paper with a gigantic number of figures in the form of tables and especially diagrams, which cannot be denied, which in the end does not bring the reader the hoped-for benefit in short form, which the certainly massive work in the creation would have deserved. Really a shame and bitter for all readers, whether politicians, managers or scientists.	Noted. We regret that the reviewer feels like this. We believe that we summarize the emerging knowledge on emission trends well. It is not the mandate of the IPCC to make policy recommendations. It is the main purpose of chapter 2 to understand developments in emissions. Within this scope we did our best to further improve the policy relevance of this Executive Summary.	David Novak	DIPLOMA Fachhochschule Nordhessen, https://www.diploma.de/, owner of the chair of sustainability	Germany
27559	5	1	5	2	It needs to be specified whether this statement refers to countries that have already reached a specific level of economic development, or includes any developing countries.	We streamlined the entire ES. This language is no longer there.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
17981	5	2	5	2	I think 'economic success' is being used as a synonym for 'economic growth' in this sentence which is potentially controversial, suggest changing success to growth.	We streamlined the entire ES. This language is no longer there.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
29537	5	2	5	2	These country cases are largely industrialized countries. What is the feasibility situation for developing countries?	We streamlined the entire ES. This language is no longer there.	Government of Norway	Norwegian Environment Agency	Norway
17983	5	3	5	3	Unsure on the definition of 'the developed countries region' - is this a particular subset of developed countries or all developed countries?	Accepted and corrected. We meant to say 'developed 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)

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
54591	5	3	5	11	The relative contributions of different countries to these emissions are trending in different directions in recent years. Hence wonder why the year 2015 was chosen here, instead of the focus year of 2018 that was discussed earlier (the first bullet). How different would the numbers be if they were provided for 2018? Also, the phrase "considerably higher" (line 3) doesn't seem accurate for characterizing a difference that is only 41% (developed) vs. 39% (Asia and Developing Pacific).	accepted. we updated the numbers to 2018. and revised the descriptive phrase such as 'considerably higher' in the whole text.	Government of United States of America	U.S. Department of State	United States of America
71135	5	3	5	11	Developed countries are neither a region, nor a homogenous block in terms of emissions performance (compare Europe to US, Australia, Canada…). Please change this formulation.	accepted and revised	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
86091	5	3	5	4	It actually seems that developed countries plus east Asia account for ,about 40% each (gvien also the trend since 2015?) so between them account for fourth fifths of global emissions on consumption basis - wow	no need to revise. But we updated the numbers after re-calculation.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
11409	5	4	5	6	The source of the statement "In developed countries consumption-based CO2 emissions from fossil fuel combustion and industrial processes peaked at 16.8 GtCO2 in 2007 with a subsequent 12% decline until 2015" cannot be identified in the main text. Please check.	accepted. It has been revised and checked with the main text.	SAI MING LEE	Hong Kong Observatory	China
11411	5	9	5	10	The source of the statement "Asia and Developing Pacific has been a major contributor to consumption-based CO2 emission growth since 2000 with an average growth rate of 6.4% per year" cannot be found in the main text. Please check.	accepted. the main text and ES have been checked for consistency.	SAI MING LEE	Hong Kong Observatory	China
17993	5	9	5	11	"Asia and Developing Pacific has been a major contributor to consumption-based CO2 emission growth since 2000 with an average growth rate of 6.4% per year" it would only seem fair to give the equivalent figures for other regions here rather than singling out.	we tried to give more information in the ES but we have very strict word limits.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
3221	5	12	5	13	it is not clear why only consumption-based emissions are discussed. NDC are related to production-based GHG emissions and decoupling is important, first of all, for production-based GHG emissions. Please change a conclusion to territorial emissions.	accepted. we added information about PBE decoupling in the text and table, but didn't go into too many details due to space limits.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
4905	5	12	5	12	I would suggest to remove subjective judgment (i.e., "Many") from the sentence	accepted. This ES is now merged with a previous one. So not applied.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
37403	5	12	5	19	The summary does not honestly capture the findings in the chapter. The summary should be rewritten to reflect that decoupling of absolute emissions and GDP has been in countries that are at high levels of per capita emissions and GDP with only a few exceptions.	accepted. This ES is now merged with a previous one. So not applied.	Government of India	Ministry of Environment, Forests and Climate Change	India
20513	5	15	5	15	Please define "absolute decoupling"	accepted. This ES is now merged with a previous one. So not applied.	Government of France	Ministère de la Transition écologique et solidaire	France
48171	5	15	5	15	Cuba and Iran as examples to illustrate the (absolute) decoupling of emissions and economies in developing countries: 1) under-representation; 2) The text is not supported. Suggest replacement.	accepted. This ES is now merged with a previous one. So not applied.	Yang Wang	Beijing Climate Center	China
51961	5	15	5	15	Presented examples for developing countries raise questions on data integrity and quality.	accepted. This ES is now merged with a previous one. So not applied.	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
54593	5	15	5	15	In summary bullets meant to be read by a broader audience, avoid jargon. Or if it must be used, define it as it is used. For example, the modifier "absolute" applied to decoupling needs some definition, wording, or cutting, as it isn't clear what it means without reading the chapter.	accepted. This ES is now merged with a previous one. So not applied.	Government of United States of America	U.S. Department of State	United States of America
71137	5	18	5	18	The per capita emissions of decoupled economies range from 0.1 to 32 tonnes per capita. Not sure what authors want to say when referring to this very large range. Perhaps better relate to +/- 2 standard deviations as it at least gives a better idea than the full range.	accepted. This ES is now merged with a previous one. So not applied.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
8297	5	20	5	28	The interpretation of trade as a 'driver' of global CO2 is questionable. Even if the amount of trade-related emissions has grown, it cannot be concluded that global emissions would have been lower in the absence of trade, as then things would be produced at the point of consumption. That is, trade creats emissions, but also avoids emissions for goods that are not produced but imported. Assessing the balance requires establishing conterfactials. See Jakob and Marschinski (2013, NCC) as well as Kander et al. (2015, NCC). DOI: 10.1038/NCLIMATE1630 and DOI: 10.1038/NCLIMATE2555. And even if you disagree with these studies, the discussion here (and in other parts of the report) is inconsistent with the (in my view more appropriate) discussion in Section 2.4.5.	accepted and revised. it's a matter of phrasing this differently. The reviewer is right that it is inherently difficult to assess the exact role, that is why 2.4.5 has a weak statement (medium agreement but limited evidence that international trade is a moderate upward driver of global GHG emissions).	Michael Jakob	MCC Berlin	Germany
17985	5	20	5	22	I think this sentence is prone to misunderstanding - it seems contradictory that trade can be an upward driver of emissions but net trade-related emissions are reducing. Are there emissions indirectly associated with trade that are causing it to be an upward driver? Or is it the intensity of trade-related emissions that have reduced rather than net emissions.	accepted. the first part of this sentence has been deleted.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
54595	5	20	5	28	The terms "carbon intensity" and "emission intensity" are used here. On page 6, line 1, "energy intensity" is used. Define these terms for the reader or what "intensity" is meant -- e.g., per capita, per GDP output, or something else?	accepted and defined.	Government of United States of America	U.S. Department of State	United States of America
72443	5	20	5	21	"International trade seems to be a moderate upward driver of global GHG emissions overall (limited evidence, medium agreement)" It is strange to draw such a conclusion based on limited evidence medium agreement. The rest of the sentence is fine given the evidence and agreement but this first part does not seem sound.	accepted. the first part of this sentence has been deleted.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
4907	5	22	5	24	The sentence is quite trivial. I would suggest to delete it	We kept the sentence and revised.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
86093	5	22			Embodied Emissions tranfers?	accepted and revised.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
20515	5	27	5	28	Please consider that this is not necessarilly true everywhere (e.g. not in 'developped countries' according to the graph in Figure 2.18 page 40), thus maybe worth to be mentioned	accepted and revised.	Government of France	Ministère de la Transition écologique et solidaire	France
5201	5	29	5	31	The wording seems confusing. As explained in the same §, industrial emisions have moved from developed to developing countries. Consequently, CO2 emissions have moved from developed to developing countries. Emissions transfers are from developed to >>> developing countries. that is not what I read??? See also § 2,3,4,1,	accepted and revised.	Michel SIMON	Retraité/ Pdt d'association	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8299	5	29	5	37	The notion of emission transfers is problematic and cannot be taken as an indication that industrialized countries outsource carbon-intensive production to developing countries. Rather, the observation that rich countries are 'net importers' of emissions is to a large part due to the fact that poor countries have less efficient production processes and more carbon-intensive energy systems. Hence, everything they produce tends to have a higher carbon content relative to the value added. Again, whether trade contributes to rising or declining emissions requires some counterfactual approach, as e.g. presentent in Jiborn et al. (2018) and Baumert et al. (2019). https://doi.org/10.1016/j.gloenvcha.2017.12.006 and https://doi.org/10.1016/j.envsci.2018.10.010. These two contributions show a much more complex picture that the simple 'North-South emission transfers' story.	accepted. We have changed the word.	Michael Jakob	MCC Berlin	Germany
64917	5	29	5	37	I would like to see here a quantification of emission transfers in GTCO2eq/yr	rejected - beyond the scope. We discussed the CO2 emissions from fossil fuel only in this section.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
54597	5	30	5	31	6.1% and 7.3% of what? This needs indicating. Absolute emission numbers would be helpful here too.	accepted and revised.	Government of United States of America	U.S. Department of State	United States of America
86095	5	30			My comments on the relevant SPM para was: << This para seems mixed and confusing. First sentence is about cumulative emissions. Second is about overall consumption footprint from developed countries (clarify, this includes domestic production plus imported goods). Final sentence seems to be about emissions embodied in trade – emission transfers (be precise) but has data I simply cannot find in Chapter 2: the most relevant stat (Ch.2 p.2.5 lines 30-31) seems to be “The net emission transfer from developing to developed 30 countries increased from 6.1% in 1995 and peaked in 2006 at 7.3%.” If that is % of global emissions (it doesn’t say) it is still a vastly smaller proportion of developing country emissions than stated – and most recent data would be relevant	accepted and revised.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
20517	5	33	5	33	"the…goods": Please consider that this may not be the only case other inputs (eg fossil energy) and environmnetal regulations matters	accepted and revised.	Government of France	Ministère de la Transition écologique et solidaire	France
4909	5	36	5	36	"most recently" is too vague. I would suggest to refer to a year	accepted and revised.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
17989	5	38	5	39	The headline of this paragraph could potentially highlight the role of affluence and population in influencing energy demand, as the rest of the paragraph focuses heavily on energy demand.	Noted - This paragraph describes the main drivers of GHG emissions and has been shortened. Energy is one of three main drivers. There are other summary paragraphs dealing with energy.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
17991	5	38	5	39	This sentence currently it reads like the strongest drivers of CO2 emissions are affluence and population (and therefore to reduce CO2, you must reduce affluence and/or population). I’d argue a country’s affluence isn’t in and of itself a driver, but it’s how they spend that wealth. Likewise with population where there are all sorts of global differences. Could the authors please consider re-wording to something like ‘historically, increased CO2 emissions have correlated with increasing GDP growth and population, but this masks significant inequalities in both which influence their carbon impact’?	Accepted - A qualifying sentence was inserted, noting that these agg	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
4911	5	40	5	40	the term "affluence" sounds uncommon in this context. I would suggest to substitute with another one	Accepted - The term 'affluence' was mostly replaced with 'GDP per capita'.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
11413	5	40	5	41	Re: "affluence (GDP per capita) and population growth increasing emissions by 2.3% and 1% per year, respectively". "1%" should read "1.2%" according to Figure 2.20. Please check and revise.	Accepted - All figures in Chapter 2 that referred to 2018 previously have been revised to 2019 values, where data were updated.	SAI MING LEE	Hong Kong Observatory	China
54599	5	41	5	41	The precise values of 2.3%/yr and 1%/yr in emission growth attributed to GDP and population cannot be found in the report, or in Sections 2.4.1 or 2.3.	Taken into account - These numbers can be found in Fig X-X. Note that all figures in Chapter 2 that referred to 2018 previously have been revised to 2019 values, where data were updated.	Government of United States of America	U.S. Department of State	United States of America
17987	5	42	5	43	Relative vs. absolute decoupling is really well explained later on in the chapter but the terms are not clarified here. It might be good to add a shorter version of this explanation here to highlight that energy demand is still increasing, but at a slower pace to economic growth.	Accepted - The sentence was changed accordingly.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
17995	5	46	6	8	Surprised not to see reference to the role of population growth in emissions in developing countries in this section (since referenced above).	Rejected - The trend for 'Developing countries' is dominated by Easter Asia (mostly China) where population growth did not contribute to emissions growth (see Fig. x-x). A more nuanced discussion of the role of population growth has now been included in Section 2.4.1.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
71139	5	46	5	46	National annual average % reductions (the 4%) should not be stressed as a benchmark indicator of mitigation in line with well below 2°C since this is simply not the case. Global average decarbonisation rates should not be applied to individual countries or regions in this way for several reasons. See our general SPM comment on this point.	Noted - The page number referred to is wrong (must be 4 instead of 5). This comment refers to Section 2.2.3.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
86097	5	46	5	47	My comment to TS paras (which I think conflated this with consumer emissions at different wealth levels): I cant find this in 2.6 and it would be interesting to see this more carefully – is it talking about national averages or what? Averaged by aggregate emissions per aggregate population – in which case the OECD is dominated by US Canada and Australia, but it MAY (I don't know) be very different if looking at China/East Asia compared the other 30 or so OECD countries?	Accepted - A more nuanced discussion of the role of population growth has now been included in Section 2.4.1. This summary paragraph has been revised accordingly	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
86099	5	46	5	47	This is not trying to engage in a "blame game" at all – it is trying to illuminate whether any countries are yet following the trajectory that is probably needed, of rich countries getting their per-capita emissions below those of emerging economies which are still constructing their basic infrastructure. It relates to fundamental questions about equitable and practical global pathways towards deep decrbonisation. The attention to rich consumers, wherever they are, is of course a vey important part of this – on which the evidence doesn't look good (though, to what extent are they also constrained by the technologies nad infrastructure available particularly vis-à-vis travel?)	Accepted - A more nuanced discussion of the role of population growth has now been included in Section 2.4.1. This summary paragraph has been revised accordingly	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
76363	6	1	6	2	Please add the extension for the acronym OECD (Oraginzation for the Economic and Co/operation Development)	Taken into account - The full name of the OECD has been added in the main text of Chapter 2 but not in the summary paragraphs (in order to keep it short).	Emilio Sessa	Carbon Credits Consulting	Italy

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
4913	6	3	6	3	I would suggest to substitute "in recent years" with a time period (i,e., from …to…)	Accepted - The sentence was changed accordingly ("between 2011 and 2018" was added).	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
4915	6	4	6	7	The sentence would benefit of some rewording	Accepted - The sentence was changed accordingly.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
51963	6	4	6	4	The statement is applicable to many countries including developing and developed courntries. Use "Many economies (developed and developing)" instead of developing counrtries.	Taken into account - The sentence was changed: "some" instead of "developed" was used. The exact number of countries is provided in a previous summary paragraph.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
54601	6	7	6	8	Not sure what the word "provision" is doing in this sentence.	Accepted - The word "provision" was deleted.	Government of United States of America	U.S. Department of State	United States of America
76365	6	7	6	8	The sentence does not mention the what played a major role	Taken into account - The major downward driver is the decline of 2.2%/yr of energy per unit of GDP, which is mentioned in the previous paragraph (and therefore does not need to be mentioned here again). It was made clearer thought that the amount of CO2 per unit of energy was only declining by 0.2% per year, globally, between 2010 and 2018. This shows the small effect of renewable energy to date.	Emilio Sessa	Carbon Credits Consulting	Italy
3223	6	9	6	14	Please add data for waste sector as well	Rejected. We receive many comments on pulling out sectors and cannot respond to these. Across the author team we agreed on a classification that strikes a good balance between detail and bird-eyes view. Sector chapters can provide further detail.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
86101	6	9	6	21	[Globally, ..] My comment / suggestion to SPM: << define energy sector, and indirect. E.g. "X% of GHG emissions came from energy sector (electricity generation plus producing and refining fossil fuels). Of end-use sectors, industry is the biggest when indirect emissions (eg. from generating the electricity consumed by industry) are included. … One dates, see my Whole Report comment MG7 suggesting 2010-2014 and 2015-2019 to get better sense of actual trends.>>	Noted. This comes with the next finding. We merged this and the subsequent finding in an effort to make ES more concide.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
11415	6	10	6	14	The information provided here cannot be reconciled with the main text in Section 2.2.4. Please check and revise as appropriate.	Accepted. We ensured concistency.	SAI MING LEE	Hong Kong Observatory	China
17997	6	15	6	15	Accounting for' could possibly be rephrased to 'reallocating', as it could be misinterpreted that these are separate emissions that aren't included in the totals.	We have merged this finding with the subsequent one. The headline does no longer exist with reference to indirect emissions.	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
61091	6	15	6	20	"In 2018, 34% (20 Gt CO2eq) of the 59 GtCO2eq GHG emissions came from the energy sector, 23% (13 Gt CO2eq) from industry, 23% (13 Gt CO2eq) from AFOLU, 14% (8.3 Gt CO2eq) from transport and 6% (3.4 Gt CO2eq) from buildings." Sectoral definitions need to be transparently mentioned. Countries report as per IPCC gudielines that include transport, building and manufacturing industry within Energy sector. Thus, it is important to clarify that the sectoral break up differs from the usual categorization of IPCC as per NGGIP.	Noted. Sectoral definitions are provided in Annex II of this report.	LOKESH CHANDRA DUBE	TERI School of Advanced Studies	India
11417	6	16	6	16	"34%" should read "35%" (Section 2.2.4, P.39, line 9). Please revise.	We provide 2019 estimates now, but make sure that everything is consistent.	SAI MING LEE	Hong Kong Observatory	China
11419	6	22	6	23	The source of the statement "Average annual growth in GHG emissions dropped from 3.2% for 2000-2010 to 1.4% in energy supply for 2000-2018" cannot be found in the main text. Please check.	Taken into account - All data in Section 2.4 that referred to 2018 previously have been revised to 2019 values. We made sure that the summary paragraph accurately reflects the updated numbers in the main section.	SAI MING LEE	Hong Kong Observatory	China
86103	6	23			In addition to energy efficiency, major factors included?	Accepted - We added the role of increased energy efficiency in the phrase "further improvements in energy efficiency (annually 2.1% less energy per unit of GDP was used globally between 2010 and 2018)"	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
5203	6	25	6	25	At the end of the sentence, add: renewables in Europe, either thermal or for electricity production when replacing fossil fuel production.	Taken into account - The summary sentence includes all forms of renewable energy and we suggest not to provide more detail here in the summary because of word count restrictions. Instead further detail is provided in Section 2.4 to which the summary paragraph refers.	Michel SIMON	Retraité/ Pdt d'association	France
51965	6	25	6	28	The statement presents an assumption with a lack of evidence/data. Assuming investments in fossil-fuel-based infrastructure will always impact emissions negatively is weak and ignore many facts around current investment trends in the sector.	Taken into account - The phrase "will continue driving emissions in the future and" was deleted.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
76367	6	25	6	28	Please, reference the piece of information	Taken into account - References in the summary paragraphs are provided in the form of references to the sub-section of the main text. Specific literature references can be found in these sub-sections. In this case sub-section 2.2.4.	Emilio Sessa	Carbon Credits Consulting	Italy
5205	6	28	6	28	replace "Renewables" by "non fossil production (renewable or nuclear)"	Rejected - The sentence refers to the transitioning of electricity production from fossil fuels to new sources of energy. Nuclear energy is an established technology where the transition has already occurred in previous decades.	Michel SIMON	Retraité/ Pdt d'association	France
27561	6	28	6	29	Delete "More efforts are required to actively phase out all fossil fuels in the energy sector, rather than relying on fuel switching alone.", as this is not a policy-neutral statement considering, for example, that technological advancement could play a key role in mitigation action.	Taken into account - The sentence was rephrased, following the suggestion provided in comment #29495.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
29495	6	28	6	29	Consider rephrasing the sentence "More efforts are required to actively phase out all fossil fuels in the energy sector, rather than relying on fuel switching alone". If all fossil fuels in the energy sector were to be phased out, more efforts than relying on fuel switching alone are required. As it stands, is a political or normative statement and not a scientifically neutral sentence. It implies that you should remove the source of the emissions rather than removing the emissions by CCS or other carbon removal technologies. This should either be deleted or rephrased to: "More ambitious efforts are required to achieve carbon neutrality in the energy sector, rather than relying on fossil fuel switching alone".	Accepted - The sentence was rephrased as suggested ("More ambitious efforts are required to achieve carbon neutrality in the energy sector, rather than relying on fossil fuel switching alone").	Government of Norway	Norwegian Environment Agency	Norway

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
51967	6	28	6	29	The statement appears subjective and refers to non-neutral opinions. It rules out all fossil fuels whether the carbon is recycled/reused, or even removed/stored underground.	Taken into account - The sentence was rephrased, following the suggestion provided in comment #29495.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
54603	6	28	6	28	"More efforts are required" seems a policy recommendation without a stated aim. To what end? More appropriate perhaps as "Emission reduction trends in the energy sector will be set by fuel switching timescales unless active efforts are undertaken to accelerate reductions of fossil fuels in this sector."	Taken into account - The sentence was rephrased, following the suggestion provided in comment #29495.	Government of United States of America	U.S. Department of State	United States of America
17999	6	30	6	30	Included' should be changed to 'reallocated' or similar to clarify that these emissions are already 'included' in overall totals, but can be reallocated to the end users.	Accepted - The sentence was changed accordingly and it was clarified that it is emissions from electricity and heat that are allocated to other sectors.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
11421	6	31	6	34	The text tends to convey the message that East Asia now has a greater share of responsibility for causing climate change. The text could be misleading because climate change is the result of long-term cumulative release of greenhouse gases (GHG) into the atmosphere instead of GHG emissions in a couple of decades. According to Global Carbon Budget 2020 (https://www.globalcarbonproject.org/carbonbudget/20/files/GCP_CarbonBudget_2020.pdf, P.88), the cumulative GHG emissions during 1850-2019 by Asia is still below those emissions by Europe and North America. It is suggested to provide a proper historical perspective to the readers before discussing recent changes in GHG emissions by region.	Taken into account - This summary is about recent changes, trends and drivers in GHG and is factually correct. However, a separate figure on historical emissions and emissions shares has been added to the main text and a separate summary paragraph has been added.	SAI MING LEE	Hong Kong Observatory	China
18001	6	35	6	35	Suggest a slight change of wording from 'in turn is driven by' to 'has been driven by', as I think the rising affluence/consumption/populations drives the demand for materials, not the other way around as is currently implied.	Accepted - The sentence was changed accordingly.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
18003	6	35	6	35	‘Affluence’ is used several times in this exec summary but it doesn’t seem to always be used to describe GDP growth; could you pin down how you are using it, or instead use a different (and less vakues-based) term? Additionally, the way ‘affluence’ is used in discussions make it seem that it’s a forgone conclusion that increasing wealth will lead to increasing emissions – changing ‘is driven by rising affluence’ to ‘has historically been driven by rising consumption emanating from increasing affluence’. This would make clearer that the affluence in and of itself is not the issue, but what it’s spent on (or historically been spent on); i.e. we need to demonstrate that wealthy individuals can choose to be less carbon-intensive. This is also true on p7, line 27.	Taken into account - The phrase "driven by rising consumption emanating from increasing affluence" has been adopted. However, affluence itself is the issue. Research has clearly shown that there is strong link between high levels of inccome/spending/affluence and indirect carbon emissions (personal carbon footprints). There is no evidence to support "that wealthy individuals can choose to be less carbon-intensive". Even if they do not use fossil fuels directly, the embodied emissions in all spending and investments is still likely to be high.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
15115	6	38	6	39	by more than 100 by 2017, change to by more than 100 on 2017	Rejected - The grammar is correct.	Noverita Takarina	Universitas Indonesia	Indonesia

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
9847	6	40		46	No mention on Southeast Asia, with presumably similar growing demand for building stock due to population growth which implies land use change from green field to brown field. However, growing demand for building stock does not always followed by an increase of building stock – as it has witnessed in Indonesia with significant housing backlog. Such backlog has been said to result from poorly structured buildings, extended family living in a single house, and not to mention disasters. In terms of building energy, we agree that the poor while may be large in numbers may contribute in less emission.	Taken into account - Compared to the speed of growth and absolute level of emissions, SE Asia is less significant than E and S Asia. This is shown in the main text of Section 2.4.2. The issue of inequality is dealt with elsewhere in the report.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
51969	6	40	6	41	Authors could consider the increased cooling demand, especially in south-east Asia. Also, consider the warming climate factor and increasing heat-waves which drove cooling/air-conditioning demand in regions like Europe and reshaped the demand curve in buildings.	Taken into account - Such details are being taken into account in Chapter 9 on Buildings. Section 2.4.2 provides a global summary overview only.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
5207	6	42	6	43	I doubt that the statement is correct for Europe, except may be in Great Britain. It is clearly false for Germany which continues to rely on coal for electricity production. False also in France where since 2010, 85% of new buildings use gas for heating due to regulatory constraints (RT 2012). Consumption of fossil fuels in Europe has remained more or less constant since 2012(consistent with data on Fig. 2.9). Development of wind mills for electricity production has had an effect on CO2 emissions only in Great Britain where coal fired plants have been actually shutdowned.	Taken into account - The statement is correct but improvements in energy intensity also play a significant role. The statement was therefore modified to "...mostly due to fuel switching, the expansion of renewables in the energy sector and increased energy efficiency of buildings".	Michel SIMON	Retraité/ Pdt d'association	France
11423	6	42	6	46	The text tends to convey the message that East Asia now has a greater share of responsibility for causing climate change. The text could be misleading because climate change is the result of long-term cumulative release of greenhouse gases (GHG) into the atmosphere instead of GHG emissions in a couple of decades. According to Global Carbon Budget 2020 (https://www.globalcarbonproject.org/carbonbudget/20/files/GCP_CarbonBudget_2020.pdf, P.88), the cumulative GHG emissions during 1850-2019 by Asia is still below those emissions by Europe and North America. It is suggested to provide a proper historical perspective to the readers before discussing recent changes in GHG emissions by region.	Taken into account - This summary is about recent changes, trends and drivers in GHG and is factually correct. However, a separate figure on historical emissions and emissions shares has been added to the main text and a separate summary paragraph has been added.	SAI MING LEE	Hong Kong Observatory	China
471	6		34	36	This sentence is more relevant to the following paragraph	Rejected - The sentence refers to the industry sector because this sector also includes the manufacturing of building materials.	Kim Hana	KAIST	Republic of Korea
16071	6		34	36	This sentence is more relevant to the following paragraph	Rejected - The sentence refers to the industry sector because this sector also includes the manufacturing of building materials.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
4917	7	1	7	11	It would be interesting to see what happened to the transport sector in 2020 during the most severe lock-down and during the relaxed one (as private transport have been likely prefered to public one). I would suggest to add such an investigation	Taken into account - This has indeed been an interesting development and has been taken into account in a separate section/box on COVID-19. The summary paragraph to which this comment refers to summarises the literature up to 2019 (i.e. before COVID).	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
54605	7	5	7	6	Can anything be added here on the GHG emission impact of increased electric vehicle use?	Noted - Not yet. The summary paragraph to which this comment refers to summarises the literature up to 2019 until when EVs did not have an impact on global emissions from transport (not significantly different in 2020/21).	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
51593	7	7	7	9	"While accounting for a small share of total GHG emissions, domestic and international aviation are growing faster than road transport emissions, with average annual growth rates of 3.0% and 2.1% respectively between 2010 and 2018." These numbers are inconsistent with the statement of Chapter 10, p. 60 lines 7-8, which says the growth of CO2 emissions of aviation for the period 2010-2018 was about 4% per year.	Noted, thanks. We have worked with Ch10 to ensure consistency.	eric lombard	Stay Grounded	France
75953	7	7	7	7	For Aviation you give GHG, but this is a bit problematic since the impact of aviation of from CO2 and various SLCFs such as ozone and contrail cirrus. (see Lee et al 2021 in Atmos Environ, as well as WGI Ch6)	Noted, thanks. We now put a footnote on this and cross-reference ch10 where an assessment is made.	Jan Fuglestvedt	CICERO	Norway
85357	7	7	7	7	Missing a reference to the source of data used.	Taken into account - Summary paragraphs do not include references to original literature. These have been provided in the underlying sub-section 2.4.2.4.	Neil Dickson	ICAO	Canada
3225	7	12	7	18	It is not clear if gross GHG emissions from AFOLU are discussed or net GHG emissions. Please, explain	Accepted - Clarified that it is net emissions.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
8061	7	12	7	18	Please add agreement and confidence levels to the statements in this paragraph.	Accepted - "medium evidence" was added to "medium confidence".	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
78837	7	12	7	18	It would be more informative to detail the CO2 and CH4 effects separately here. Is the 70% value very sensitive to the CO2-eq metric used for methane? If so, then this is not a very robust quantifiication.	Taken into account - The 70% number is simply to illustrate how much these two sources account for together (more information is provided in the detailed sub-section 2.4.2.5). After that land-use CO2 and methane are indeed discussed separately.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
4919	7	14	7	16	The sentence is too vague. I would suggest to add percentages and the time period, the pieces of information are treferred to.	Accepted - Absolute numbers were added.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
65265	7	14	7	15	Could you help the reader understand what enteric fermentation is? Policy makers are educated, but this needs 'spelling out', especially as the policy options to address are very doable if the science is clear and strong in its message of consequence. Also, clarity on % in low and middle income countries on actual animal-based consumption v.s trade to outside their regions, to satisfy other consumers. Are those figures available?	Accepted - "digestion in cattle and sheep" was added as explanation for enteric fermentation. There is a qualitative statement on the international transfer of AFOLU emissions in Section 2.4.2.5, but we refer to the AFOLU Chapter 7 for details.	Lindsey Cook	Quaker United Nations Office / Friends World Committee for Consultation	Germany
4921	7	16	7	18	As in the previos comment	Accepted - Absolute and relative numbers were added.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
71141	7	16	7	16	not clear what "highest" refers to -highest in absolute terms (which would be strange)?	Noted - Yes, "highest" refers to the absolute amount in these regions. Absolute numbers were added.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
17771	7	19	7	20	(2 ES) important statement rebutting those who say mitigation condemns the global south to poverty	Accepted - agree with the comment	Jonathan Lynn	IPCC	Switzerland
37407	7	19	7	20	The headline statement should be removed. The evidence from section 2.4.3 itself suggests that the provision of decent living standards does not have negligible implications for emissions growth. Since the eradication of extreme poverty (which is also not qualified) is only a minimum requirement, this statement is irrelevant and should not be in the executive summary of the chapter.	Rejected. There is considerable literature that supports the statement, so we retain it.	Government of India	Ministry of Environment, Forests and Climate Change	India
61547	7	19	7	24	does evidence rebutt the argument that growth slowdown also slows down investment in cleaner technology (eg cooking ighting) and energy effiiency measures? Useful to say so if so.	Rejected - the slow down in growth is a separate point to poverty alleviation, though one can lead to less of the other	tom howes	International Energy Agency	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
65267	7	19	7	20	For the finding - Eradicating extreme poverty and providing universal access to modern energy services to poor populations across the globe has negligible implications for emissions growth - you may want to add to this sentence, "yet positive implications for reducing poverty'.	Rejected - The sentence starts with the phrase 'eradicating poverty" so does not need repeating again at the end of the sentence.	Lindsey Cook	Quaker United Nations Office / Friends World Committee for Consultation	Germany
86105	7	19	7	28	Is there a possible contradiction between these two paras, given that quite a lot of poverty eradication seems to have been assocaited with moving to cities? Would be nice to reconcile	Rejected - Eradicating urban poverty does not increase emissions significantly, it is affluence, which is more concentrated in urban areas that drives emissions growth	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
3227	7	25	7	28	The conclusion leads to a misleading impression that urbanization in developed countries is not associated with increasing GHG emissions	Taken into account - We clarify that "Rapid and large-scale urbanisation" is "mostly occurring in developing and transition countries".	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
77423	7	25	7	28	It should be considered that migration from rural areas to urban areas lead changes in the landuse which also creates different emissions. For instance; migration from rural to urban lead to use of agricultural land for another purpose. For instance in Turkey there are several examples of this land use changes.	Noted - Section 2.4.4 deals with the overall and strongest drivers of GHG emissions from rapid urbanisation and refers to Chapter 8 for more detail. Land-use change is discussed in Chapter 7.	Özge Önenli	Engie	Turkey
54607	7	29	7	29	Bold text is unclear. It would be better as "Evidence exists for rapid transitions in energy sources, but only ..."	Accepted. Energy transitions is well known and is included in the glossary. The text suggested here reflects a narrow version of the concept than we intend.	Government of United States of America	U.S. Department of State	United States of America
60721	7	29	7	30	Which sub-global scales are these evidence of rapid energy transitions?	Countries and City level. We could say countries but we want to make the point that ultimately global is what matters and needed to be extremely concise here.	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
86107	7	37			Rapidly globalised?	Rejected. We noted agree this is more concise but consider that many unfamiliar with these concepts woul find it difficult to unpack a "a rapidly globalized energy transition"	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
54609	7	38	8	7	Define what is meant by "low carbon technologies".	This term is well used throughout the entire AR6 assessment and covered in the glossary and elsewhere	Government of United States of America	U.S. Department of State	United States of America
65269	7	40	7	45	In general this paragraph is unclear on what you are really trying to say. I appreciate the IPCC is not policy perscriptive but past IPCC Reports on these issues have been clearer. For example, this para states - "The development of other low-carbon technologies such as bio- and fossil carbon capture has been slower than the growth rates anticipated in stabilisation scenarios". Is this about the modeling miscalculations, or the effectiveness of bio energy and/or CCS in this framing? If the latter, a very clear and effective language concerning research findings on effectiveness is in the SR1.5C: "The political, economic, social and technical feasibility of solar energy, wind energy and electricity storage technologies has improved dramatically over the past few years, while that of nuclear energy and carbon dioxide capture and storage in the electricity sector have not shown similar improvements." This is such an important issue, please be clear on what you are trying to relay.	Accepted. "The political, economic, social and technical feasibility of solar energy, wind energy and electricity storage technologies has improved dramatically over the past few years, while that of nuclear energy and carbon dioxide capture and storage in the electricity sector have not shown similar improvements."	Lindsey Cook	Quaker United Nations Office / Friends World Committee for Consultation	Germany
43059	7	42		44	This puts many scenarios in question: "The development of other low-carbon technologies such as bio-and fossil carbon capture has been slower than the growth rates anticipated in stabilisation scenarios."	Noted. No change requested.	Graeme Taylor	BEST Futures	Australia

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
5209	7	43	7	43	Add one sentence after "scenarios" : Nevertheless, production of electricit by renewableremain marginal : 5.5% for wind mills and 2.4% for solar, while nuclear power plants have produced more than 10% of total world electricity".	Reject. That is not a helpful comparison. Wind+solar were 9% of electricity in 2020 and are expected to rise by 2022 when the report comes out. Nuclear is about 10% and not rising. So I don't see the point here to take upt he space to say they are about the same.	Michel SIMON	Retraité/ Pdt d'association	France
15117	7	43	7	43	by experts and by mitigation scenarios - by expert and mitigation scenarios or by expert and mitigation scenarios respectively	Reject. The first is what we mean. By experts and by mitigation scenarios.	Noverita Takarina	Universitas Indonesia	Indonesia
60723	7	45	7	47	What would be examples of large scale technologies vs. modular technologies?	Accept. We edit the text to provide examples of both	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
473	7		1	11	If possible, the impact of the COVID could be added(very shortly)	Taken into account - Rather than including the effect of COVID-19 in every individual sector summary, a separate box on COVID was included and a summary paragraph added to the Executive Summary.	Kim Hana	KAIST	Republic of Korea
475	7		36	39	Personally, I agree with it, but without confidence expression, it seems rather like a political argument. If there is any confidence expression, please insert it.	Accept, we add confidence statement.	Kim Hana	KAIST	Republic of Korea
477	7		19	24	This paragarph will fit better together with other paras in next page regarding distribution of income -, the top 10% emitters -	Rejected - The finding here relates to income poverty and inequality as a driver of emissions. The other paragraphs on the next page refer to emissions inequalities	Kim Hana	KAIST	Republic of Korea
16073	7		1	11	If possible, the impact of the COVID could be added(very shortly)	Taken into account - Rather than including the effect of COVID-19 in every individual sector summary, a separate box on COVID was included and a summary paragraph added to the Executive Summary.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16075	7		36	39	Personally, I agree with it, but without confidence expression, it seems rather like a political argument. If there is any confidence expression, please insert it.	Accept, we add confidence statement.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16077	7		19	24	This paragarph will fit better together with other paras in next page regarding distribution of income -, the top 10% emitters -	Rejected - The finding here relates to income poverty and inequality as a driver of emissions. The other paragraphs on the next page refer to emissions inequalities	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
3229	8	1	8	2	The conclusion about "adoption" is too policy-prescriptive and to be reformulated	Reject. This follows directly from the evidence. The only reason it is medium and not high is that some think the current rastes are adequate. But there is nothing about policy here.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
15119	8	1	8	1	the rates of adoption of low carbon technologies – the adoption rates of low carbon technologies	Accept. Reworded as suggested.	Noverita Takarina	Universitas Indonesia	Indonesia
54611	8	1	8	6	Bold text is a policy statement that may not be true. The point is more accurately stated with regard to emission reductions goals. Non-bold text needs to be parsed into multiple sentences, as it is long and difficult to understand as it is now.	Reject first comment,Accept second. This follows directly from the evidence. The only reason it is medium and not high is that some think the current rates are adequate. But there is nothing about policy here. As for the text, good point, it is too long and we have separated into two sentences.	Government of United States of America	U.S. Department of State	United States of America
47317	8	7	8	11	we can add a new idea in this section 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".	Reject. Too policy prescriptive and beyond ch2 scope.	Khaled Mohamed Madkour	Ain Shams University, Cairo, Egypt	Egypt

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
54613	8	7	8	17	It could be argued that bullets characterized as having "low agreement" or a point having "low evidence" are inappropriate to include in the Executive Summary of the chapter. For lines 7-11, perhaps a similar point could be made if it were less universal -- e.g., "in some countries" or "the incentives have proven effective for accelerating the transition ... in some regions."	Accept. Changed to medium agreement	Government of United States of America	U.S. Department of State	United States of America
60725	8	7	8	9	I am grppling with the confidence level "robust evidence,low agreement'-it does not make sense.	Accept. Changed to medium agreement	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
60727	8	9	8	11	Uncertainty language (confidence level) must be italicized.	Reject. Confidence statements are italicised.	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
15121	8	12	8	12	a rebalancing of – a rebalancing on	Noted. Text edited.	Noverita Takarina	Universitas Indonesia	Indonesia
60729	8	13	8	19	Same comment as above.	Noted. Text is edited.	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
15123	8	15	8	16	more slowly change to slower; erase 'and'	Accepted. Text changed	Noverita Takarina	Universitas Indonesia	Indonesia
18005	8	18	8	18	I think there is potential for this sentence to be misinterpreted, perhaps simplify to 'The global wealthiest 10% on a per capita basis contribute about 36-45% of global GHG emissions'. Also, what is meant by emitters (people, households, companies, countries)? What is the Oxfam citation referring to? (It is missing from the references. Also, please ensure that this meets the guidelines on use of grey literature.)	Accepted. Text is changed. The Oxfam citation refers toHardoon D (2015) Wealth: having it all and wanting more. Oxfam Wealth, Oxford	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
29539	8	18	8	18	Please specify who or what the "emitters" are - 10 % of individuals/countries/companies?	Noted. Text has been edited to "The global wealthiest 10% on a per capita basis contribute about 36-45% of global GHG emissions"	Government of Norway	Norwegian Environment Agency	Norway
65271	8	18	8	23	This seems a low figure for the top 10%, and if robust, 36-45% is a wide difference? For example, the Oxfam study reported in Carbon Brief - - https://www.carbonbrief.org/daily-brief/worlds-richest-1-cause-double-co2-emissions-of-poorest-50-says-oxfam --- or is this different outcome because of CO2 v.s GHG?	Noted. There is a difference between CO2 emissions and GHG emissions reprted by Oxfam.	Lindsey Cook	Quaker United Nations Office / Friends World Committee for Consultation	Germany
86109	8	18			... are also the .. ?	Noted. Text changed.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
86189	8	21	8	22	This may confuse more than add ... the extravagance of the rich in some emerging countries is striking ...?	Noted. Text added to account for wealthy consumers "in all continents"	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
7907	8	24	8	25	"Carbon-intensive consumption patterns and lifestyles of wealthy consumers are emulated by middle and low-income segments of the population" ? I don't understand the sentence: does it mean that the rich consumers are expanding more money to show that they are not poor? (sorry I'm not an english-native speaker).	Noted. Text means that the lifestyles of wealthy consumers in all continents are copied and become like an aspiration for all middle and low income consumers and families.	Caroline ROELANDT	Federal Agency for Nuclear Control	Belgium
20519	8	24	8	25	Why would the fact that "Carbon-intensive consumption patterns and lifestyles of wealthy consumers are emulated by middle class and low income segments of the population" increase inequality in a country ? This could be clarified	There are two separated statements in the paragraph.No causality was expressed in the first sentence between lifestyle patterns and inequality. The statement does link inequality with with increasing problems of redistribution and social cohesion	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
29541	8	24	8	27	Unclear - Please concretize why does emulasion among social groups lead to failure to accept mitigating policies?	emulation leads to higher emissions. Increase inequality leads to problems of redistribution and social cohesion which make difficult to promote changing practices to achieve mitigation.	Government of Norway	Norwegian Environment Agency	Norway
64919	8	24	8	28	I did not understand the driving mechanism in first sentence and link with second sentence before reading the full chapter	Noted. Text is edited for clarification..	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
18011	8	29	8	43	This paragraph would benefit from adding some figures on the different timescales for retirement of the infrastructure. It doesn't specify what early retirement means in terms of years, or earlier in the paragraph what current lifetimes are, so 'much earlier' used in the penultimate sentence and the years quoted in the last sentence are not placed in context.	Rejected. While we appreciate the need for more detailed information, the ES has a tight word limit and we need to restrict content to very focussed, synthettic statements. But we streamline the finding to ensure that the statement is self-contained. Therefore, we also deleted the last sentence and replaced it by more synthetic language that highlights the interconnection between future CO2 emissions estimates from fossil fuel infrastructure and the scenario literature on residual fossil fuel emissions that highlights the importance of decarbonizing the power sector quickly in order to "make space in the carbon budget" for hard-to-avoid emissions from non-electric energy.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
65273	8	29	8	43	This may confuse readers - please find a space to clarify reference to targets 'below 1.5C', and 'limit to 1.5C' (as in the Paris Agreement). I am not aware of climate advocacy calling for 'below 1.5C' - few would think this is still an option, yet there is great public engagement to try, however hard, to seek a 'limit to 1.5C'. Please take time to outline the progression/difference, to avoid misunderstanding by the readers.	Accepted. We consistently use the langauge "limiting to 1.5°C" here - and throughout the chapter. Note that we no longer refer to carbon budgets, but net cumulative CO2 emissions from 1.5°C scenarios with no or low overshoot.	Lindsey Cook	Quaker United Nations Office / Friends World Committee for Consultation	Germany
83027	8	29	8	43	The enormous uncertainties in the WG1 carbon budget calculations and the many substantial changes in the WG1 methodology (between SR1.5 and AR6) might warrant to avoid the countdown language used here	Noted. We do not provide countdown language, but provide a comparison of two relevant quantities here. Note that we also account for important parts of the uncertainties. Finally, we note that switched from carbon budgets to cumulative net CO2 emissions from pathways that limit likely warming to 2°C or lower.	Geden Oliver	German Institute for International and Security Affairs	Germany
18007	8	30	8	32	What is the difference between the two estimates of 715 and 658?	Accepted. We provided two comprehensive estimates side-by-side. This is confusing. As central estimate and range are of very similar magnitude we drop one set of estimates to avoid confusion. We keep the estimate from Tong et al. (2019), which is consistent with the subsequent estimate of future CO2 emissions from existing and planned fossil fuel infrastructure.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
86111	8	31	8	35	See my comments both on carbon budgets (consistency with Chapter 3, precision in meaning – emissions to point of net zero, or to end of century, etc.) and on terminology: if committed emissions hugely exceed the carbon budget, normal interpretation would be the temperature limit is obviously unfeasible	Noted. We cannot talk about feasibility from such a simple comparison. Otherwise, we take your comment on board and provide very precise language. We no longer report carbon budgets, but estimates of cumulative net CO2 emissions from pathways that limit likely warming to 2°C or lower in chapter 3.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
15125	8	32	8	32	please add signed or reference after 715 and 658	Rejected. We do not add references in the ES. The line of sight in curly brackets at the end of the finding points the reader to the relevant section in the report, where all the relevant references are provided.	Noverita Takarina	Universitas Indonesia	Indonesia

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
30637	8	32	8	32	It would be better to explain what the parentheses refer to. The sentence reads "715 (546-909) GtCO2 … well below 1.5°C with a 66% (50%) probability "? but does it mean 715 GtCO2 for 66% probability and 546-909 GtCO2 for 50% probability. Why is there a range only for 50%?	Accepted. We better described the estimates provided. We no longer report carbon budgets, but estimates of cumulative net CO2 emissions from pathways that limit likely warming to 2°C or lower in chapter 3 and use the adequate language to describe those.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
61523	8	32	8	32	Please correct ambiguous expressions. What do you mean the description of "715 (546-909) GtCO2 … well below 1.5°C with a 66% (50%) probability "? More explanations on values described in the parenthesis are needed.	Accepted. We better described the estimates provided. We no longer report carbon budgets, but estimates of cumulative net CO2 emissions from pathways that limit likely warming to 2°C or lower in chapter 3 and use the adequate language to describe those.	Takashi Homma	Research Institute of Innovative Technology for the Earth (RITE)	Japan
85917	8	32	8	32	Suggest clarification: Is there a unit missing? Should this read ' 658 (455-892) GtCO2 '?	Accepted and corrected. Note that we have removed one set of estimates as this caused confusion.	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
18009	8	34	8	34	Adding some clarification to say 'probability of exceeding the budget by 310'	We no longer report carbon budgets, but estimates of cumulative net CO2 emissions from pathways that limit likely warming to 2°C or lower in chapter 3 and use the adequate language to describe those.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
43391	8	37	8	37	Replace the phrase "retirement of fossil energy infrastructures" with "decarbonization of energy sector" , because all types of energy must be part of the solution to achieve clean energy and a green climate.	Rejected. We want to specifically point to the various options decarbonizing the power sector with reference to the way the reported estimates are derived.	sadegh zeyaeyan	Head of national center for forecasting and weather hazards management of Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
50297	8	37	8	37	Replace the phrase "retirement of fossil energy infrastructures" with "decarbonization of energy sector" , because all types of energy must be part of the solution to achieve clean energy and a green climate.	Rejected. We want to specifically point to the various options decarbonizing the power sector with reference to the way the reported estimates are derived.	Government of Iran	Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
63459	8	37	8	37	Suggest changing "include" to "will include some combination of" in order to recognize the uncertainty of retirements, and negative emission technologies. i.e., to recognize the possibility that, for example, CCUS is not required due to significant retirements, or retirement not required due to CCUS breakthroughs and deployment.	Noted. We have completely redeveloped this second part of the finding. The language makes implicitly clear that we are talking about some combination of measures. We stripped out the reference to CDR as it is a complex topic that is better addressed in other parts of the report.	Government of Canada	Environment and Climate Change Canada	Canada
7819	8	38	8	38	Is the word "utilization" necessary here? Does this mean that existing fossil energy infrastructure need not be subject to early retirement if they capture carbon and use it again, even if those recycled carbon is ultimately emistted to the atnosphere, usual case of CCU? In my view, when it comes to net zero emissions, CCS and CCU is completely different technologies where the former can achieve zero or negative emissions (with bioenergy) and tha latter can reduce emissions to certain extent but can not achieve zero emissions, especially in case of synthetic fuel.	Yes, we believe that this is necessary, because we want to connect to way and data used for deriving the estimates of future CO2 emissions from existing fossil fuel infrastrucutres. These apply information on how fossil fuel infrastructure has been used (utilization factor and lifetime). These also provide intervention points towards net-zero. We can already start reducing emissions by using the existing fossil fule infrastructure less, and it is also important to decommission earlier. We have rewritten the findings. I believe all this is much clearer now.	Mitsutsune Yamaguchi	Research Institute for the Innovative Technology for the Earth (RITE)	Japan
15127	8	42	8	42	please add signed or reference after 23 and 19	Rejected. We do not add references in the ES. The line of sight in curly brackets at the end of the finding points the reader to the relevant section in the report, where all the relevant references are provided.	Noverita Takarina	Universitas Indonesia	Indonesia
29543	8	42	8	42	Unclear what is meant by "23 (11-33) and 19 (11-16) year". Please consider clarifying by eg. specifying "year of life"/"year of operation".	We removed this sentence from the ES.	Government of Norway	Norwegian Environment Agency	Norway

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
54615	8	47	8	47	Use of word "scrapped" is colloquial and may not be widely understood or objectively interpreted.	Accepted. Changed.	Government of United States of America	U.S. Department of State	United States of America
479	8		32		Why the esimtated numbers are two (715 and 658)? In addition GtCO2 should be inserted after parathesis (455-892)	Accepted. We provided two comprehensive estimates side-by-side. This is confusing. As central estimate and range are of very similar magnitude we drop one set of estimates to avoid confusion. We keep the estimate from Tong et al. (2019), which is consistent with the subsequent estimate of future CO2 emissions from existing and planned fossil fuel infrastructure.	Kim Hana	KAIST	Republic of Korea
16079	8		32		Why the esimtated numbers are two (715 and 658)? In addition GtCO2 should be inserted after parathesis (455-892)	Accepted. We provided two comprehensive estimates side-by-side. This is confusing. As central estimate and range are of very similar magnitude we drop one set of estimates to avoid confusion. We keep the estimate from Tong et al. (2019), which is consistent with the subsequent estimate of future CO2 emissions from existing and planned fossil fuel infrastructure.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
15129	9	1	9	2	for 2009 - 2014 change to during or on period of	Noted. We removed this material from the report as the underlying evidence was not accepted in time.	Noverita Takarina	Universitas Indonesia	Indonesia
65275	9	1	9	20	This summary has an important pyschological as well as scientific role. How you present the findings, what you leave the reader with, makes a difference on whether we feel acting urgently would make a difference, save what we love, or not. The final paragraphs could be stronger in summarizing the most effective mitigation transformation if humanity is to have a chance to limit GTR to 1.5C/below 2C (what ever you are saying still has a chance). The SR1.5C was empowering in this way, and yet the current draft of this chapter leaves one deflatedrather than called to act urgently and save what we still can, if we had the political will (IPCC past reports are clear that we already have the knowledge and technology for needed transformations).	Noted. This is a summary of the science and this chapter has only a very specific remit. Other chapters have much more a solution focus and will bring this missing dimension to the table.	Lindsey Cook	Quaker United Nations Office / Friends World Committee for Consultation	Germany
43041	9	2		4	Also, “Every year, carbon committed from newly built energy infrastructure exceeds carbon emissions “saved” due to decommissioning of energy infrastructure d (medium confidence). As a result, future CO2 emissions from current energy infrastructure has failed to peak.”	Noted. We have removed this finding to save space in an effort zo streamline the ES.	Graeme Taylor	BEST Futures	Australia
18013	9	3	9	4	This is a key point and highlights the challenges of moving past fossil fuels; is it possible to put it nearer the top on p4 so it’s on that first page of the exec summary?	Rejected and thank you for the appreciation of this finding. However, we removed this finding in an effort to streamline the ES.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
86113	9	3			See comment on terminology	Accepted. We have changed our terminology as indicated previously.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
12667	9	4	9	4	Typographic error "infrastructure"	Finding was removed.	Donald Falk	University of Arizona	United States of America
15131	9	4	9	4	infrastructure d change to infrastructured	Finding was removed.	Noverita Takarina	Universitas Indonesia	Indonesia
7821	9	7	9	7	Please add at the bottom of the sentence "if new capacity of CCS, BECCS, DACCS or other negative emissions technologies do not follow".	Finding was removed.	Mitsutsune Yamaguchi	Research Institute for the Innovative Technology for the Earth (RITE)	Japan

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
86115	9	8	9	12	The slowdown – notwithstanding the continued rise of China – does seem to follow upon the large surge in climate legislation (partially associated with entry-into-force of the KP) noted in Chapter 13? I'd separate general legislation from carbon pricing – both had impacts. In general worth reviewing the policy-linkage stastements here and in discussion with Ch.13?	Noted. The bullet reflects the conclusions of the section in which the assessment is limited to a few policy instruments such as carbon pricing due to space constraints. Ch13 is more elaborate.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
15133	9	10	9	11	The part of sentence can be changed into the magnitude of the reduction rate varies on the data and methodology used, country, sector	Accepted.	Noverita Takarina	Universitas Indonesia	Indonesia
30639	9	11	9	12	Some readers will not understand the carbon pricing gap. Please add reference based on the footnote in pages 98-99 or explanation it additionally.	Rejected. The suplementary explanation of 'higher carbob price' and the reference to 2.8.2.1 are already in the paragraph.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
61521	9	11	9	12	Why does a lower carbon pricing gap mean higher carbon price? More explanations are needed.	Rejected. The detailed explanation is too long to be seated here and is provided in 2.8.2.1 which is referenced here.	Takashi Homma	Research Institute of Innovative Technology for the Earth (RITE)	Japan
18015	9	13	9	13	This is a key point; it would be great if it could go on p4 somewhere	Noted. Will be considered in the next stage of drafting Executive 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)
20521	9	13	9	15	This is a rather strange definition of "non-climate" policies - the point is that policies to reduce emissions generally target specific changes in production or consumption, exactly the things in this list	Taken into account. Changed the words to 'Other climate-related policies'	Government of France	Ministère de la Transition écologique et solidaire	France
25123	9	13	9	19	This ES statement mentions RE policies as non-climate policies. However the underlying section on non-climate policies (2.8.3) just shows one sentence on RE. The previous section (2.8.2.2) on climate policies also includes REs. Some countries however would implement RE for energy security or access. Its not incorrect to call these non-climate policies. But if this is elevated to the ES, I'd request authors to include an assessment in the relevant section- perhaps an assessment of contexts in which Renewable energy policies were implemented for reasons other than cc mitigation? An easy fix might be to delete Renewable energy from the ES	Taken into account. More assessment on renewable energy policies will be included the related subsection.	Minal Pathak	WGIII TSU, Ahmedabad University	India
30641	9	13	9	19	Why are subsidies for clean transportation and support to renewable energy categorized into "non-climate policies?" Why is climate policy limited to only carbon pricing? On the other hand, in section 2.8.4, renewable portfolio standards are included in climate policies. In general, climate policy would be not limited to only carbon pricing. It would be better to use a consistent definition in the report.	Accepted. The expression of non climate policies is changed to 'other climate-related policies' and the problematic expression in 2.8.4 is deleted.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
45761	9	13	9	18	"non climate policies" seems a misleading term when it still refers to subsidies for clean energy etc. which can also be part of climate policy measures. Please revise.	Taken into account. Changed the words to 'Other climate-related policies'	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
60731	9	13	9	16	Why are taxes and subsidies for clean transporttion and support for renewable energy sources, etc. non-climate policies? What would fall under climate policies?	Taken into account. Changed the words to 'Other climate-related policies'	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
61093	9	13	9	13	what is meant from 'Non-climate policies' need to be defined.	Taken into account. Changed the words to 'Other climate-related policies'	LOKESH CHANDRA DUBE	TERI School of Advanced Studies	India
61519	9	13	9	19	Important definitions should be clarified. Why are subsidies for clean transportation and support to renewable energy "non-climate policies?" I don't understand why climate policy is limited to only carbon pricing. On the other hand, in section 2.8.4, renewable portfolio standards are included in climate policies.	Accepted. The expression of non climate policies is changed to 'other climate-related policies' and the problematic expression in 2.8.4 is deleted.	Takashi Homma	Research Institute of Innovative Technology for the Earth (RITE)	Japan

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
63461	9	13	9	13	it would be very useful to provide a definition for these, as common understanding may dictate that policies supporting renewable energy or controlling pollution are "climate policies".	Taken into account. Changed the words to 'Other climate-related policies'	Government of Canada	Environment and Climate Change Canada	Canada
64921	9	13	9	19	AFOLU sector related policies should be mentioned	Accepted	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
86117	9	13	9	16	Not sure I'd consider the "non-climate" policies	Taken into account. Changed the words to 'Other climate-related policies'	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
30435	9	16	9	18	Text here (that emissions could be 10-20% higher than EDGAR) appears inconsistent with uncertainty estimates (20% and 60%) below.	Accepted. Added a more straitforward expression: 'less carbon intensive'	Steven Smith	PNNL/JGCRI	United States of America
3231	9	20	9	20	There are few more points to be added to the summary: 1. on sink trends in AFOLU; 2. results of afforestation policy around the world; 3. the contribution to the overall trends of carbon capture and storage	Accepted. added a more straitforward expression: 'less carbon intensive'	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
74693	9	21	9	21	Given the acknowledged dependence of 1.5°C pathways on the availability of substantial CO2 removal capacities, I suggest you add a key finding along these lines: "Progress in CO2 removal and durable storage remains negligible, with less than 0.1% of CO2 generated by fossil fuel extraction and use currently returned to geological storage in the the lithosphere, and continued net release of CO2 from the biosphere."	Rejected. This topic is briefly mentioned but not discussed in the underlying section; see in Chapter 7.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
481	9		13		Tend to be more carbon efficient? This expression needs to be modified to enhance the readers' understanding.	Accepted. Added a more straitforward expression: 'less carbon intensive'	Kim Hana	KAIST	Republic of Korea
16081	9		13		Tend to be more carbon efficient? This expression needs to be modified to enhance the readers' understanding.	Accepted. added a more straitforward expression: 'less carbon intensive'	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
80419	10	1	10	2	Please include explicitly in sentence "The scale-up...progressed as rapidly" to include what the "as rapidly" refers to (Does it refer to "as rapidly as projected in AR5"?) and ideally also some absolute values. (reasoning: with values and/or references this statement would become much clearer).	Rejected. Such a sentence does not exist at the indicated location and, in fact, in the whole chapter.	Moritz Riede	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
20523	10	29	10	29	This vision is too simplistic and does not take into account the systemic dimensions of how society functions. There are very few causal relationships between sets of drivers of this type. This vision reflects the lack of consideration of work in the social sciences. Lorek Sylvia and Vergragt Philip, 2015, "Sustainable consumption as a systemic challenge : inter- and transdisciplinary research and research questions", in Reisch Lucia and Thogeren John (eds.), Handbook of research on sustainable consumption, Cheltenham, Edward Elgar, p. 19-32.	Rejected. The figure is not a vision but simply a road map for the chapter, declared to be a simplified illustration. Social sience work is amply assessed in sections 2.3 and 2.6	Government of France	Ministère de la Transition écologique et solidaire	France
72527	11	1	11	2	I am a little bit confused about Figure 2.1. Usually we go through a chapter from 2.2 to 2.8 but the arrows shown in Figure 2.1 have opposite directions.	Rejected. The figure shows the chapter road map as we go from observed trends to what drives them while arrows show the directions of the driving effects.	Yun Hang	Emory University	United States of America
80421	11	1	11	10	Suggestion: replace the Adoptions with TWh/year generated for solar, wind, offshore and CSP or at least add the values? In the end, what matters is the energy delivered, less so the capacity installed.	Rejected. Unrelated to the indicated location.	Moritz Riede	University of Oxford	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
83029	11	1	11	2	It seems that ch12 is missing here, which does not represent what's to be found in ch2	Partly accepted; Ch12 now in Fig 2.1. As explained in the text on p. 10, the figure shows only "the most important linkages." not only ch12 is missing.	Geden Oliver	German Institute for International and Security Affairs	Germany
53305	11	2	11	2	Figure 2.1 does not show any linkage between 2.2 (trends of territorial GHG emissions) and 2.3 (trends of consumption-based GHG emissions). A comparison.verification of the results of both exercises would be crucial to understand that they different but consistent. This is also important because 2.2-2.7 provide inputs for both approaches. It this is considered in the report an arrow should be added. Overall, informaiton on this is relevant to understand the accuracy of both approaches	Rejected. Arrows indicate drivers. There are no driver interactions between territorial and consumption-based emissions. Sections 2.2 and 2.3 present trends from two different perspectives, both are driven by the same drivers, as indicated by the common set of black arrows.	Florin Vladu	UNFCCC Secretariat	Germany
53307	11	2	11	2	Figure 2.1: consider renaming "2.5 technological change' as "2.5 technological innovation and change' .	Accepted, partly. Changed to Technological change and innovation.	Florin Vladu	UNFCCC Secretariat	Germany
53313	11	3	11	21	Consider revising this part. This part should had been a simple explanation of the figure, but in relaity it is complex, goes back and forth and includes views on some of the factors which are not necessary in this part (e.g., and is a significant hindrance to fast and deep reduction of those emissions.)	Accepted. Large parts of the additional explanation deleted. Long-lived infrastructure can be a significant hindrance to fast and deep reductions of GHG emissions.	Florin Vladu	UNFCCC Secretariat	Germany
53309	11	10	11	12	"Some other drivers such as beliefs, traditions, religious and cultural rules shaping behavioural choices and lifestyles are difficult or outright impossible to quantify, hence model formally." Consider adding a reference or documantation. Othewise, consider deleting because it is irrelevant for the discussions and adds variables that may be reflected in 2.6.	Rejected. The sentence briefly introduces the topic of Section 2.6 where related literature is assessed. The cited statement is a widely accepted opinion in the scientific literature.	Florin Vladu	UNFCCC Secretariat	Germany
71143	11	10	11	12	Sentence unclear. Suggest removing "Some" and replacing "hence" with "let alone".	Sentence deleted.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
53311	11	12	11	12	"Sections shown in the second row of boxes assess" change tp "Sections shown in the second row of yellow boxes assess"	Accepted. Changed.	Florin Vladu	UNFCCC Secretariat	Germany
64923	11	13	11	15	The sentence starting with "A huge" is difficult to understand. A simpler way to introduce the role of long-lived infrastructure could be found	Accepted. Changed.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
86119	11	22			From Tech Sum comment on Covid recovery: „[From TS comments] I couldn't immediately find the ref in section 2.2. My impression has been that economies tend to return to trend growth rates after shocks, but from lowered base and do not get back to the ex-ante projections? But this will be for wider discussion with better data in the final report. => ch1, ch2 covid boxes	Noted, thanks. Since we focus in these sections on historical emissions, we document the impact of COVID on 2020 emissions, but do not explore potential future emissions changes.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
8063	11	23	11	25	Please correct: the sector AFOLU comprises more than agriculture, forestry, and land use change. It covers all sorts of land USE, not only CHANGE.	Accepted. We changed the terminology further to CO2 from LULUCF (land use, land use change and forestry)	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
53315	11	23	12	1	This part only mentions 'emissions'. Reference to 'emissions and removals' would be more appropriate, in particular because the AFOLU sector is covered here.	Accepted. We refer to net CO2 emissions from LULUCF now. Note that we changed terminology from CO2-AFOLU to CO2-LULUCF in line with WG1 and chapter 7.	Florin Vladu	UNFCCC Secretariat	Germany
75955	11	23	12	2	This definition of GHG is useful but comes late. I also think you need to give a bit more detailed info about the gases; HFCs, SF6, PFCs, NF3)	Accepted. We have added further detail to the definition of f-gases. We also highlight that many F-gases from the Montreal Protocol are not covered.	Jan Fuglestvedt	CICERO	Norway
53317	11	25	12	1	"fluorinated gases". A short footnote could help understanding what gases are included here. This should had been probably in the glossary. but actually I could not find it in the current version, or other parts (no references found), but this is the first reference in this chapter and it is essential to undertand the discussion of trends.	Accepted. We have added this to the text.	Florin Vladu	UNFCCC Secretariat	Germany
483	11				I love this schematic flow chart. But one thing is the numbering of the chapter should be adjusted. Excluding chatper number or including chapter number for other chapters are linked to the sub-chapters in the yellow-shaded box.	Noted. This is exactly the idea: link chapters most relevant to the given section in Chapter 2.	Kim Hana	KAIST	Republic of Korea

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
16083	11				I love this schematic flow chart. But one thing is the numbering of the chapter should be adjusted. Excluding chatper number or including chapter number for other chapters are linked to the sub-chapters in the yellow-shaded box.	Noted. This is exactly the idea: link chapters most relevant to the given section in Chapter 2.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
53319	12	1	12	2	"aerosols and tropospheric ozone". A short footnote could help understanding what elements are included here. This is probably in the glossary and other parts, but this is the first reference in this chapter.	We adjusted the language, but did not include a footnote. This is not a major part of our assessment. We therefore mainly refer to WG1.	Florin Vladu	UNFCCC Secretariat	Germany
75467	12	1	12	2	The text should be clearer on aerosol, ozone forcing of climate these are different and important.	Noted. But as this is not a major focus of the chapter we keep it generic and refer to WG1.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75469	12	1	12	2	Replace "like" with including warming and cooling climate forcing by species including ozone, aersols .	Noted. We edited the sentence carefully	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
10517	12	2	12	2	Concerning Collins et al, reference to WG1 contribution is necessary	Accepted	Philippe Waldteufel	CNRS	France
64925	12	2	12	2	Incomplete reference (missing year)	Accepted	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
75957	12	2	12	2	Incomplete reference	Accepted	Jan Fuglestvedt	CICERO	Norway
53321	12	3	12	3	It might be important to know what GHG are considered in this report, in particular F gases. Are all gases included or only those that are not covered by the Montreal protocol? The gloassry appears to indicate that all gases are considered, including those covered by the Montreal protocol. A clarification here is important.	Accepted. The language makes this very clear now.	Florin Vladu	UNFCCC Secretariat	Germany
75463	12	3	12	11	How can AR6 GWP 100 values be used if the AR6 is not yet published?	In previous drafting rounds we were always provided with the most recent values by WGI colleagues. In the meantime the WG1 report is published.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75959	12	4	12	5	I dont think "with climate feedbacks" is needed. This is now default in WGI. But if you keep it, then you should change to climate-carbon feedback	Accepted	Jan Fuglestvedt	CICERO	Norway
71145	12	6	12	8	Use of the AR6 GWP100 may be consistent with Paris Agreement reporting decisions, but this is somewhat misleading since the Parties agreed to use the metric from AR5 (and not necessarily its version including climate feedbacks).	A decision by the WGIII Co-Chairs and Bureau was made to use AR6 GWPs as they reflect the most recent science - in line with the IPCC mandate. The Paris Agreement reporting decisions leave it open to use the most recent GWP values.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
75465	12	6	12	9	Can a clear reference to accounting decsion under UNFCCC/CMA be provided?	Accepted	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
3793	12	8	12	8	"Other GHG emissions metrics exist, all of which have limitations and uncertainties" This is, of course, correct, but the wording implies that the GWP doesn't have "limitations and uncertainties". I suggest a small reword "Other GHG emissions metrics exist, all of which, like the GWP100, have limitations and uncertainties". This would reflect the wording at page 24 line 40 that makes it clear that GWP100 has limitations	Accepted	Keith Shine	University of Reading	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
74695	12	8	12	8	It is important to be up-front about the issues with GWP100 if it is to be relied upon so heavily in this report. Please insert the sentence "GWP100 provides an accurate indication of the relative warming impact of very long-lived climate pollutants, including carbon dioxide and nitrous oxide. Representing a short-lived climate pollutant such methane as CO2eq using GWP100 overstates the global temperature impact of a steady methane source (established many decades ago) by a factor of 3.5--4, while understating the impact of any new methane source by a factor of 4--5 over the 20 years following the introduction of the new source. (Allen et al, 2018; Cain et al, 2019; Collins et al, 2019; Smith et al, 2021)"	Rejected. The wording suggested by the reviewer would be correct only for additional warming compared to the warming caused by the current rate of SLCF emissions; the statement is incorrect if the interest lies in the damages caused by each emission. The explicit cross-reference to the cross-chapter box on GHG metrics provides more detailed information.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
1955	12	12	12	13	Where the Emissions Database for Global Atmospheric Research (EDGAR) is mentioned, it should be briefly included in parentheses who established it and with what type of gases it is completed	Accepted. We added the missing information.	Betty Ramírez	INAMEH VENEZUELA	Venezuela
53323	12	12	12	21	The justification for the use of EDGAR should be improved or a reference added where it could be found in other parts of the report. But the most important point may be that there should be a reference to a comparison between EDGAR and Parties' estimates as submitted annualy to the UNFCCC. From table 2.1 it appears that EDGAR does not rely on national data. The fact that EDGAR may not have emissions per fuel may be an hindrance. The fact that EDGAR is at the top of the range may require further explanation for its choice	Accepted. We have added a sentence on this that also points the reader towards comparisons between the data used here and UNFCCC inventories.	Florin Vladu	UNFCCC Secretariat	Germany
54617	12	12	12	12	EDGAR does have land use emissions (see Petrescu, https://bg.copernicus.org/articles/9/3437/2012/).	Noted. This was already stated explicitly in the text. We revised the wording to make it more obvious to the reader.	Government of United States of America	U.S. Department of State	United States of America
61569	12	12	49	7	Due to the significance of EDGAR as an emissions data source it is requested that an annexure or information box is included in this chapter to describe the model to increase transparency of the model itself. Model assumptions, the modelling framework and the method to estimate emissions should be included. With increased transparency of the EDGAR model in the AR6 it can increase trust from the reader on the emissions data presented.	Accepted. We have added online supplementary material to the chapter, which provides this information. It also contains a comprehensive discussion of uncertainties including a comparison with other databases.	Kent Buchanan	Department of Environmental Forestry and Fisheries	South Africa
54619	12	15	12	15	The use of "AFOLU CO2" is unusual. Assume the authors use this phrase because AFOLU includes non-CO2 gases, but in most cases, the authors only present CO2 fluxes. The assumption behind using AFOLU CO2 language should be explained.	Accepted. In liaison with IPCC WG1 we term these emissions now CO2-LULUCF: CO2 from land use, land-use change and forestry.	Government of United States of America	U.S. Department of State	United States of America
61567	12	18	12	20	The model EDGAR is stated to be chosen to be used as a major source for emissions information because it 'provides the most comprehensive data set'. It is requested that In the same paragraph information regarding the relative quality of data relative to other models should be provided. Information about uncertainty of EDGAR is presented in line 12 to 15 of page 18 - however it is requested these uncertainties as well as the quality of data are compared to other models in page 12.	We have expanded the discussion of uncertainties in EDGAR estimates in a new set of online supplementary material to the chapter. Still, space and resources are limited. Our discussion therefore also refers to the wider literature comparing datasets. The description of the data and uncertainties presented here is unprecedented in IPCC WGIII.	Kent Buchanan	Department of Environmental Forestry and Fisheries	South Africa
53325	12	20	12	20	"We report emissions at two significant digits". It is crucial to understand the units used. Otherwise the accuracy of 2 digits is not reflected in the text. Besides, it would be expected that undertatinties vary from sector to sector and gas and not be fixed. A reference justifying the 2 digits might help here. In several instances in the text only one digit is used.	Reporting at two significant digits gets around the problem of scale. However, we still added the units as this is good practice.	Florin Vladu	UNFCCC Secretariat	Germany
5067	12	22	12	22	"In section we first…" - which section?	Accepted. Deleted. Non-essential and incomplete material.	Lina Hollender	n/a	Germany
10519	12	22	12	24	careless writing	Accepted. Deleted. Non-essential and incomplete material.	Philippe Waldteufel	CNRS	France
27563	12	22	12	24	The paragraph remains incomplete.	Accepted. Deleted. Non-essential and incomplete material.	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
54621	12	22	12	22	Which section?	Accepted. Deleted. Non-essential and incomplete material.	Government of United States of America	U.S. Department of State	United States of America
54623	12	22	12	24	Incomplete sentences and paragraph.	Accepted. Deleted. Non-essential and incomplete material.	Government of United States of America	U.S. Department of State	United States of America
71147	12	22	12	24	Seems the whole paragraph is incomplete and should perhaps have been removed?	Accepted. Deleted. Non-essential and incomplete material.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
54625	12	23	12	23	"We believe" implies there is not a factual basis; recommend not using this language.	Accepted. Deleted. Non-essential and incomplete material.	Government of United States of America	U.S. Department of State	United States of America
8229	12	24	12	24	"However we admit…" Please end the sentence.	Accepted. Deleted. Non-essential and incomplete material.	Frida Zahlander	DanChurchAid	Denmark
11425	12	24	12	24	Re: "we admit". The sentence is incomplete. Please revise.	Accepted. Deleted. Non-essential and incomplete material.	SAI MING LEE	Hong Kong Observatory	China
20525	12	24	12	24	The sentence is missing	Accepted. Deleted. Non-essential and incomplete material.	Government of France	Ministère de la Transition écologique et solidaire	France
50437	12	24	12	24	Sentence hanging	Accepted. Deleted. Non-essential and incomplete material.	Hoy Yen Chan	ASEAN Centre for Energy	Malaysia
64927	12	24	12	24	Unfinished sentence	Accepted. Deleted. Non-essential and incomplete material.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
72927	12	24	12	24	“However we admit”, looks like a part of the sentence is missing	Accepted. Deleted. Non-essential and incomplete material.	Antoine BONDUELLE	EE-Consultant	France
76369	12	24	12	24	The sentence is broken. Something is missing here.	Accepted. Deleted. Non-essential and incomplete material.	Emilio Sessa	Carbon Credits Consulting	Italy
78299	12	24	12	24	hanging sentence	Accepted. Deleted. Non-essential and incomplete material.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
82507	12	24	12	24	I believe there is something missing after the statement "However, we admit"… It seems that that's an incomplete sentence.	Accepted. Deleted. Non-essential and incomplete material.	Fei Luo	VU Amsterdam	Netherlands
84409	12	24	12	24	However, we admit”	Accepted. Deleted. Non-essential and incomplete material.	Mattias Lantz	Uppsala university	Sweden
30437	12	26	12	37	It is not clear what "modelled warming from emissions of each gas - calculated using the reduced-complexity 10 climate model FAIRv1.6 " means. There is no unique way of showing this given: non-linearities in the system and fundamental methodological uncertainty in how to treat ocean lag. So this figure should be labeled as illustrative, and a more detailed methodological description needs to be provided (in SI?).	The text reference is unclear and does not match what is described here.	Steven Smith	PNNL/JGCRI	United States of America
78839	12	26	12	26	F-gases is not a very comprehensive definition. WG I uses "Halogenated compounds" and the same terminology should be maintained in WG III for consistency. Not all halogenated compounds contain fluorine - does this definition exclude these?	Noted. We have added a comprehensive discussion earlier on to clarify what is included in this definition and what is not. Moreover, we explicitly talk about F-gases that are not conventionally covered in GHG emissions inventories - most importantly CFCs, HCFCs and halon.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
82509	12	26	12	26	"historic GHG" --> historical GHG	Accepted and changed.	Fei Luo	VU Amsterdam	Netherlands
82511	12	27	12	28	Maybe change the second "whether", so that you don't have two "whether" in one sentence.	Accepted. We resolved this mainly through changes in the punctuation.	Fei Luo	VU Amsterdam	Netherlands

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8065	12	32	12	36	Please check: each method to estimate emissions has uncertainties of its own, to be analysed by e.g. error propagation. So the list presented here is does not show different ways to examine uncertainties, it is concentrated on comparing results achieved by differend methods and / or from different sources. Modelling is also just one method, so point 4) can be subsumed under point 1) and should be deleted.	Accepted. We have revised the text considerably taking on board your advice to merge 1) and 4). Thank you.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
51971	12	33	12	36	Differences between data providers present challenges for presenting a clear evidence base to policymakers, the public, and the international community. Such differences are quite common in CO2 reporting and occur due to the use of different source information, methodologies, and assumptions. This has to be stated clearly in the chapter.	We clearly state those differences and discuss the uncertainties surrounding the estimates presented.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
53327	12	33	12	36	There are probably other ways to estimate uncertainties (e.g., monte carlo). Please consider replacing 'there are' by "This report considered four…"	Accepted. The new language makes clear that there could be other ways to quantify uncertainties. Monte Carlo based methods where already covered in the previous description.	Florin Vladu	UNFCCC Secretariat	Germany
72929	12	33	12	34	where exactly lies the difference between point 1) and point 2) ?	1) refers to different methods; 2) refers to different estimates from one (group of) method(s).	Antoine BONDUELLE	EE-Consultant	France
15137	12	34	12	34	made by change to resulted from	Accepted. Clarified the language.	Noverita Takarina	Universitas Indonesia	Indonesia
5211	12	35	12	35	I strongly ecommnend to specify "Direct emissions", not including emissions tied to imported products.To illustrate my concern, France direct emissions are around 5 TCo2eq/capita, but total emissions are around 11 TCO2eq/capita.	Comment cannot be related to the referenced text.	Michel SIMON	Retraité/ Pdt d'association	France
18017	12	35	12	36	This comment just refers to the use of remote sensing data, i.e. satellite data. There is a significant amount of literature using ground-based atmospheric observations to estimate GHG emissions on global and regional scales. These are useful methods for assessing the uncertainty in inventory estimates and should be considered.	Accepted. We make clear that there could be other methods. Most of the ones mentioned fall into one of the three buckets. We do not expand further due to space constraints.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
54627	12	38	14	33	There are also now top-down estimates of fossil-fuel emissions from the US that are derived from atmospheric measurements of CO2 and 14C of CO2 (Basu, PNAS, 2020, https://www.pnas.org/cgi/doi/10.1073/pnas.1919032117) that provide insight into these discussions on uncertainties for CO2 ff emissions.	Noted. We make clear that there could be other methods. Atmospheric meausrements are covered by our classification.	Government of United States of America	U.S. Department of State	United States of America
53329	12	41	12	42	"However, estimates are not independent as they all ultimately rely on the same data sources" Please indicate which sources of information are these. This is not evident from the text of table 2.1	Rejected. This would be too specific. Still, we revised the language to avoid any misunderstandings.	Florin Vladu	UNFCCC Secretariat	Germany
71149	12	41	12	42	However, estimates are not independent as they all ultimately rely on the same data sources. I would balance this statement by replacing "all" with "most often".	Noted. We tried to re-balance the statement, but due to other changes the entire language changed.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
53331	12	42	12	43	"For example, all global inventories use one of four global energy datasets to estimate CO emissions from energy use." Please note that this may inconsistent with reference to 9 datasets in table 2.1	This is not inconsistent with the reference to the nine emission inventories. Those emission inventories depend on four different input sources for energy data. Note that the table has been moved to the supplementary material of the chapter.	Florin Vladu	UNFCCC Secretariat	Germany
76371	12	43	12	43	Here a reference should be put	This language is no longer there as we had to cut down the chapter. We address this in the supplemetary information to the chapter.	Emilio Sessa	Carbon Credits Consulting	Italy
53333	12	47	12	47	The text mention 'seven global datasets', but table 2.1 lists 9	Noted. Checked for inconsistencies. Text is shifted to the supplementary material-	Florin Vladu	UNFCCC Secretariat	Germany
72449	13	1	13	2	the notion of "system boundaries" needs to be explained.	Accepted. Explanation added.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
10521	13	3	13	3	Would "time," be missing after "at the same" ?	Due to cutting down the section, this sentence is no longer there as it was.	Philippe Waldteufel	CNRS	France
54629	13	3	13	3	"at the same time"?	Due to cutting down the section, this sentence is no longer there as it was.	Government of United States of America	U.S. Department of State	United States of America
71151	13	3	13	3	At the same time -"time" is probably missing in this sentence? Otherwise it is hard to understand.	Due to cutting down the section, this sentence is no longer there as it was.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72931	13	3	13	5	Difficult to understand the sentence properly	Due to cutting down the section, this sentence is no longer there as it was.	Antoine BONDUELLE	EE-Consultant	France
5069	13	7	13	14	Explain the abbreviations and data sources here already (Table 2.1) rather than only explaining on the next page (below figure 2.2)	Accepted. We explain the data sources at their first mention now. Note that the table has been shifted to the supplementary material.	Lina Hollender	n/a	Germany
53337	13	7	13	14	It would be important to know if all datasets cover global emissions at 100%	We cannot say this for certain, but Table 2.1 tries to make the differences between global emissions inventories clear. The table has been removed though and is now part of the supplementary material to the chapter.	Florin Vladu	UNFCCC Secretariat	Germany
53335	13	10	13	11	"The partial use of IPCC default emissions factors by UNFCCC Common Reporting Format (CRFs) inventories". This reference is ambiguous because this variable is not visible in the table.	The word "partial" is used in column "Uses IPCC emission factors" for the "UNFCCC CRFs". Note that the table has been shifted to the supplemetary material.	Florin Vladu	UNFCCC Secretariat	Germany
54631	13	11	13	12	Not following this argument about the IPCC default emission factors being a strength. The way this is written, it seems the more "accurate" country-specific factors should be better.	We agree that this was confusing. Adjusted the caption of the Table, which is now shown as part of the supplemetary information	Government of United States of America	U.S. Department of State	United States of America
72933	13	11	13	12	Didn't really get the difference between 'default factors' and 'country specific factors'	We agree that this was confusing. Adjusted the caption of the Table, which is now shown as part of the supplemetary information	Antoine BONDUELLE	EE-Consultant	France
3233	13	13	13	14	One more data base is absent: CAIT. Please, add.	CAIT was intentionally excluded. While it has more detailed methods for other GHGs, for fossil CO2 it simply presents emissions directly from CDIAC-FF before 1971 and from IEA from 1971, except for Lesotho. Note that the table has been shifted to the supplementary material to the chapter.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
86121	13	16	13	17	This strikes me as actually quite important. I wonder if possibly to synethesis as „	I do not understand what the proposal is. Seems to be an incomplete comment.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
53339	13	20	13	20	How well aligned is EDGAR with the national estimates? Please indicate a value or a range	We do not discuss this here, but provide such a comparison in the section on Regional emissions trends.	Florin Vladu	UNFCCC Secretariat	Germany
72935	13	26	13	26	“systematically” instead of “systematic” maybe?	Language has been removed. It is still in the new supplemnetary material for the chapter, where we have coorrected it.	Antoine BONDUELLE	EE-Consultant	France
485	13		13		The 7th column heading has an issue. Non-fuel use based on?, the cell in the 2nd column and the bottom row, partial needs to be shaded in red.	1. The heading of the column is intended to be read with the elements in the column, for example the first element indicates that "Non-fuel use based on national data". 2. This instance of 'partial' is intentionally not shaded red as explained in the table's caption. Note that the table has been shifted to the supplementary material	Kim Hana	KAIST	Republic of Korea

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
16085	13		13		The 7th column heading has an issue. Non-fuel use based on?, the cell in the 2nd column and the bottom row, partial needs to be shaded in red.	1. The heading of the column is intended to be read with the elements in the column, for example the first element indicates that "Non-fuel use based on national data". 2. This instance of 'partial' is intentionally not shaded red as explained in the table's caption.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
4923	14	6	14	7	The meaning of the sentence is not clear. There might be a mistake within the sentence.Please, revise it	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
5071	14	6	14	6	"products such as cement take up large amounts of cement" - check sentence, cement does not take up cement	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Lina Hollender	n/a	Germany
10523	14	6	14	7	You possibly mean "large amounts of CO2"?	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Philippe Waldteufel	CNRS	France
18019	14	6	14	6	I was confused by this sentence - 'products such as cement also take up large amounts of cement'. Was the second use of cement meant to be CO2?	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
25043	14	6	14	6	In the following sentence, "large amount of cement" should read "large amount of CO2": "At the same time, products such as cement also take up large amounts of cement over their life cycle, which are often not fully considered in carbon balances”	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	|Claude Lorea	GCCA	Belgium
51973	14	6	14	6	Large amount of CO2 not cement. Correct the sentence.	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
54633	14	6			"At the same time, products such as cement also take up large amounts of cement …" Presumably the second "cement" should be "CO2".	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Government of United States of America	U.S. Department of State	United States of America
64929	14	6	14	7	I did not understand this sentence (cement also take up a large amound of cement)	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
70121	14	6			"[industrial] products such as cement also take up large amounts of [carbon dioxide] over their life cycle [- or approximately 43% of direct CO2 emissions from production.] "	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Rayner Andersen	Department of Fisheries and Oceans	Canada
71153	14	6	14	6	I think the word "cement" should be replaced by "CO2 emissions" or else the sentence does not make sense.	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72937	14	6	14	6	There's maybe a problem or typo with the following sentence “products such ascementalso take up a large amounts ofcement”	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Antoine BONDUELLE	EE-Consultant	France
76373	14	6	14	6	The repetition of the word cement does not make much sense here.	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Emilio Sessa	Carbon Credits Consulting	Italy

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
86123	14	6			Oops ..	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
25045	14	8	14	10	Recarbonation is better understood in carbon balance now and it would be usefull to add a reference to recent literature. A total CO2 uptake in the use stage and end-of life stage of 23% of the national calcination emission, is presented, as a value for use in Tier 1 [Carbonation as a method to improve climate performance for cement based material R. Anderssona,⁎, H. Strippleb, T. Gustafssonb, C. Ljungkrantzc]	We have corrected the sentence. Thanks for pointing this out. It is part of the supplementary material now, but we added it also in the result discussion.	|Claude Lorea	GCCA	Belgium
51975	14	12	14	14	The section should also highlight the difference in the frequency of data release and update cycles between major datasets; and how the absence of reliable, granular data can undermine the evidence base for policy planning.	We provide a clear and thorough assessment of the uncertainties - which is a precondition for policy applications. It is not possible within the limited space of the chapter to comment on each and every dataset and ist release cycles (which are also not always clear). We still add an extensive list of GHG datasets in the supplementary material. We also add data needs in the "gaps in knowledge and data" section.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
15205	14	18	14	21	The statement here concluded that the uncertainty of CO2 emissions from fossil fuel combustion is 15-20% for China. This conclusion is based on three papers from 1999, 2012 and 2008, which are too old to reflect the current situation objectively and do not match the conclusions of the current national communications. It is suggested to be revised as "around 5% for China". The supporting literature is as follows: People's Republic of China. 2018. The Third National Communication on Climate Change of the People's Republic of China. Available at: https://unfccc.int/sites/default/files/resource/China_NC3_Chinese_0.pdf [2019-06-27]	This is no longer part of the chapter discussion. We remove it also from the Supplementary Information, as it is non-essential information.	Government of China	China Meteorological Administration	China
5073	14	26	14	31	I find the explaination of your choice of 8% uncertainty insufficient; it appears to be somewhat random given that other studeis estimate uncertainites of 8.4 / 9 / 5-10%. So why 8%	We have clarified the justification. We are reporting here a 90% confidence interval as other studies report at 1sigma or 2sigma. This is fully in line with AR5 in WG3 as well as GCP or WG1 AR6, which report 5% at 1 sigma.	Lina Hollender	n/a	Germany
8067	14	35	14	39	Please do not equalize normal forest management activities with deforestation or forest degradation. Clear-cutting can be employed for land use change, but it is a silvicultural technique employed in sustainable forest mangement schemes, too. In addition, harvest activities are not to be generally considered as "degradation".	Taken into account: text revised to: "[…] afforestation, harvest activities, land-use-related forest degradation […]"	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
45763	14	35	14	39	Please do not equalize normal forest management activities with deforestation or forest degradation. Clear-cutting can be employed for land use change, but it is a silvicultural technique employed in sustainable forest management schemes, too. In addition, harvest activities are not to be generally considered as "degradation".	Taken into account: text revised to: "[…] afforestation, harvest activities, land-use-related forest degradation […]"	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
8069	14	39	14	41	Please revise this statement. Models are not the only means to estimate natural and anthropogenic fluxes, inventories can be used, too. Basic reference: IPCC 2006 GL and 2019 Refinement.	Taken into account. We generalized to that *generally* models are used for this and that this differs from the NGHGI / IPCC guidelines approach, which partly include fluxes attributed to natural drivers in global carbon cycle models (this had been mentioned elsewhere in the text; we reference it now at this place for clarity).	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
72529	15	1	15	2	Its hard to tell Figure 2.2 on page 15. I would suggest to make the figure color darker and zoom in lines shown in charts "Annual global FFI-CO2" emissions and "Annual global CH4 emissions".	Noted. Final figure production will be done in liaison with the Technical Support Unit.	Yun Hang	Emory University	United States of America
82513	15	1	15	1	Maybe choose another darker color for the title and axes.. As they are a bit hard on my eyes. (Can't see them too clear).	Noted. Final figure production will be done in liaison with the Technical Support Unit.	Fei Luo	VU Amsterdam	Netherlands
24887	15	2	15	19	Please add "The AFOLU CO2 estimates in this figure are not necessarily comparable with country GHG inventories (see Chapter 7)".	Taken into account: caption extended by: "The CO2-LULUCF estimates in this figure are not directly comparable with national GHG inventories (see 2.2.2.1 and Chapter 7)."	Giacomo Grassi	Joint Research Centre, European Commission	Italy
18021	15	6	15	6	Consider changing the units to be CO2eq across the four graphs so that they can be readily compared in terms of magnitude.	Rejected. There has been a decision within the author team to report in native units whenever possible. This is one of the few occasions, where we can actually do this.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
18023	15	6	15	6	Consider including a plot of the F-gases as this would complete the set of different gases/types discussed.	Rejected. We do not include information on F-gases as there are much fewer datasets avaialble. However, in the supplementary material to the chapter, this is included.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
78301	15	20	15	20	could be useful to provide a very concise statement of the high level methods employed by book-keeping models and other approaches. Could be reflected in Annex C also.	Accepted. We added this to the new supplementary material of the chapter.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
487	15		23		The Fig 2.2. consists of four charts. Please tag indivudal part as small alphabets then cite it in the text (like Figure 2.2b) It will be much better.	We added alphabetical labelling of the panels.	Kim Hana	KAIST	Republic of Korea
16087	15		23		The Fig 2.2. consists of four charts. Please tag indivudal part as small alphabets then cite it in the text (like Figure 2.2b) It will be much better.	We added alphabetical labelling of the panels.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
3235	16	4	16	6	It is not clear what is "additional sink capacity" - please explain	Taken into account. We have added the definition and a further reference.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
54635	16	5	18	20	In addition to the global estimates of CH4 emissions made using techinques mentioned in Houweling et al. (2017), much progress has also been made on regional estimates of CH4 emissions -- e.g., https://doi.org/10.1073/pnas.1314392110 -- which may warrant some additional mention as they provide emission estimates independent of inventories and independent of the loss uncertainties that affect global values.	accepted. TD approaches can be used at different scales (site to global). This has been further mentioned in the supplementary material to the chapter, where most of this discussion is taking place npw - and we use a recent study (Maasaker et al., 2021).	Government of United States of America	U.S. Department of State	United States of America
20527	16	21	16	21	"but…regions" : Biomass remain difficult to estimate at large scales in tropical regions, because data from satellites (L-band SAR data) cannot quantify values exceeding 100 Mg.ha-1. After reaching a maximum value, SAR backscatter correlates negatively with forest biomass (Mermoz et al., 2015. Title of the paper : Decrease of L-band SAR backscatter with biomass of dense forests", published in Remote Sensing of Environment. http://dx.doi.org/10.1016/j.rse.2014.12.019). The launch of the BIOMASS satellite at the end of 2022 should lead to better estimates in the near future.	Rejected. This is beyond the mandate of this section. We agree, but since our sentence is about non-tropical regions, we do not see the need to discuss biomass uncertainties for tropical regions.	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
8071	16	22	16	23	Please be more specific what you consider "remote-sensing derived estimates". Since the data used in modelling often are also derived from remote sensing, this sentence targets them, too.	Taken into account in the supplementary material, where this discussion now takes place due to streamlining requirements. We clarify that we refer to observations of carbon stock changes derived from remote-sensing. These are not typically input to neither bookkeeping nor dynamic global vegetation models (i.e. the models applied here for estimating CO2-LULUCF).	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
8073	16	24	16	28	Please correct this statement. There are various studies around on tracking biomass changes from remote-sensing. This is, e.g., a common method in forest resource assessments or GHG Inventories.	Taken into account in the supplementary material, where this discussion now takes place due to streamlining requirements. We agree and had referenced several such studies. We now added a sentence to clarify that we refer to a limited applicability only with respect to the global CO2-LULUCF flux estimates provided by global carbon cycle models.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
8075	16	24	16	28	Please explain how the models you cite here distinguish natural from anthropogenic disturbances. Most disturbances are sub-grid scale and can also hardly be distinguished without ground-based data.	Taken into account in the supplementary material, where this discussion now takes place due to streamlining requirements. We have added to the supplemental methodology that since environmental effects are excluded by the bookkeeping approach, the bookkeeping CO2-LULUCF emissions estimates isolate anthropogenic effects (independent of scale).	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
20585	16	24	16	24	Another reference worth mentioning and analysing is by Avitabile et al. (2016) ("An integrated pan-tropical biomass map using multiple reference datasets" published in Global Change Biology, https://doi.org/10.1111/gcb.13139)	Rejected. While Avitabile et al is a great study, please note that we do not cite biomass assessments per se, but only such studies that derived CO2 fluxes partly attributable to LULUCF from them.	Government of France	Ministère de la Transition écologique et solidaire	France
72939	16	24	16	28	This long sentence could be shortened or maybe more clearly explained	Taken into account in the supplementary material, where this discussion now takes place due to streamlining requirements. This section was revised in response to other comments.	Antoine BONDUELLE	EE-Consultant	France
20529	16	28	16	28	It should also be noted that current large-scale biomass maps show strong disparities due to a flaw in the validation methods, which ignore spatial autocorrelation in data, leading to overoptimistic assessment of model predictive power (Ploton et al., 2020. "Spatial validation reveals poor predictive performance of large-scale ecological mapping models" in Nature Communications, https://doi.org/10.1038/s41467-020-18321-y).	Rejected. This is beyond the mandate of the text here. The purpose of our text is to caution the reader against equating remote-sensing derived CO2-flux estimates to CO2-LULUCF from global carbon cycle models (due to the various reasons listed in the text), and the text, consequently, does not compare any numbers or trends. Additional uncertainties of remote sensing data per se are thus irrelevant.	Government of France	Ministère de la Transition écologique et solidaire	France
24767	17	5	18	20	Hmiel, B., Petrenko, V. V., Dyonisius, M. N., Buizert, C., Smith, A. M., Place, P. F., … Dlugokencky, E. (2020). Preindustrial 14CH4 indicates greater anthropogenic fossil CH4 emissions. Nature, 578(7795), 409–412. https://doi.org/10.1038/s41586-020-1991-8	Accepted. We have added this to the text. Please note this is part of the spplementary metrail now.	Michelle Cain	cranfield university	United Kingdom (of Great Britain and Northern Ireland)
24769	17	5	18	20	I inserted the reference to Hmiel et al 2020 in the box/comment above, which I think should be cited here as it adds additional uncertainty to current methane emissions estimates.	Accepted. We have added this to the text. Please note this is part of the spplementary metrail now.	Michelle Cain	cranfield university	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
66187	17	5	18	20	With regard to methane emissions, cattle sheep and goats are no worse than their wild predecessors on natural grasslands that produced just as much methane (Tiwari et al 2015). With regard to mitigation, it should also be noted that animal husbandry plays a role, with permanent grassland being preferable to cultivated crop cattle feed, due to the presence of methanotrophs in permanent pasture soil (Coolen et al 2004). References Coolen, MJL, Hopmans, EC, Rijpstra,WIC, Muyzer, G, Schouten, S, Volkman, JK, Sinninghe Damsté, JS. 2004. Evolution of the methane cycle in Ace Lake (Antarctica) during the Holocene: response of methanogens and methanotrophs to environmental change. Organic Geochemistry, 35, 10, 1151-1167. doi.org/10.1016/j.orggeochem.2004.06.009. Tiwari,S, Singh,JS, Singh, DP. 2015 Methanotrophs and CH4 sink: Effect of human activity and ecological perturbations. Climate Change and Environmental Sustainability 3(1): 35-50. DOI: 10.5958/2320-642X.2015.00004.6	Rejected. Comment not related to the substance of the discussion.	Donal OCallaghan	Teagasc (retired member)	Ireland
43155	17	6	17	8	Find another quote that includes all methane emissions; since there was no production of manure from cattle, pigs, rabbits	Accepted. The sentence has been re-written to be more specific, though too many details is not possible here to be implemented. Note that the material has been moved to the supplementary information of the chapter.	Betty Ramírez	INAMEH VENEZUELA	Venezuela
75471	17	6	17	9	Can the percenatge contributions from the main listed sources be included in this paragraph?	This is not the result section, but deals with the major uncertainties associated with anthropogenic methane fluxes. We looked into adding these numbers, but felt that it would disturb the flow. Note that this discussion has been shifted to the supplemetary information.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75475	17	6	17	13	Can anthropogenic methane be defined here? Also can fossil methane be differenciated from non-fossile anthropogenic methane?	Accepted - and implemented. Note that this discussion has been shifted to the supplemetary information.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
45765	17	8	17	14	It should be mentioned that remote sensing by satellites are also providing data to improve the knowledge on methane emissions.	Accepted. Two sentences have been included to reflect this in the supplementray material.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
76375	17	15	18	20	I believe people get lost among all these continual reference to the EDGAR emission Inventory. I believe changing this entire passage would slim down and improve the chapter readability	Noted. But it is not possible to get around this completely. For example, it is important to note for which version of EDGAR uncertainties estimates were provided - or how much estimates from one EDGAR version deviate from another version. Note that this discussion has been shifted to the supplemetary information.	Emilio Sessa	Carbon Credits Consulting	Italy
71155	17	17	17	17	The reference (Höglund-Isaksson, 2012) should be replaced with (Höglund-Isaksson et al., 2020) because the GAINS inventory referenced here and in Table 2.3 refers to the latter. A link to the published reference can be found here: https://iopscience.iop.org/article/10.1088/2515-7620/ab7457.	We corrected this now at various places of the chapter and supplemetary material, where most of this discussion is now located.	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
54637	17	23			Text says "anthropogenic emissions" but, if biomass burning is included from the mentioned/cited sources, this is total biomass burning (i.e., natural and anthropogenic sources), as those inventories don't distinguish between natural and anthropogenic.	Accepted. This is difficult to separate anthropogenic from natural biomass burning, while a large part is triggered by human actions. (about90%). Lightning ignited fires would represent a small part (10%), and is quite negligeable as biomass burning (nat + anthrop) represents roughly 5% of anthropogenic emissions. We have added a sentence on this , which is now part of the Supplementary material.	Government of United States of America	U.S. Department of State	United States of America
71157	17	25	17	26	Suggest replacing "However, they may differ in the assumptions and data used for the calculation." With "However, they may differ in the assumptions and data used for the calculation and in the choice of IPCC Tier levels for the methodology." Differences in estimates are quite often due to differences in Tier level, i.e., reflecting differences in the level of granularity of the country-/region- specific information that feeds into the process of deriving emission factors.	Accepted. Note that this is now part of the supplementary material-	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
75473	17	26	17	26	Replace UNFCC with UNFCCC	Accepted. Note that this is now part of the supplementary material-	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
30439	17	30	17	30	Suggest modifying this text. There is a small, but non trivial, long-term temperature response to past forcing due to "memory" in the ocean (models differ on the magnitude of this effect since ocean heat uptake is uncertain). Note that not all simple climate models accurately represent this effect. This is also true for CO2 emissions, however what happens physically is that there is an offset once CO2 emissions reach net zero because CO2 concentrations tend to decrease (decreasing forcing). There is no such offsetting effect for SLCFs.	This comment seems to refer to a different piece of text. Not relevant here. Not treated	Steven Smith	PNNL/JGCRI	United States of America
54639	17	33	17	33	Error in EDGAR version numbers: v4.3.2 is corrected, v4.2 is old, there is no v32.	Accepted. We have coorect the text, which is now part of the supplementary material-	Government of United States of America	U.S. Department of State	United States of America
30441	17	40	17	40	This box is too long. Its gets too deep into esoteric modeling and theoretical arguments that are may have limited relevance to real world climate forcing mitigation.	We believe that the text references are wrong, but relate to the cross-chpater box on emissions metrics, which has been trimmed.	Steven Smith	PNNL/JGCRI	United States of America
3237	17	41	17	41	Please, explain "BU" and "TD" here	Accepted. Thanks. Part of supplementary material now	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
54641	17	41			Spell out "bottom-up" and "top-down".	Accepted. Thanks. Part of supplementary material now	Government of United States of America	U.S. Department of State	United States of America
78841	17	41	18	20	WG I, chapter 5 and 6 should be referenced here. Do the value quoted here agree with WG I?	Noted. We have trimmed down this section. The discussion in the main chapter is brief and we decided not to cross-reference to WG1. In general, the same foundations are used for the uncertainties assessments, which are the works of the Global Carbon Project.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
4925	18	5	18	5	OH should be defined somewhere in the chapter before its use	clarified, but this discussion is now part of the supplementary information	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
72941	18	5	18	5	“OH” for hydroxyl radicals?	clarified, but this discussion is now part of the supplementary information	Antoine BONDUELLE	EE-Consultant	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
72445	18	12			Reference to Quéré et al., 2018 (P143, L30-31) should be to Le Quéré et al., 2018 (P143, L37-38). There are several occurrences of this mispelling in the Chapter	Noted	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
30443	18	15	18	16	Table caption here and elsewhere needs to provide data source (e.g. EDGAR). This is presented as a definitive set of emission numbers, whereas these are just once choice (justifiable, but still just one choice) of figures. For example, as mentioned previously EDGAR CO2 emissions are consistently higher than other estimates.	The text reference is unclear and does not match what is described here.	Steven Smith	PNNL/JGCRI	United States of America
75477	18	18	18	20	Can anthropogenic methane be clearly defined in terms with the fossil methane component be differenciated from the non-fossil component?	Accepted and clarified in the supplementary material, where most of this discussion now takes place.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
5075	18	19	18	20	Again, the choice of 20% as best value judgement appears to be random, especially considering EDGAR's estimations of 32% and 57% uncertainty! This really needs better explanation in order to maintain the scientific credibility of any statements in this report that are based on these uncertainty estimates.	In principle, we agree and changed the uncertainty estimate to 30% at a 90% confidence interval.	Lina Hollender	n/a	Germany
71159	18	19	18	20	The best value judgement of +/- 20% for global anthropogenic methane emissions appears on the lower side from a bottom-up perspective, however, I think it is justified as being in the right ballpark when considering validation against top-down isotopic budgets for fossil/biogenic/biomass burning categories. Suggest mentioning of using top-down isotopic budgets as a method to narrow down bottom-up assessments. May be interesting for laymen readers to know that such possibilities for verification exist.	In principle, we agree and changed the uncertainty estimate to 30% at a 90% confidence interval.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
18025	19	1	19	1	The column purely related to USA emissions implies a greater weight is given to the emissions from the USA. Please either consider justifying its inclusion more or consider removing it.	Note that this table has been removed from the main text and is now only part of supplementary material. The choice/example ahs been clarified.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
54643	19	1	19	3	Table 2.3 has estimated uncertainty in CH4 inventories in the USA. The estimates are based on NASEM (2018) but the US Inventory submitted to the UNFCCC also has characterized uncertainty associated with methane emissions: https://www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-annexes.pdf	Note that this table has been removed from the main text and is now only part of supplementary material. Values in this report are very similar if not the same as in the USA UNFCCC reporting annex.	Government of United States of America	U.S. Department of State	United States of America
75479	19	1	19	10	Inclusion of current emissions levels from the sources would assist in the consideration of how important the uncertainties are.	Levels become important when we consider emission trends. This comes later in the chapter. The table is illustrative and has been moved to the supplementary material.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
18027	20	14	20	17	Would the GCP have any value in this section on global emission inventories? Could the authors please consider whether it would be useful here?. Further, please can each model be referred to consistently e.g. FAO-N2O is also referred to as FAOSTAT and FAOSTAT-N2O.	We are not entirely clear what the intention is with regard to GCP, but made sure that the referencing to global inventories is consistent.	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
71161	20	16	20	16	Here the reference (Höglund-Isaksson, 2012) should be replaced with (Winiwarter et al., 2018), which describes GAINS N2O emission estimates. (Höglund-Isaksson, 2012) only refers to CH4 and is also outdated (see above for the more up-to-date reference Höglund-Isaksson et al., 2020). The full Winiwarter et al., 2018 reference is found here: https://iopscience.iop.org/article/10.1088/1748-9326/aa9ec9/pdf.	Thanks. Taken on board throughout the chapter and supplementary information, where most os this discussion is now taking place.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
30445	20	19	20	20	Table caption should note that the same uncertainty range is applied over all years, whereas uncertainties will likely be higher for the most recent data.	Not sure what table is referred. Text references do not match content	Steven Smith	PNNL/JGCRI	United States of America
78843	20	30	20	46	WG I, chapter 5 should be referenced here. Do the value quoted here agree with WG I?	We had to trim down text and only have a short note on this in the main chapter. A reference to WG1 would not fit. We still cover a detailed discussion in the supplementary material to the chapter. Note that our assessment is - like WG1 - importantly based on the work by the Global Carbon Project/ N2O budget.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
18029	21	1	21	1	Should be CEDS be added to this table?	We decided not to add CEDS to the table, which is now part of the supplementary material to the chapter. Our inventory comparison figure in the main chapter covers it alongside other inventories not present in this 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)
18031	21	1	21	1	There was no discussion as to how the F-gas uncertainty was derived. The F-gas inventory was not given sufficient discussion. Please consider expanding the details on the F-gas emissions and how they were derived. Comparison with atmospheric data and top-down studies are particularly important here, both globally and regionally.	Accepted. We have added a section on f-gas emissions and pulled an additional leading expert on this subject into the team as a contributing author.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
71163	21	1	21	4	The header to 2.4 should refer to the GAINS publication Winiwarter et al., 2018 (see above) instead of (Höglund-Isaksson, 2012).	Accepted. Table is moved to new online supplementary material-	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
75481	21	1	21	4	Inclusion of data on uncertainty levels for these emissions would assist in the consideration of how important theses are.	Rejected. This information is not available. The assessment here focusses on global constant relative uncertainties - without any sectpr resolution.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
86203	21	4	21	5	Effect of EMISSIONS of SLCFs on temperature are shown in WG1 Chapter 6 (section 6.4.2).	Taken into account. Thanks. This is also shown in the subsequent figure of the material. We have ensured consistency with WG1 material.	Sophie Szopa	LSCE	France
50053	21	6	21	7	I don't understand this sentence. Should "the previous section" be the subject of this sentence?	Apologies. This is fixed now	Masahiro Sugiyama	University of Tokyo	Japan
64931	21	6	21	6	replace "with" with "we"	Apologies. This is fixed now	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
76377	21	6	21	6	Replace with with we	Apologies. This is fixed now	Emilio Sessa	Carbon Credits Consulting	Italy
86125	21	6			? we compared ?	Apologies. This is fixed now	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
30447	21	10	21	11	Error bars do not appear to be correct. (e.g. 50% for LULUC, 60% for N2O).	Text reference does not seem to be correct.	Steven Smith	PNNL/JGCRI	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
54645	21	14	21	21	There is hardly a mention of F-gas emission uncertainties in Section 2.2.1. Top-down global estimates are plentiful (pointers to original work can be found in the quadrennial Science Assessment reports of the Montreal Protocol) that allow comparisions to inventory estimates such as EDGAR. Given that the F-gas emission contribution is stated earlier as being "non-negligible", it would seem important to discuss this in the chapter to enlighten the reader on the degree of consistency (sometimes lack of consistency) in inventory-based estimates vs. those derived from what are, in some cases, rather straightforward top-down methods. Note that top-down national-scale estimates for a number of countries (UK, Switzerland, Australia) are included in their National Inventory Reporting alongside inventory-based estimates. Estimates for some F-gases are also available for the US: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL074388. These methodologies have matured in recent years so that they provide estimates of magnitudes and trends for F-gas emissions (and for that matter, fossil CO2, CH4, and N2O) that are independent of inventories and, therefore, directly relevant to the discussions here about uncertainties in inventory estimates.	We fully agree. It was a shortcoming of the SOD that it lacked that section on f-gases. We have added it and, for that, brought in a leading scholar as a contributing author. Important insights are provided by this new assessment. Most of the material is part of the supplementary information, but we add a paragraph in the main chapter as well as a figure.	Government of United States of America	U.S. Department of State	United States of America
54647	21	15	21	15	The budgets of the F-gases have not yet been discussed as they have for N2O, CH4, and CO2.	We fully agree. It was a shortcoming of the SOD that it lacked that section on f-gases. We have added it and, for that, brought in a leading scholar as a contributing author. Important insights are provided by this new assessment. Most of the material is part of the supplementary information, but we add a paragraph in the main chapter as well as a figure.	Government of United States of America	U.S. Department of State	United States of America
78845	21	16	21	18	This sentence on adding +/- 10% for CO2eq wasn't very clear. Is this the extra uncertainty due to uncertainty in the emission metrics? If so the basis for this calculation should be explained. What underatiny is assumed in the values of the emission metrics themselves?	Accepted. We have changed our quantification of aggregate GHG emissions we take the squareroot of the sum of the squared uncertainties of the individual gases contributing to the CO2eq flux. This ensures that we acknowledge the importance of the species-composition of the aggregate GHG emissions flux, which can differ considerably by country or sector. Moreover, we provide an estimate for the metric uncertainty as well.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
18033	22	1	22	1	There was no figure b - a breakdown of Kyoto minor gases as mentioned in the caption. The term 'Montreal' was used in figure a, please can it be defined. The HFCs are now covered under both the Montreal and Kyoto Protocols so there is confusion as to what gases this relates to, CFCs and HCFCs only or also HFCs.	Accepted. Sorry. We further improved the figure and made sure that the new version is adequately described in the caption. Note that we add a lot of substance on f-gases both in the chapter as well as in the supplementary material to the chapter.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
75967	22	3	22	5	I think this needs rewording. I understand that you want to point to the different behaviour of SLCF and gases that accumulate in the atmosphere. But it is obvious that they dont have the same tenperature response.	Accepted. Our language makes this clear now	Jan Fuglestvedt	CICERO	Norway
78303	22	3	22	3	The term "short-lived climate forcer" may not be familiar to all in the WG III user audience. They'd be familiar with methane, particulates etc. A simple statement of what is included in SLCF could help - without going to the glossary	Accepted. We use a more descriptive language now.	Jim Skea	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
24771	22	7	22	13	This text doesn't make sense. The figure has the wrong number of panels to the caption. The dotted line looks quite different to the shading, so I am not clear how it doesn't show a 'vastly different story'. I am not clear what point is being made overall. Is it that GWP100 is OK for representing SLCPs over the historical period, but not for future mitigation scenarios? THat's the only point I can pick out, so I suggest you make it more explicit that GWP100 works for SLCPs if they are following an increasing emissions trend, but that it stops providing any link to temperature outcome once the SLCP emissions start declining.	We reworked the figure entriely and revamped the text.	Michelle Cain	cranfield university	United Kingdom (of Great Britain and Northern Ireland)
74733	22	7	22	8	There is a real opportunity here to provide IPCC report readers with some very useful information. "But we are often most interested in the actual warming caused by historical, AND FUTURE emissions of each gas" (crucial insertion: emissions will, we hope, not always be increasing). You can then add: "The IPCC SR1.5 stated: 'Reaching and sustaining net zero global anthropogenic CO2 emissions and declining net non-CO2 radiative forcing would halt anthropogenic global warming on multi-decadal times cales (high confidence). The maximum temperature reached is then determined by cumulative net global anthropogenic CO2 emissions up to the time of net zero CO2 emissions (high confidence) and the level of non-CO2 radiative forcing in the decades prior to the time that maximum temperatures are reached (medium confidence).' In quantitative terms, human-induced warming over any multi-decade period length deltat is determined by, in order of importance across scenarios, (i) cumulative CO2 emissions G, (ii) any change in non-CO2 radiative forcing DeltaF, and (iii) the average level of non-CO2 radiative forcing Fbar, all computed over that period: DeltaT = kappa x (G + DeltaF / alpha + rho x Fbar x deltat / alpha) (very high confidence: what else could it depend on?). The coefficients kappa, alpha and rho are determined by well-known climate system properties: kappa is the TCRE, about 0.45 K per 1000 GtCO2 (very high confidence if you add the uncertainty range); rho is the rate of decline of radiative forcing required to give stable temperatures, or (ECS-TCR)/(TCR x d2), where d2 is the centennial thermal response time of the climate system, so rho is approximately 0.33% per year (Solomon et al, 2009; Cain et al, 2019; and many references in between) (high confidence); and alpha is determined by matching the forcing response to constant CO2 emissions to the AGWP of CO2, alpha=AGWP_H/(gamma x H) =1.09 W/m2 per 1000 GtCO2 where gamma=0.85 for rho=0.33% and H=100 years (Smith et al, 2021; Allen et al, 2021: again, this follows from the definition of AGWP_H, so presumably high confidence). Since this expression applies on multi-decadal timescales, DeltaF can be computed by differencing forcing between the 20 years leading up to the beginning of the multi-decade period in question, and the 20 years leading up to the end."	Rejected. From a mitigation perspective, the contribution to warming from historical emissions is of different significance compared to the contribution from future emissions, since mitigation actions can only reduce future emissions. The formula advocated by the reviewer belongs in the domain of WGI but does not provide information about how much future emissions, which could be addressed by mitigation actions, would contribute to future warming. As this chapter is about observed emission trends and drivers we do not consider the broader statement from SR15 to be relevant here.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
75483	22	7	22	8	We are very interested in effective ways to limit future warming to well below 2C. How does this figure assist in finding solutions?	Rejected. This chapter is related to historical emissions trends. Here we evaluate how different gases have contributed to warming historically - and juxtapose this with the way gases are aggregated using a GWP-100 metric.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
30449	22	9	22	10	This paragraph needs to be re-written. Emissions out to 2019 are highly uncertain for these species and the statements here are presented as too definitive. The largest source of BC emissions is residential biofuels and diesel road vehicles and there is not driver data for either of these out to 2019 (and biofuel consumption is particularly uncertain. Note that in many lower income countries, where biofuel use is large, consumption is a model result not data, and therefore trends are not very reliable). OC emissions are not being reduced to control ozone. CH4 should probably be removed from this section (is discussed above). Expectations about future NMVOC trends are not appropriate here, particularly given the very large uncertainty between inventories and possible underestimates of NMVOC emissions in current inventories (e.g., Volatile chemical products emerging as largest petrochemical source of urban organic emissions, McDonald etal 2018). There are few NH3 control measures anywhere, including much of the developed world.	Text reference of the comment does not match the substance-	Steven Smith	PNNL/JGCRI	United States of America
20531	22	11	22	13	There appears to be a problem with figure 2.3 that does not correspond to the title. It looks like only two out of three panels are shown. Given that the figure does not seem to show all the elements, it is not possible to assess whether it accurately shows the message claimed.	Accepted. We have revised the entire figure and developed an adequate caption.	Government of France	Ministère de la Transition écologique et solidaire	France
74697	22	11	22	13	This is misleading to the point of disingenuous unless it is immediately qualified with the fact that this is a coincidence that will no longer hold as soon as emissions stabilise or start to fall. The reason relative warming impact and cumulative CO2-e emissions measured by GWP100 happen to more-or-less coincide over this period is that methane emissions were increasing at roughly 1% per year. Warming due to methane over a multi-decade period is proportional to the TCRE x cumulative warming-equivalent emissions, defined using CO2-fe, CGTP, GWP* or whatever. Using the GWP* definition of warming-equivalent emissions for simplicity, annual CO2-warming-equivalent emissions of methane are given by E*(t)=4.53xE(t)-4.25xE(t-20), if E(t) is methane CO2-e emissions in year t measured with GWP100 (Smith et al, 2021, updating Cain et al, 2019). So E*(t)=E(t) if and only if E(t)/E(t-20)=4.25/3.53=1.2, or methane emissions are increasing at 1% per year, which, as it happens, they were over much of this period. If methane emissions are stable, then E*(t)=0.28xE(t), out by a factor of 3.5, and if methane emissions fall by 0.33% per year, then E*(t)=0, and E(t) provides a vastly (infinitely) different story than modelled warming of CO2 and CH4.	Taken into account. The text has been revised to make clearer that the relatively good agremeent between contribution to warming and GWP100-weighted emissions is related to the fact that emissions have been rising. However, neither the text nor the GWP100 metric imply that temperature change from non-CO2 gases should be a linear function of their cumulative emissions. This chapter is not concerned with projections of future warming in mitigation scenarios. The cross-chapter box on metrics picks up those points in more general terms.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
75485	22	11	22	13	What are the important differences? Can these be stated?	Taken into account; the wording has been revised to make clearer that GWP100-based underestimate the actual warming over the historical period.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75969	22	11	22	13	I can't see that figure 2.3 highlights this. Both graphs have deg C on the vertical axes.	This conclusion can be inferred from comparing Figure 2.3 with Figure 2.1.	Jan Fuglestvedt	CICERO	Norway
78847	22	11	22	14	It is not obvious how figure 2.3 highlights that GWP-100 "doesn't provide a vastly different story"	This conclusion can be inferred from comparing Figure 2.3 with Figure 2.1.	William Collins	University of Reading	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
78849	22	11	22	14	This needs to be more explicit that for the *historic* emission trajectory only GWP100-weighted emissions correspond approximate to the relative contributions to modelled warming. It needs to be made clear that this correspondence will not necessarily apply to any *future* emission trajectory.	Accepted and incorporated into revision of the text.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
75487	22	13	22	18	How to the values in Figure 2.3 (a) compare with the those in WGI e.g. WG1 Figure TS.13:?	The Figure is consistent and was calculated using the same calibration to WGI AR6 models. Note that the WGI Figure TS.13 shows the contribution by gas in the atmosphere, whereas the figure here shows the contribution to warming from emissions of each gas; the contribution from methane emissions is significantly greater due to indirect effects (which are discussed in WGI Section 7.6).	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75511	22	13	22	18	The warming contributions in Figure 2.3 for the main GHGs seem to be different from WGI TS.24. Can this be explained?	We are unsure what WGI TS.24 the reviewer refers to (as Figure TS.24 is not in any way comparable to the information provided here). The Figure is consistent and was calculated using the same calibration to WGI AR6 models, and gives the same results as shown in WGI Figure SPM.2. Note that for example the WGI Figure TS.13 shows the contribution by gas in the atmosphere, whereas the figure here shows the contribution to warming from emissions of each gas; the contribution from methane emissions is significantly greater due to indirect effects (which are discussed in WGI Section 7.6).	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
3239	22	14	22	15	Figure 2.3 is not clear	Accepted. We designed a new figure and hope that it is much clearer.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
8077	22	14	22	18	Figure 2.3: Please revise figure. One panel is missing and the panel on the right-hand side seems to be labelled incorrectly (y-axis). How can a gas have a warming contribution that is positive and negative at the same time (SOx)?	Accepted. We designed a new figure and hope that it is much clearer.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
45767	22	14	22	18	Fig. 2.3 seems incomplete there are only two panels but the caption mentions three.	Accepted. We designed a new figure and hope that it is much clearer.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
54649	22	14	22	14	Figure 2.3 has a title that promises warming due to emissions over 1750-2018, but only shows warming contributions starting in 1970. Also, there is no discussion in the text of Montreal and Other-Kyoto forcers. There is no Figure 2.3c. Readers might not be familiar with what is shown on Figure 2.3b. A new figure that matches the discussion in the text is needed here.	The figure shows historical warming since 1750 cumulatively, but we focus on the period 1990-2019 as the main historical reference period in WGIII AR6. We have extended the f-gas discussions across the entire chapter. We restrict the discussion here to a clarification in the caption.	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
74735	22	14	22	18	This figure is misleading since it suggests an equivalence between cumulative CO2-e emissions under GWP100 that is known to be inconsistent with the underlying physics: it is simply a coincidence resulting from the fact that SLCF emissions are rising at approximately 1% per year over much of this period. I suggest you insert beforehand: "Forcing due to constant emissions of any SLCF is equal to E_S x AGWP_H, where E_S the rate of SLCF CO2e emissions expressed using GWP_H, and AGWP_H is the AGWP of CO2 for time-horizon H (Shine et al, 2005; Smith et al, 2021), while the warming impact of emissions of very long-lived greenhouse gases, E_L, is similar to the impact of an equivalent quantity of CO2, with CO2-e again defined using GWP_H. Hence (given the expression in my previous comment) warming due to greenhouse gas emissions over a multi-decade period is given by DeltaT = kappa x sum [E_L(t) + 4.53 x E_S(t) – 4.25 x E_S(t-20)], so emissions reported as CO2-equivalent using GWP100 can be used to calculate impact on global temperature provided aggregate emissions of very-long-lived greenhouse gases are reported separately from SLCFs." and then replot the figure using cumulative warming-equivalent emissions, extending it into the future using a representative mitigation scenario to show how cumulative emissions and warming behave under declining emissions. If desired, you could also plot cumulative CO2-e emissions and FaIR-calculated warming to show how misleading these become as soon as SLCF emissions start to decline	Taken into account. The figure simply shows the warming that has occurred based on a FaIR simulation. The text already stated, but has been revised further, to make clear that the broad similarity between the observed warming and cumulative GWP100 emissions of CO2 and CH4 occurs in the context of rising emissions, and that this would not hold when emissions start to decline. However, we are not in any way asserting through this figure or accompanying text that cumulative SLCF emissions are a good indicator of warming, so we do not see a need or way to revise a statement that is not being made.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
75965	22	14	22	18	Fig 2.3: The fig caption refers to a, b and c. Something is missing	Accepted. We have redesigned the figure and added an adequate and comprhensive caption	Jan Fuglestvedt	CICERO	Norway
83031	22	14	22	18	The left panel shows warming of almost 1.5C since 1750 (which is not the established baseline for pre-industrial) Is this consistent with the WG1 assessment?	Taken into account: the caption has been amended to make clear that this is warming from GHG emissions only, i.e. excluding the net cooling effect of aerosols. This is based on forcings which typicalyl start in 1750.	Geden Oliver	German Institute for International and Security Affairs	Germany
65239	22	15	22	18	Missing panel b, spelling mistake in caption: shot -> short	Accepted. We have redesigned the figure and added an adequate and comprhensive caption	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
86127	22	15			I cant see a (b) ..	Accepted. We have redesigned the figure and added an adequate and comprhensive caption	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
4225	22	16			Please, add to the line 16 after the year 1750 in parenthesis the words "(x-axis of the Figure 2.3 is from the year 1970 to the year 2018)".	Accepted. We have redesigned the figure and added an adequate and comprhensive caption	Ilkka Savolainen	VTT Technical Research Centre of Finland	Finland
71165	22	16	22	18	Not clear what a), b) and c) in the Figure caption refer to in the Figure.	Accepted. We have redesigned the figure and added an adequate and comprhensive caption	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
74791	22	16	22	18	Figure 2.3: only two figures are shown without labelling yet the caption indicates refers to Figure 2.3 a, b, c. Where is figure c? Proper figures and labels should be included	Accepted. We have redesigned the figure and added an adequate and comprhensive caption	Government of Kenya	Kenya Meteorological Service	Kenya
86205	22	16	22	16	Figure 2.3: the results of this figure are not consistent with Figure 6.12 of WG1 AR6 Chapter 6. In particular the net NOx effect is a cooling due to effect on methane lifetime and NMVOc effect is a warming. The BC effect seems overestimated here and that of SOx underestimated. In addition methane is part of the SLCF. The current effect of SLCF on GSAT is assessed to be near zero due to compensating effects.	Taken into accont. These estimates are based on the WGI FaIR version delivered to WGIII. This Figure has been revised to better match Figure SPM2b of WGI	Sophie Szopa	LSCE	France
12669	22	17	22	17	Typographic error "short-lived"	We revised figure and caption.	Donald Falk	University of Arizona	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
18035	22	20	26	18	This cross-chapter box is extremely clear in its explanations and analysis and helps clarify a number of issues regarding the utility of GWP compared with other metrics, and the application and limitations of new metrics.	Thank you	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
30297	22	20	26	19	Some elements of the contents in this box are problematic because it might be interpretted by the reader as recommendations from the IPCC for using spesific metric also under other circumstances and applications. Examples of this are in the para from page 24 line 40 to page 25 line 29.	Taken into account: we have taken care in the final draft to avoid instances where the factual assessment might be perceived as recommendation.	Government of Norway	Norwegian Environment Agency	Norway
30453	22	20	26	18	Here and elsewhere chapter authors should harmonize language. The terms developed/developing are not used so often in the literature now as they are static, can be considered pejorative, and overly broad.	Taken into account: this report uses a range of classifications as relevant depending on context. The box on GHG metrics does not make this type of differentiation.	Steven Smith	PNNL/JGCRI	United States of America
71167	22	20	26	20	Cross-chapter box 2 (metrics) The comprehensive nature of this box, including the policy relevance of common metrics, is much appreciated. Consider the following improvements: i) a more pedagogical explanation of the points on cost-benefit and cost effectiveness (is it as simple as GWP100 being associated with low discount rates - which are typically necessary to give any importance at all to long-term phenomena?); ii) point out that common metrics are not a panacea. Each have their pros & cons. In this context it is perfectly possible for policymakers to continue with GWP100 as the common metric (e.g. for accounting and reporting) AS WELL AS taking targeted action on SLCFs. Also see our separate comment on CGTP and GWP*	Thank you, the suggestions for additional content were taken into account in the final revisions, but the more pedagogical points were taken up mainly in the Annex due to page constraints in the main chapter. Page 26 lines 4-11 already state that all metrics have shortcomings.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
75505	22	20	26	19	Box is useful. It should also recognise that under NDCs the application of climate policy is a matter for the Country including if an how GHG are aggregated to achieve climate outcomes.	Accepted, this has been clarified (although the accounting decision 4/CMA.1 does explicitly require countries to use the reporting framework agreed on in 18/CMA.1 for accounting, so the flexibility is mainly in how targets are formulated rather than the accounting per se under the existing ruleset).	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75507	22	20	26	19	It may not be clear how a balance of emissions and removals is achived if emissions metrics are updated in each IPCC report. This is apparent in Figure 2.4 were the impacts if changing GWP values is shown. Some text on this could be usefully included	Accepted; this is contained in Annex B but we brought a brief mention of it into this box.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75509	22	20	26	19	The box is useful but can also clearly state that the most important data are the actual emissions data in mass/time. These are in national inventories. How these are combined, or not, is a policy matter, including at national and subnational levels.	Taken into account; this was already stated (page 26 lines 4-11) but the expression has been clarified further.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
83471	22	20	26	18	This box provides an excellent overview of GHG metrics issues. One aspect that is currently not covered is the limitations of GWP* and CGTP when used for single-year targets as is the case for NDCs or oven net-zero targets. As the annual CO2 equivalent emissions expressed through these metrics reflect the instantaneous temperature rate of change rather than the total warming, they leave much more room for variation and ambiguity in the temperature outcome when used to set single-year targets.	Noted but no change made in this box but rather in the Annex. It's not clear based on this comment that this is a problem specific to GWP* or CGTP, but any single year target is problematic for its temperature outcome even if it is achieved via GWP100.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
85747	22	20	26	18	Cross-Chapter Box 2: This material is relevant, helpful and clearly written.	Thank you.	Government of Australia	Department of Industry, Science, Energy and Resources	Australia

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
75541	22	25	22	25	Does it support or inform mitigation policy? If it supports policy how can this be validated?	Accepted; replaced "support" with "inform".	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75489	22	28	22	28	The IPCC has avoided stating an atmopsheric lifetime fro CO2. Has this changed? If not then this should be referenced?	Noted but no change made; CO2 does not have a simple exponential decay but we don't consider it incorrect to refer to differing lifetimes in those general terms. The difference in lifetimes is discussed extensively in WGI which is already referenced.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
80599	22	28	22	33	Given that the intent of WGIII is to provide information that "can support choices about priorities and trade-offs in mitigation policies and emission targets," why is information on co-emissions only considered in the context of short-lived climate forcers and not CO2? (The only mention of "co-emission" in Chapter 2 is on 2-33 line 8 in the context only of short-lived climate forcers.) As described in Dreyfus et al. (in preparation), this ignores the well-known correlation between coal combustion and co-emission of CO2, SO2, and black carbon (e.g., Hayhoe et al., 2002; Wigley, 2011). When this relationship was considered by Feijoo et al. (2019), they observed near-term warming and a significant deviation from the established transient carbon response relationship. How do the different metrics discussed in this box address (or not) the issue of co-emission and impacts on near-term warming identified in the literature? CITATIONS: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Hayhoe K., Kheshgi H.S., Jain A.K., & Wuebbles D.J. (2002) Substitution of Natural Gas for Coal: Climatic Effects of Utility Sector Emissions, Climatic Change 54(1): 107–139. Accessed at https://doi.org/10.1023/A:1015737505552. ("Using the electric utility sector as an example, changes in emissions of CO2, CH4, SO2, and BC resulting from the replacement of coal by natural gas are evaluated, and their modeled net effect on global mean-annual temperature calculated. Coal-to-gas substitution initially produces higher temperatures relative to continued coal use. This warming is due to reduced SO2 emissions and possible increases in CH4 emissions, and can last from 1 to 30 years, depending on the sulfur controls assumed. This is followed by a net decrease in temperature relative to continued coal use, resulting from lower emissions of CO2 and BC."). See also Wigley T.M.L. (2011) Coal to gas: the influence of methane leakage, Climatic Change 108(3): 601. Accessed at https://doi.org/10.1007/s10584-011-0217-3. 607 ("In summary, our results show that the substitution of gas for coal as an energy source results in increased rather than decreased global warming for many decades — out to the mid 22nd century for the 10% leakage case. This is in accord with Hayhoe et al. (2002) and with the less well established claims of Howarth et al. (2011) who base their analysis on Global Warming Potentials rather than direct modeling of the climate. Our results are critically sensitive to the assumed leakage rate. In our analysis, the warming results from two effects: the reduction in SO2 emissions that occurs due to reduced coal combustion; and the potentially greater leakage of methane that accompanies new gas production relative to coal. The first effect is in accord with Hayhoe et al. In Hayhoe et al., however, the methane effect is in the opposite direction to our result (albeit very small). This is because our analyses use more recent information on gas leakage from coal mines and gas production, with greater leakage from the latter. The effect of methane leakage from gas production in our analyses is, nevertheless, small and less than implied by Howarth et al."). Feijoo F., Mignone B.K., Kheshgi H.S., Hartin C., McJeon H., & Edmonds J. (2019) Climate and carbon budget implications of linked future changes in CO2 and non-CO2 forcing, Environmental Research Letters 14(4): 044007. Accessed at http://iopscience.iop.org/article/10.1088/1748-9326/ab08a9/meta. ("However, total	Taken into account: we added text making clear that metrics can be used to understand aggregate climate outcomes from co-emissions of different gases. However, the comment is not fully accepted, because metrics provide information on the warming contribution from the emission of individual gases; whether such gases are co-emitted depends on the process and cannot be incorporated into metrics which are intended to be process-neutral. If co-emissions are known, then metrics can be used to evaluate the aggregate climate outcome. The text makes clear that we hear discuss only metrics for gases and not for aerosols.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
80743	22	28	22	33	Given that the intent of WGIII is to provide information that "can support choices about priorities and trade-offs in mitigation policies and emission targets," why is information on co-emissions only considered in the context of short-lived climate forcers and not CO2? (The only mention of "co-emission" in Chapter 2 is on 2-33 line 8 in the context only of short-lived climate forcers.) As described in Dreyfus et al. (in preparation), this ignores the well-known correlation between coal combustion and co-emission of CO2, SO2, and black carbon (e.g., Hayhoe et al., 2002; Wigley, 2011). When this relationship was considered by Feijoo et al. (2019), they observed near-term warming and a significant deviation from the established transient carbon response relationship. How do the different metrics discussed in this box address (or not) the issue of co-emission and impacts on near-term warming identified in the literature? CITATIONS: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Hayhoe K., Kheshgi H.S., Jain A.K., & Wuebbles D.J. (2002) Substitution of Natural Gas for Coal: Climatic Effects of Utility Sector Emissions, Climatic Change 54(1): 107–139. Accessed at https://doi.org/10.1023/A:1015737505552. ("Using the electric utility sector as an example, changes in emissions of CO2, CH4, SO2, and BC resulting from the replacement of coal by natural gas are evaluated, and their modeled net effect on global mean-annual temperature calculated. Coal-to-gas substitution initially produces higher temperatures relative to continued coal use. This warming is due to reduced SO2 emissions and possible increases in CH4 emissions, and can last from 1 to 30 years, depending on the sulfur controls assumed. This is followed by a net decrease in temperature relative to continued coal use, resulting from lower emissions of CO2 and BC."). See also Wigley T.M.L. (2011) Coal to gas: the influence of methane leakage, Climatic Change 108(3): 601. Accessed at https://doi.org/10.1007/s10584-011-0217-3. 607 ("In summary, our results show that the substitution of gas for coal as an energy source results in increased rather than decreased global warming for many decades — out to the mid 22nd century for the 10% leakage case. This is in accord with Hayhoe et al. (2002) and with the less well established claims of Howarth et al. (2011) who base their analysis on Global Warming Potentials rather than direct modeling of the climate. Our results are critically sensitive to the assumed leakage rate. In our analysis, the warming results from two effects: the reduction in SO2 emissions that occurs due to reduced coal combustion; and the potentially greater leakage of methane that accompanies new gas production relative to coal. The first effect is in accord with Hayhoe et al. In Hayhoe et al., however, the methane effect is in the opposite direction to our result (albeit very small). This is because our analyses use more recent information on gas leakage from coal mines and gas production, with greater leakage from the latter. The effect of methane leakage from gas production in our analyses is, nevertheless, small and less than implied by Howarth et al.").	Taken into account: we added text making clear that metrics can be used to understand aggregate climate outcomes from co-emissions of different gases. However, the comment is not fully accepted, because metrics provide information on the warming contribution from the emission of individual gases; whether such gases are co-emitted depends on the process and cannot be incorporated into metrics which are intended to be process-neutral. If co-emissions are known, then metrics can be used to evaluate the aggregate climate outcome. The text makes clear that we hear discuss only metrics for gases and not for aerosols.	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
80743	22	28	22	33	(continued) Feijoo F., Mignone B.K., Kheshgi H.S., Hartin C., McJeon H., & Edmonds J. (2019) Climate and carbon budget implications of linked future changes in CO2 and non-CO2 forcing, Environmental Research Letters 14(4): 044007. Accessed at http://iopscience.iop.org/article/10.1088/1748-9326/ab08a9/meta. ("However, total forcing (panel c of figure 1), which includes the contribution from both CO2 and other forcing agents, does not immediately deviate from the Reference Case and, to the extent that it does deviate, actually increases relative to the Reference Case. The primary reason for this effect is that SO2 forcing is a mirror image of CO2 emissions (compare panel a to panel e of figure 1), a consequence of the fact that CO2 emissions are strongly correlated with SO2 emissions (both are produced from the combustion of coal), but that the radiative forcing contribution from SO2 emissions is negative. The temperature trajectories (panel d of figure 1) largely follow the total forcing trajectories. The significant increase in SO2 direct forcing (panel e of figure 1) and related indirect forcing constrains the feasibility of certain global temperature objectives.").				
75491	22	31	22	31	Does it support or inform policy? If it supports policy how can this be validated?	Accepted; replaced "support" with "inform".	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
80591	22				Does Figure 2.3 include all species in Forster 2020a Table 7.5? What species are included as "Montreal" in Figure 2.3? It appears panel b is missing. In panel "c", given that different shot-lived climate forcers have different sources, from a climate mitigation perspective, what is the value of the "net SLCF" dotted line?	Throughout the chapter we clarify now what f-gas species are considered. When we refer to "Montreal Protocol" we refer to f-gas species that are not covered by the Paris Agreement - acknowledging that HFCs are covered by both.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
80735	22				Does Figure 2.3 include all species in Forster 2020a Table 7.5? What species are included as “Montreal” in Figure 2.3? It appears panel b is missing. In panel “c”, given that different shot-lived climate forcers have different sources, from a climate mitigation perspective, what is the value of the “net SLCF” dotted line?	Throughout the chapter we clarify now what f-gas species are considered. When we refer to "Montreal Protocol" we refer to f-gas species that are not covered by the Paris Agreement - acknowledging that HFCs are covered by both.	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
75493	23	4	23	4	Published not developed in the literature.	Accepted, change made	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75495	23	12	22	13	Can a reference to the accounting decision be included?	Accepted, this has been included (4/CMA.1 states that accounting for future NDCs will be in accordance with reporting under 18/CMA.1)	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
53341	23	14	23	14	For a complete reference of the UNFCCC decision (decision 18/cma.1) the following should be added "(e.g. global temperature potential)"	Rejected; we would like to avoid highlighting a specific metric here since this could be seen as implicitly not including e.g. GWP*. Given that the text only states "e.g." it is inclusive of all metrics that are discussed in the AR6, not only GTP.	Florin Vladu	UNFCCC Secretariat	Germany
76379	23	15	26	11	The definition of GTP is not enough explained compared to GWP. I would suggest a sharper initial ddifferentiation than simply saying it is static against dynamics.	Taken into account: the existing text does not say it is static against dynamics. A more complete explanation is provided in the Annex. Given page constraints we hage added an additional cross-reference to the Annex.	Emilio Sessa	Carbon Credits Consulting	Italy
53343	23	16	23	16	"and continue to be the dominant metrics used in the scientific literature". A reference to this statement is relevant here.	We're not aware of a simple reference that could demonstrate this, as it is the collective body of literature used in the AR6 that demonstrates this.	Florin Vladu	UNFCCC Secretariat	Germany
70129	23	21			(e.g. using GWP20)(Lynch et al. 2021, Fuglestvedt et al. 2000) https://www.frontiersin.org/articles/10.3389/fsufs.2020.518039/full ; https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/1999GL010939	Noted; it is not clear what part of the text this comment refers to or what change is being requested. These references have been incorporated into the final draft.	Rayner Andersen	Department of Fisheries and Oceans	Canada
70131	23	21			https://www.frontiersin.org/files/Articles/518039/fsufs-04-518039-HTML/image_m/fsufs-04-518039-g001.jpg A single emissions pathway (left) reported as CO2-equivalents using the 100-year Global Warming Potential (GWP100) can have very different impacts (right) depending on the gas-specific composition, illustrated by showing the warming contribution if the CO2-equivalent emissions are entirely nitrous oxide (green), entirely carbon dioxide (blue), entirely methane (orange), or various combinations of carbon dioxide and methane (blue-to-orange spectrum; 50% methane, 50% CO2 shown as stronger purple line). (Lynch et al. 2021)	Noted; it is not clear what part of the text this comment refers to or what change is being requested. The different temperature outcomes are demonstrated in Annex B. Due to page constraints we are not using figures in this box.	Rayner Andersen	Department of Fisheries and Oceans	Canada
74703	23	21	23	21	Given the focus on GWP and GTP, it is important to clarify the relationship between them: "For cumulative or very long-lived climate pollutants such as nitrous oxide, values of GWP and GTP are similar to each other an approximately independent of time-horizon. For SLCFs, both GWP and GTP decline with increasing time-horizon, with GTP declining faster: for methane, the value of GWP100 is approximately equal to GTP40, for example. Hence GWP100 understates the warming impact of the release of a tonne of methane on timescales of 1-40 years, and overstates this warming impact on all timescales greater than 40 years." (Figure 8.30 of Myhre et al, 2013)	Taken into account; this detail is provided in the WGI assessment and page constraints mean we cannot repeat this assessment here. However, we have included text explaining that the metric values for SLCFs declines with increasing time horizon.	Myles Allen	University of Oxford	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
53345	23	24	23	27	Giving the conclusion that there was medium evidence a that time, this AR has revised the conclusion? If so it would be important to refer here. Otherwise, it could be important to mention that no progress was made. Otherwise, refer to the part of this report where this is mentioned.	Taken into account; this para describes the findings of the AR5, not the results from AR6. The revised conclusions are covered later in this box. The wording in the AR5 was quite vague, so we don't specifically update that generic finding but provide more specific conclusions in this assessment.	Florin Vladu	UNFCCC Secretariat	Germany
81663	23	24	23	27	This is a really important narrative (i.e. choice of metric can have a significant effect on policy decisions if a significant proportion of a country's sector is made up of non C02 emissions) - useful if this could be in the SPM and could outline when other GHG metrics might be more appropriate. Would also be useful to outline some of the assumptions here regarding cost - this small global result is because non-CO2 gases are a small proportion of global GHG emissions?	This detail is covered in the Annex, we are not able to expand this material here given page constraints. We have edited the text to make clear that the relevance for some sectors and regions arises where their share of SLCFs is higher than in the global average. The SPM author team will consider whether to include a statement on GHG metrics and the revised SPM will be submitted to governments for further comment.	Government of New Zealand	Ministry for the Environment	New Zealand
53347	23	28	23	29	There is reference to 'the choice of time horizon" but there is a specific reference to GWP100. Check if the GWP reference should be more general.	Noted; most of the criticism is indeed specific to GWP100, given that this is by far the most widely used time horizon. No change made.	Florin Vladu	UNFCCC Secretariat	Germany
53359	23	29	29	38	The effects of the covid-19 in emission trends in 2020 appear to be temporary. Although they are interesting facts, they distract from the overall trend that is more important for a report such as AR6. Consider including information on 2020 and Covid as a separate box.	Noted, thanks. We only have one paragraph and one figure on the COVID related emissions trends in 2020. As of FGD It is dealt with more substantively in cross chapter box 1. Further, we now emphasize that emissions have rebounded by the end of 2020.	Florin Vladu	UNFCCC Secretariat	Germany
83033	23	29	23	38	It would be informative to add an indication about nonCO2 emissions during COVID, even if only in qualitative language. There might not be reliable numbers yet, but probably there arent't stark COVID-related changes, which means the temporary decline was even smaller	Rejected. We are aware of no available information on this in the literature, even qualitative.	Geden Oliver	German Institute for International and Security Affairs	Germany
81661	23	31	22	33	Suggest state here that GWP100 underestimates the warming effect of short lived gases in the short term and overestimates their warming impact in the long term as it averages their warming impact out over 100 years and assumes they continue to accumulate over the 100 years (whereas they actually have a very large warming impact in the short term then start to be removed from the atmosphere after a few decades). This can pose issues for policymaking as it means it cannot be used to generate a very accurate pathway and endpoint date for reaching a climate temperature target, particularly where SLCF form a large part of a country's emissions profile.	Taken into account: page constraints limit the additional detail we can provide in this box, but we added that using GWP100 to estimate temperature change from cumulative emissions underestimates warming in the first century and overestimates warming in subsequent centuries.	Government of New Zealand	Ministry for the Environment	New Zealand
83461	23	33	23	33	This statement can be made more accurate. First, it is unclear why this would only apply to long-term emissions targets. For balance, the box should also highlight the ambiguity in temperature outcomes when defining single-year targets with GWP* of CGTP.	Partially accepted; we deleted "long-term" as it indeed applies to all emission targets. The box already highlights that no metric is perfect for everything. We do not highlight that single year targets leave ambiguity regarding future temperature outcomes as this is not a unique feature of GWP*: future temperature outcomes always depend on future emissions, for any metric.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
81677	23	35	23	35	Useful to outline reasons why GWP100 is consistent with a cost-benefit framework - if peak warming needs to be by 2050 shouldn’t the time horizon be shorter? Also helpful to reframe the second sentence to state that the dynamic GTP can be more aligned with a cost-benefit framework if it is used to assess the impact in the year of peak warming i.e. if the wrong time horizon is chosen it will not give a good indication of costs.	We have added some more explanation of cost-benefit and a cost-effectiveness frameworks for comparing emissions. However, page constraints mean that we have to focus on assessment rather than background explanation.	Government of New Zealand	Ministry for the Environment	New Zealand

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
3805	23	42	23	42	The text might be improved by an explicit acknowledgement that the Convention (and by implication the Paris Agreement) is a cost-effective framework (see Article 3, Para 3), so I wonder why you give primacy to the cost-benefit advantages of the GWP. I know I am far from an impartial observer on this, but it seems you come up with quite compelling arguments that the dynamic-GTP is the preferred approach, and any caveats can also be levelled at any other metric.	Rejected. We do not agree that the Convention or the Paris Agreement can be described as cost-effectiveness frameworks, since neither specifies a single fixed target (let alone peak temperature year) against which any individual emission could be evaluated. Paris has a temperature goal that covers a significant range, and it speaks to emissions peaking "as soon as possible" and balance of emissions and removals during the second half of the 21st century - all of those ranges signal the need to balance costs and benefits of actions rather than a single prescribed goal. Different levels of ambition, within the temperature goal of the Paris Agreement, could imply a temperature peak year anywhere between about 2045 and close to 2100 - which gives very different dynamic GTP values for SLCFs. Similarly, the stabilisation goal of Art 2 UNFCCC represents a balancing of the costs and benefits of action as no specific stabilisation target is presented. The cost-effectiveness expectation in UNFCCC Art 3.3 only applies to those actions that are taken, but the UNFCCC does not provide a fixed target that any individual action can be evaluated against. We have included text (already contained in the Annex) that dynamic GTP values depend on the assumed peak year.	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
74699	24	1	24	1	Please insert: "The use of warming-equivalent emissions metrics, such as CGTP or GWP*, also have this effect of increasing the weight given to SLCF emissions as a target time is approached, but have the advantage over the dynamic GTP in that they act to equate warming outcomes on all timescales, including after the target time (Lynch et al, 2020)"	Rejected for two reasons. One is that this para discusses GWP and GTP and not GWP* or CGTP. The other is that despite the quoted sentence, GWP*-based CO2-we emissions are the same for a given emissions time series regardless of whether the target is 1.5 degrees or 4 degrees. GWP* values do not depend on a target year. CGTP is based on a sustained, constant level of emissions continued up to the target year, which means CGTP values decrease rather than increase as the target is approached.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
81679	24	1	24	2	This sentence " the dynamic GTP does not fully match the price ratio between gases in least cost mitigation pathways because the most cost-effective weighting of each emission also depends on the discount rate" is not plain english - suggest explaining further what this means, is the discount rate wrong - if so why?	Taken into account. The reviewer seems to be unaware that the dynamic GTP does not have a discount rate as it is a purely physical metric. We adjusted the wording in page 23 line 44 to page 24 line 3 to simplify the sentence to and to reduce this apparent misunderstanding about discounting.	Government of New Zealand	Ministry for the Environment	New Zealand
81665	24	4	24	7	Suggest clarify that GTP with any static time horizon (rather than just GTP100) is not closely matched with a cost-benefit framework	Accepted: replaced "a" with "any"	Government of New Zealand	Ministry for the Environment	New Zealand
20533	24	12	24	14	This message is highly politically relevant. Would deserve to be displayed in the summary of the chapter	Discuss with Chapter 2 CLAs	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
85749	24	12	24	21	Consider adding a sentence to note that this analysis adds support for using the emission pathways derived from IAMs that use GWP100 (bearing in mind all other limitations of IAMs)	Rejected as this would be policy prescriptive. Whether a metric that results in a few percent higher costs is acceptable is a political decision for Governments, not for IPCC - the existing text simply lays out the basis on which such a decision can be made. Also, it would be highly ambiguous and open to differing interpretations what is meant by "using" emission pathways from IAMs. As pointed out in lines 35-39, whether and how one wants to use IAM pathways (to set global targets? national targets? sectoral targets? emissions prices?) depends on additional judgements about equity that phsyical metrics cannot reflect, and the use of metrics other than GWP100 (e.g. dynamic GTP) could still have significant implications for countries and sectors with high shares of SLCFs even if there is not much difference in global mitigation costs.	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
3807	24	20	24	20	GTP100 (i.e. no subscript).	We have made an editorial decision to present the time horizon of metrics as subscripts.	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
61527	24	22	24	27	Add the additional note that because of the very recent event of COVID19, it remains unclear what the impact on emissions trends will be.	Rejected as this would be policy prescriptive. Whether a metric that results in a few percent higher costs is acceptable is a political decision for Governments, not for IPCC - the existing text simply lays out the basis on which such a decision can be made. Also, it would be highly ambiguous and open to differing interpretations what is meant by "using" emission pathways from IAMs. As pointed out in lines 35-39, whether and how one wants to use IAM pathways (to set global targets? national targets? sectoral targets? emissions prices?) depends on additional judgements about equity that phsyical metrics cannot reflect, and the use of metrics other than GWP100 (e.g. dynamic GTP) could still have significant implications for countries and sectors with high shares of SLCFs even if there is not much difference in global mitigation costs.	Takashi Homma	Research Institute of Innovative Technology for the Earth (RITE)	Japan
81667	24	22	24	34	Useful to further explain why there isn't much difference between GWP100 and the dynamic GTP costs - this is not an intuitive outcome. Why is the methane value similar? Are there some situations where using GTP may make more sense? (at the national rather than global level?) Are there GHG metrics other than either of these two which could be used?	We have made an editorial decision to present the time horizon of metrics as subscripts.	Government of New Zealand	Ministry for the Environment	New Zealand
74727	24	26	24	28	The potential policy disruption of a continually evolving metric, occassionally substantially updated, should also be noted.	Taken into account. Some of those explanations are provided in the Annex and page constraints do not allow to bring them all into this Box. We have modified the text at the end of this para to further explain the role of abatement costs in how metrics would drive mitigation choices in cost-effective mitigation pathways.	Myles Allen	University of Oxford	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
3795	24	28	34	28	"offers only a limited" - I would say that the text has morphed from being quantitative ("a few per cent" on line 23) to making a value judgement that a few per cent reduction is "only limited" (and, reading between the lines, not worth it). Isnt "a few percent" worth achieving, especially if it was one of several measures, each of which achieved "a few per cent"?	Rejected: the degree of policy disruption is speculative and no reference has been provided. Other reviewers have cautioned in the opposite direction, pointing out that the GWP100 value for methane has changed substantially since the SAR without any major problems even though market mechanisms such as the CDM rely on this metric. Since there is no literature on policy disruption (or not) from changing metrics we do not feel we can offer a comment one way or the other in this box.	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
74701	24	34	24	34	Please explain the reason for this: the value of GWP100 for methane happens to be the same as the GTP40, and the date of peak warming happens to be about 40 years away in 1.5C and well-below-2C scenarios. So replacing GWP100 with a dynamic GTP targetting 2060 right now would make no difference, but this situation will change rapidly as 2060 is approached, and GWP100 will become progressively more misleading.	Accepted; we replaced "limited" with "few percent".	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
24773	24	40	24	43	I would add 'over specific time horizons' after 'non-CO2 gases'. This is because as shown in Allen et al 2016, the pulse emission comparison of GWP100-equivalent emissions do not show equivalent effect on temperature at different time periods. The GWP100 was specifically integrated over 100 years after a pulse. That is the exact scenario that it works well for.	Taken into account. We added an explanation at the end of this para, and provide more detail in the Annex. The main reason is that most of the mitigation potential for CH4 contained in IAMs is exhausted at the high carbon prices in mitigation pathways consistent with 1.5 or well below 2 degrees even under GWP100. Using a metric that provides a higher marginal price does little to change the actual abatement under the different metrics.	Michelle Cain	cranfield university	United Kingdom (of Great Britain and Northern Ireland)
74705	24	40	24	43	This is nonsense: all these metrics are based on a linearisation of the climate response, so the impact of cumulative emissions is just the sum of the impacts of a sequence of emission pulses. If GTP or GWP were to accurately equate the impact of an emission pulse of an SLCF with an emission pulse of CO2, then they would also get the response to cumulative emissions right. The problem is, they don't.	Accepted and change made	Myles Allen	University of Oxford	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
74707	24	43	25	2	Lots of errors here. The near-linear relationship between cumulative CO2 emissions and CO2-induced warming (not temperature change) results from the approximate cancellation between the logarithmicity of CO2 radiative forcing and increasing airborne fraction. The millenial persistence of CO2 is actually somewhat incidental here (although of course very important). The relationship doesn't have to be linear for there to be a finite remaining carbon budget consistent with any given temperature: just imagine if the AR5 SPM10 figure were logarithmic, you could still read off carbon budgets corresponding to any given temperature target, you just don't have a single value for the TCRE. And the relationship between methane emissions and methane-induced warming is only marginally more complicated than the relationship between CO2 emissions and CO2-induced warming. I suggest you replace this entire paragraph with something like this: "Warming due to greenhouse gas emissions over a multi-decade period is proportional to total cumulative CO2-e emissions over that period of very long-lived gases such as CO2 and nitrous oxide plus contributions from both cumulative CO2-e emissions and any change in CO2-e emission rate of SLCFs such as methane (high confidence). To a good approximation: DeltaT \simeq TCRE x \Sum [E_L(t) + 4.53 x E_S(t) - 4.25 x E_S(t-20)] where E_L(t) and E_S(t) are, respectively, total CO2-e emissions calculated using GWP100 of very long-lived and short-lived greenhouse gases in year t and E_S(t-20) is total CO2-e emissions of short-lived gases in the year 20 years prior to t. Hence SLCF emissions increasing faster than 1% per year have a greater warming impact than is implied by their cumulative CO2-e emissions based on GWP100, while SLCF emissions decreasing faster than 0.3% per year have the same impact on global temperatures as active CO2 removal. This behaviour cannot be captured if it is assumed that global warming follows cumulative CO2-e emissions using GWP100 or GTP." This is trying to distill down lots of papers on warming-equivalent emissions into the shortest paragraph I can give you, but the most up-to-date reference would be Smith et al, 2021. You can certainly assign high confidence to the first statement (what else could it depend on?), and perhaps medium confidence to the coefficients in the equation (they follow from the definition of AGWP, although there is only one paper -- but how many papers do we need to assign confidence to a piece of maths?).	Rejected. The point made in the text is that GWP and GTP-based equivalence is for specific time horizons only (and they are 'accurate' over the specified time horizon). However, the distribution of climate effects from SLCF emissions is not constant over that time horizon, in contrast to CO2. Hence the warming from cumulative SLCF emissions over an extended period of time is not cumulative. We have refined the text, including based on a comment from another reviewer, to make that point more clearly.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
78851	24	47	24	47	This sentence could be written more positiively "By contrast, for SLCFs such as methane there is a simple relationship between changing rate of emissions and temperature."	Taken into account. The wording has been revised to make clearer the shape of the CO2 induced warming vs that from SLCFs. The text makes clear that there is no simple relationship between cumulative methane emissions and temperature change (as the temperature change depends on the time frame over which those emissions occur). The reviewer is technically correct that the existence of a finite carbon budget is not logically dependent on the linear relationship between cumulative CO2 emisisons and temperature change and we have therefore deleted that sentence. We have not included the suggested text and equation since that has been assessed by WGI and the focus of WGIII is on the relevance for climate change mitigation.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
30451	24	48	24	48	the statement here about industrial BC needs to be more cautious. Only EDGAR shows such as large contribution from industry. This is not the case in either CEDS or GAINS (which are largely independent estimates of BC/OC emissions.)	Taken into account. We do want to make the point that cumulative SLCF emissions are NOT useful to predict temperature change, but we have included the positive formulation that SLCF-induced warming at any point in time depends largely on the rate of emissions.	Steven Smith	PNNL/JGCRI	United States of America
75497	25	1	25	4	This is important information but is presented in a complex manner. What exactly is being communicated?	Taken into account: these sentences have been edited to make them simpler and clearer.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
75499	25	1	25	4	Does the rate of decline of a SLCF have to be rapid to reduce warming? Does this include all SLCFs?	Taken into account. The decline has to be rapid enough, since constant SLCF emissions still result in gradual further warming as demonstrated by the equation in Cain et al (2019). We have modified the wording to quantify the "rapid" as being more than about 0.5% per year, based on Cain et al (2019) and Smith et al	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75501	25	1	25	4	It would be useful to comment on the atmospheric concentration which is the claime forcer	Text reference seems to be wrong.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
53351	25	2	25	2	Clarify if CO2 emissions from AFOLU reflect net emissions or not The same in other figures in this report.	Accepted. We clarify this right at the beginning of the section now. And in relevant figures too.	Florin Vladu	UNFCCC Secretariat	Germany
53349	25	3	25	3	Clarify if fluroinated gases cover only those gases not covered by the Montreal Protocol. The same in other figures in this report.	Accepted. We clariffy now right at the beginning of section 2.2.	Florin Vladu	UNFCCC Secretariat	Germany
85751	25	3	25	4	Consider adding a sentence to note the relevance of this statement to emissions targets expressed as CO2-equivalent under the Paris Agreement (FCCC/PA/CMA/2018/3/Add.2)	Rejected; this is discussed in three paragraphs further down with regard to emission targets, including interpretations of the balance of emissions and removals as stated in the Paris Agreement Article 4.1. We therefore consider it unnecessary and duplicative to also discuss this here, especially given overall word constraints.	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
86207	25	3	25	3	"and hence their cumulative emissions continue to increase" does it really make sense to talk about cumulative emissions when talking about SLCFs?	Taken into account; the fact is that some climate policies do treat CO2-eq emissions of SLCFs similar to CO2 emissions, including in cumulative emissions budgets. The purpose of the text is to demonstrate the consequences of doing so. The text has been edited to further emphasize the limited utility of applying a cumulative emissions concept to SLCF emissions.	Sophie Szopa	LSCE	France
30311	25	5	25	13	Here you use terms like "novel metrics", "new metrics" ect. In the cross chapter box in chapter 2: "recently developed" is used. In our view this shows that using "novel" and "new" on metrics recently described in scientific literature is unfortunate as they are still immature and need further development and consideration before extensively discussed in IPCC reports, besides in WG1 context.	Taken into account. There is some disagreement between reviewers, with this reviewer wanting to emphasize the novel nature and by implication immaturity of these metrics, while another reviewer emphasizes their well-established physical principles and early formulations. To balance these perspectives, we have dropped the label 'novel' and simply make the statement of fact that the key step/pulse metrics assessed here and in WGI have been published since the AR5, without applying a qualitative label regarding their novelty.	Government of Norway	Norwegian Environment Agency	Norway

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
74713	25	5	25	8	CGTP and GWP* are frequently referred to here as "novel" (perhaps to no-to-subtly suggest "dangerous"), but the basic idea of equating a sustained change in emission rate of a short-lived climate pollutant with a pulse emission or removal of a cumulative climate pollutant dates back to Wigley (1998)'s Forcing Equivalent Index, Shine et al (2005)'s GTP_S and Lauder et al (2012)'s mixed metrics. These metrics do not "construct an equivalence..." -- the climate system does. Suggest replace with "So-called "warming-equivalent" emission metrics developed since the AR5, including CGTP (Collins et al, 2019) and GWP* (refs), building on earlier concepts such as Forcing Equivalent Index (Wigley, 1998), GTP_S (Shine et al, 2005), mixed metrics (Lauder et al, 2012) and CO2-forcing-equivalent emissions (Jenkins et al, 2018; Cain et al, 2019; Mengis & Matthews, 2020), exploit the well-established fact that a step-change in the rate of SLCF emissions has a similar impact on global temperature over a broad range of timescales as a one-off pulse emission or removal of CO2. These metrics..."	Taken into account. There is some disagreement between reviewers, with another reviewer wanting to emphasize the novel nature and by implication immaturity of these metrics, while this reviewer emphasizes their well-established physical principles and early formulations. To balance these perspectives, we have dropped the label 'novel' and simply make the statement of fact that the key step/pulse metrics assessed here and in WGI have been published since the AR5, without applying a qualitative label regarding their novelty.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
74719	25	5	25	43	Spending one paragraph (5-13) introducing warming-equivalent emissions metrics, and then three paragraphs (14-43) discussing why you don't like them, seems rather prescriptive. I understand there are IPCC authors who are strongly against anything that might seem like an endorsement of warming-equivalent metrics on the grounds that they might distrupt European-style, Kyoto-vintage climate policies. But this should not preclude a balanced assessment (and it would look very bad indeed for IPCC if it did). I suggest you delete 14-29 entirely, since the whole marginal vs additional distinction is both confused and not supported by the literature. To be honest, it also looks a little hystrionical: when iGTP or dynamic GTP, for example, were introduced, I don't recall multiple paragraphs in IPCC reports devoted to warning of the dangers of "novel metrics", yet introducing a metric that is explicitly time-dependent such as the dynamic GTP could also be highly disruptive (distorting investment flows in anticipation of changing metric values, for example, or inducing abrupt changes in the event of failure to meet a particular target date for peak warming). I suspect some of the motivation for seeking to drive a stake through the heart of warming-equivalent metrics as soon as possible lies in a concern that some people might see the logic, in the design of policies aiming to meet a long-term temperature goal, of using metrics that allow options to be directly compared in terms of their impact on global temperatures. But it should be up to policy-makers whether they wish to make use of this information, not up to IPCC authors to warn them off even considering it.	Rejected. We see no evidence for the bias claimed by the reviewer, and the reviewer provides no specific evidence for this. The text describes the factual key differences between the different metrics, namely that GWP* and CGTP measure temperature CHANGE, relative to the warming from a reference level of emissions in a given reference year, whereas GWP and GTP measure the effect on climate from an emission relative to the absence of that emission. This has important consequences for how these metrics can be applied to inform mitigation choices, which is a core task for WGIII. We don't see the basis for the reviewer's assertion that we 'don't like them'. To guard against any unintended bias we have revised text to further clarify the utility of GWP* and CGTP in predicting temperature change from a time series of SLCF emissions (relative to the warming level when the time series starts); but this temperature change is not the same thing as understanding the climate benefit of avoiding an emission (i.e. the warming that occurs with compared to without this time series of emissions). More recent literature that further discusses this distinction, including the separation of marginal vs additional warming, has been added (but marginal warming is a fundamental concept underpinning studies of the economics of multi-gas mitigation since the 1990s).	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
74725	25	5	25	5	You should also reference CO2-forcing-equiva	Rejected; the emphasis of this assessment is on metrics that were published and used in studies since the AR5, and their implications for mitigation decisions. Given page constraint, we do not see the need to also cover the physical science background and historical development, including the CO2-forcing-equivalence concept developed by Wigley, which are the subject of the assessment by WGI.	Myles Allen	University of Oxford	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
75503	25	5	25	13	Rather than refer to new or novel metrics perhaps describe as metrics which address the disconnect between earlier emissions metrics and the impact of the emission on global warming	Rejected; we feel that this would potentially confuse the motivation and consequence of these metrics. The original design of GWP* and the earlier work by Lauder et al, and CGTP, was simply to recognise the equivalence, in terms of temperature change, between a step-change in SLCF emissions and a one-off CO2 emission, and to design metrics that capture this equivalence and that are therefore less sensitive to the choice of time horizon. The fact that this then results in different temperature outcomes when these metrics are applied to existing emission targets is a consequence of applying these metrics in a specific policy context. This is covered in detail two paras further below.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
24775	25	6	25	6	There is a Smith et al 2021 paper on GWP* which should also be cited (it will be cited in WG1), which will shortly appear in npj Climate and Atmospheric Science.	Accepted and the additional reference has been included	Michelle Cain	cranfield university	United Kingdom (of Great Britain and Northern Ireland)
3809	25	7	25	7	"construct an equivalence" This wording is a bit odd as it is the climate system that constructs the equivalence! Maybe better to say that they "recognise the equivalence, in terms of impact on future temperatures, between …"	Taken into account: the revised text makes clear that a sustained step-change in SLCF emissions is indeed (nearly) equivalent to a one-off CO2 emission in terms of temperature change.	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
29655	25	8	25	13	Quotation "a near-linear relationship between temperature and cumulative CO2-equivalent SLCF emissions" may seems somewhat misleading as SLCFs are not so much cumulative. What the metrics do is to provide a "relationship between a time series of SLCFs and temperature" (and this includes not only emissions but also biogeophysical perturbations). We propose to mention that one of the features with new metrics is how black carbon and other short lived perturbations are included when estimating warming levels	Taken into account , the wording has been revised to avoid the misleading interpretation of 'cumulative SLCF emissions'. GWP* and CGTP have not been applied and quantified for black carbon so we are unable to provide an assessment of this (plus we would consider this to fall into the domain of WGI rather than WGIII).	Government of Norway	Norwegian Environment Agency	Norway
30309	25	8	25	13	It seems somewhat strange that GWP* and CGTP are highlighted as more suitible for calculating the remaining carbon budget, especially since calculations of the remaining carbon budget itself is not itself dependent on choice of metric. Our understanding is that this report uses scenarios when calculating influence from non-CO2 forcers in the carbon budget. Therefore, it is at least important that the text describes that metrics have not been used when calculating the carbon budget and the way short lived climate forcers are included in the carbon budget. Therefore the comparisons between GWP/GTP and GWP*/CGTP is arbitrary since GWP is not commonly used in that way.	Taken into account: we have revised the text to clarify that the metrics are useful to calculate how much the remaining carbon budget would CHANGE for different assumptions about SLCF mitigation.	Government of Norway	Norwegian Environment Agency	Norway
74709	25	9	25	9	Replace CO2-equivalent with CO2-warming-equivalent for consistency with the literature.	Accepted, the term has now been included in relevant text.	Myles Allen	University of Oxford	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
30299	25	10	25	13	The content of this sentence is problematic because it only focuses on the remaining carbon budget , and might be interpretted by the reader as a recommendation from the IPCC for using spesific metric also under other circumstances and applications. In our view this illustrates that the science around new metrics are immature and need further development and consideration before extensively discussed in IPCC reports, besides in WG1 context	Accepted, we have revised the text to make clearer that this is indeed specific to estimating the effect of SLCF mitigation on the remaining carbon budget and does not imply utility for other policy applications.	Government of Norway	Norwegian Environment Agency	Norway
74715	25	10	25	13	It's not clear why this statement is medium confidence: is is supported by multiple lines of evidence from independent research groups and well-understood theory.	We decided to remove the confidence statement as the evaluation of physical performance of metrics falls into the WGI domain. We have revised the text to make clearer that the performance of GWP* in predicting temperature change depends on the smoothness of the SLCF time series, as can be seen in Lynch et al (2020).	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
83463	25	10	25	13	This statement should make the specifics clear first, before making a generalizing statement that can be taken out fo context. Moreover, the literature speaks mainly to methane, and the entire evidence provided in this section speaks to methane. No evidence is provided for other SLCF (which include also aerosols). The generalisation made in this statement and the confidence level thus seems to lack evidence. Suggested edit: "Available studies and this assessment have focussed on methane and the applicability of GWP* and CGTP on other SLCFs is very underexplored. Collectively, these studies therefore provide only low confidence that cumulative CO2-equivalent SLCF emissions expressed using CGTP or GWP* are more closely proportional to their implied global warming than when expressed using GWP or GTP, particularly for scenarios with rapidly falling SLCF emissions. More evidence is available in the literature for methane, leading to medium confidence that the previous statement is true in case of methane specifically."	Taken into account: we have revised the text to make clearer the physical relationships that those metrics address. We decided to remove the confidence statement as the evaluation of physical performance of metrics falls into the WGI domain. We have revised the text to make clearer that the performance of GWP* in predicting temperature change depends on the smoothness of the SLCF time series, as can be seen in Lynch et al (2020), and that GWP* has only been demonstrated for CH4 so far.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
29657	25	12	25	12	It seems like a misunderstanding when the sentence suggests that new metrices are relevant for "particularly methane" since this is of similar relevance also for other SLCFs. Please consider to delete the reference to methane in this sentence.	Taken into account. The reason why our text emphasized methane was twofold; one is that methane is the second-most important GHG and hence of particular relevance for mitigation compared to other SLCFs; the other is that GWP* has only been applied to methane, and while it is conceptually applicable to other forcers as well, its performance for other forcers has not been evaluated quantitatively in the literature as yet. CGTP has been applied to other forcers but its use has only been demonstrated for simple permanent step-changes in emissions. The text has been revised to reflect those reasons more clearly.	Government of Norway	Norwegian Environment Agency	Norway

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
74711	25	14	25	29	This is pure (and rather confusing) assertion, unsupported by the literature: the words marginal and additional are almost synonymous in this context, so it is very unclear what the distinction is supposed to mean. All of these metrics describe the impact of additional emissions: how much warmer the climate would be with, compared to without, a specified emission that occurs in addition to all other past and future emissions. The difference between GWP/GTP and GWP*/CGTP is that the latter allow a "specified emission" to include a sustained constant emission while the first only considers pulse emissions (although note that Shine et al, 2005, also introduced GTP_S on which GWP* and CGTP are based, but this is true of the way GTP is commonly understood as GTP_P).	Rejected. We disagree that 'marginal' and 'additional' are almost synonymous in this context, as is clearly demonstrated in lines 24-29: the marginal effect on warming from CH4 emissions is always positive (every CH4 emission makes Earth warmer than it would be in the absence of that emission), whereas the additional effect can be negative if CH4 emissions are declining sufficiently rapidly. Since every CH4 emission makes the climate warmer than it would be otherwise (and we aassume that the reviewer is not contesting that fact), CGTP and GWP* could not result in negative CO2-warming-equivalent values if they indeed described the marginal effect of those emissions. The concept of marginal warming has also been demonstrated in the literature (Reisinger et al 2021) and is fundamental to economics, including in the context of mitigation, from where this term is borrowed.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
3811	25	16	25	19	This section essentially says that the "GWP describes how much warmer the climate would be with a specified emission" but this is not correct. There is no direct relationship between a pulse emission, its impact on temperature and the GWP. Indeed, as has been shown on several occasions, in tempertaure terms the GWP is more equivalent to a sustained GTP, in terms of measuring the impact on temperature (and that is the root of why GWP values can be used in the GWP*). Maybe a looser wording here would serve a purpose - instead of implying that the GWP tells us directly about warming, you could say "climate effect"?	Accepted and wording modified accordingly.	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
29659	25	16	25	20	The sentence proposes that "GWP and GTP describe the marginal effect of emissions, i.e. how much warmer the climate would be with, compared to without, a specific emission". This perspective might be true if the comparison only considers a single emission species that is, the marginal effect with, compared to without, an emission of CO2). We propose however, that as GWP are used for comparisons across emission species, the quotation is misleading. If the quotation should be valid also across species, it would imply that the marginal effect of an extra emission of CO2 can be equated with an "equivalent" amount of methane. (Or else, the marginal effect of an extra emission of CO2 can be eliminated by the removal of an "equivalent" amount of methane.) However, the marginal effect of additional amounts of CO2 is - as indicated - also additional/cumulative. The marginal effect of an additional amount of methane is, however, not additional/cumulative. The limitations with the quotation and with GWP/GTP can also be demonstrated by considering albedo, as albedo avoids the comparison altogether. It just makes no sense to describe "how much warmer the climate would be with, compared to without, a specific albedo". Rather, albedo fits well within perspectives of additionality as discussed for GWP*	Rejected; the discussion of metrics as stated in the beginning is only for well-mixed GHGs and does not apply to aerosols let alone albedo changes. The text as written is correct for all well-mixed GHGs (every emission of every well-mixed GHG makes Earth warmer than it would be in the absence of that emissions. And it is indeed correct that the effect of an extra emission of CO2 can indeed, in principle, be eliminiated or compensated by a reduction in methane. The fact that this elimination is not perfect at all times is not related to the distinction of marginal vs additonal metrics, but to the cumulative vs non-cumulative nature of gases with different lifetimes. We have revised earlier text to make this clearer, but we consider the text in this paragraph to be robust and correct.	Government of Norway	Norwegian Environment Agency	Norway

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
3801	25	21	25	29	I quite like this discussion of additional versus marginal, but it still misses something, in my view. If I choose to cut my SLCF emissions, I really do reduce the warming relative to the current value. By contrast, if I choose to cut CO2 by the GWP-100 equivalent value I cause additional warming relative to the current value. The CO2-equivalence implied by GWP and GTP is faulty as there is no equivalence in terms of tempertaure outcome. And that is the problem. The GTP (for example), correctly encodes the equivalance of positive emissions of CO2 and SLCFs. However, it doesnt encode the effect of reductions of emissions. You cannot equate the temperature impact of a reduction of SLCFs with a reduction of CO2 emissions. You can only equate it to a removal of CO2 from the atmosphere. I know the authors know this, but I dont think it comes across clearly enough. A further problem is that the nuance of the text is that the "marginal" approach is the preferable one, but this is implied.	Taken into consideration. The reviewer's concern about differentiating CO2 and SLCF effects is related to wanting to distinguish whether past emissions have an on-going effect on climate. But from a mitigation perspective, this is only relevant when it comes to retributive justice, i.e. the extent to which emitters of past emissions should be held accountable for the warming those past emissions continue to cause. The marginal effect is inded the same for both gases, which focuses on the warming from a specified emission only - and CH4 and CO2 are the same in that both cause temperature to be higher than it would have been in the absence of those specified emissions. We trust that revisions to previous paragraphs (incl lines 1-4) have made this clearer; we now say explicitly that reducing SLCF emissions have a near-equivalent effect on climate as a CO2 removal. Regarding the implied message: we do indeed consider that the marginal warming is often more relevant to inform mitigation, as it can tell us what amount of climate change we would avoid by avoiding a given future SLCF emission (which are the only SLCF emissions reductions that policy can influence). We have edited text and added some key references to make that clearer (i.e. more explicit and justified).	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
24777	25	21	25	29	This discussion of marginal and additional does not make sense to me. Is this a new idea, or is there published literature to reference? I would be reassured if some of those involved in the creation of GWP100 had input to this characterisation. The first sentence in this para wrongly implies that GWP* and CGTP only work on a step change that is continuous. This isn't the case, as they are applied to a time series of emissions in WG1.	Taken into account: literature dealing with marginal warming has been included. The concept of marginal effects is a core term of economics as well as in the Social Cost of emissions and some illustrative references have been included. We further revised text to clarify that GWP* can indeed by applied to a variable time series, but CGTP has only been demonstrated for step-changes over specified time periods.	Michelle Cain	cranfield university	United Kingdom (of Great Britain and Northern Ireland)
71169	25	21	25	43	This section should go further in setting out the pros & cons of CGTP and GWP* and, in particular, separate the theoretical benefits for scientific purposes from practical considerations. Would inventory and emissions trading systems based on GWP* be plausible given its mixture of pulses and step change? Is there a way of calculating an individual economic operator's contribution to a 'step change'?	Rejected; while we sympathise with the reviewer's interest, there is almost no literature yet that has thought through how GWP* or CGTP could be used in economic applications or specific policy contexts. We are unable to speculate about the ways this could be done as we are limited to an assessment of the literature.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
74723	25	21	25	21	It should be noted that this similarity results from the coincidence that the time of peak warming is about 40 years away on these scenarios, so GWP100 happens to have approximately the “correct” value right now, but this situation will change rapidly.	Rejected; we are not sure how this comment relates to the text in question, and we consider that this has been stated clearly on the preceding page already.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
81669	25	24	25	29	Really important narrative-suggest ensuring some of it included in the SPM (i.e. on how reducing the total amount of short lived gases released into the atmosphere results in declining global temperatures, which means slcp mitigation could help the world to reach global temperature goals and that we will not need to reduce SLCF to net zero to stabilise global warming (as the gas will naturally be removed from the atmosphere in cycles of a few decades/will not continue to accumulate like CO2 does).	Thank you, this request will be raised with the SPM author team.	Government of New Zealand	Ministry for the Environment	New Zealand

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
74721	25	30	25	33	This sentence is completely opaque: the debate does not centre on "marginal versus additional effects", whatever that distinction means. It focusses on whether the use of warming-equivalent metrics introduces an inbuilt "grandparenting" advantage to established methane emitters, at either country, corporate or individual level.	Taken into consideration. We accept that the existing literature where debate occurred did not use the terminology of marginal vs additional warming, hence we have removed this here and revised this sentence in light of this and other comments.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
74729	25	30	25	35	Given that this whole marginal versus additional distinction seems confused and has no support in the literature, I suggest you replace these lines with something like the following: "The potential application of warming-equivalent emissions such as CGTP, GWP* or CO2-fe emissions, has been contested on three grounds: (i) the additional volatility these metrics introduce to reported emissions; (ii) a perceived “grandparenting” advantage they may appear to give to established emitters, by acknowledging the differential warming impacts of constant versus increasing SLCF emissions; and (iii) inconsistency with pre-defined climate goals (Rogelj and Schleussner, 2019; Schleussner et al, 2020). The problem of volatility reflects the actual impact of SLCF emissions on global temperatures, which has been widely noted (e.g. Shindell et al, 2012): it is alleviated by incorporating a minimum 20-year averaging period into the definition of warming-equivalent emissions (Allen et al, 2018; Cain et al, 2019; Smith et al, 2021). The issue of grandparenting can be addressed by including consideration of historical warming (which is proportional to aggregate CO2-warming-equivalent emissions, Allen et al, 2018, & figure 2.3) in discussions of policy priorities, a point that also applies to CO2 (Cain et al, 2021; Rogelj and Schleussner, 2021). Potential inconsistency of novel metrics with pre-defined climate goals, insofar as these have been designed with specific metrics in mind, would apply to any change to emissions metrics. Adopting GTP, dynamic GTP or any variant of warming-equivalent emissions, but retaining the same numerical CO2-equivalent emissions targets, would result in different climate outcome…" and so on	Taken into consideration. We accept that the existing literature where debate occurred did not use the terminology of marginal vs additional warming, hence we have removed this here, but we did not accept the proposed replacement text as written. Given space constraints we do not expand on the greater volatility of GWP*-based CO2-we emissions and there is no literature that properly evaluates from a policy angle the extent to which this would be a problem or could be a desirable feature (and we do not consider that this is a key point in the debate over GWP* in policy). We expand on the issue of grandparenting, also in response to other review comments, since this is indeed where most of the controversy and misunderstandings seem to lie. The text on the effect of changing metrics has also been revised in light of this and other comments.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
81675	25	30	25	30	Useful if before starting this critique there is an example of where using GWP* would be helpful for policy i.e. it is helpful in providing an accurate warming effect prediction for a specific end point date and all the dates leading up to that date when sustained SLCP emissions (such as methane) are predicted to change in a in a country where they make up a large proportion of the emissions profile. GWP* could help that country to better understand how policy changes for SLCF (i.e. for livestock, waste, or rice production sectors which produce methane) could affect their national contribution to global temperature goals.	Taken into account - revisions to previous paragraphs have made clearer that GWP* can provide information on how warming due to SLCF emissions could decline under declining emissions.	Government of New Zealand	Ministry for the Environment	New Zealand
3803	25	31	25	32	I don’t think it is as clear cut as marginal versus additional. One side of the debate seems to be saying that you should take responsibility for your past SLCF emissions (and therefore additionality is wrong) but not do the same for your past CO2 emissions.	Taken into account. Our assessment is that the arguments made against GWP* do not say that one should take responsibility for past SLCF emissions. There is agreement on the physical science that past SLCF emissions have little effect on future warming (in contrast to CO2). The disagreement is rather whether the fact that past SLCF emissions have caused past warming means that we should therefore ignore the future warming caused by future SLCF emissions of the same magnitude. We have revised the text to make this clearer.	Keith Shine	University of Reading	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
81671	25	31	25	33	Should elaborate on what this equity issue is - i.e. the potential grandfathering issue if use the gwp* findings in xyz way for policy. Also should outline that GWP* is a more involved calculation which requires more data (the literature currently states it requires data from 20 years prior to make the calculation).	Taken into account: we have revised and expanded the text that deals with grandfathering, but we consider that a definitive resolution of the debate evident in the literature has not been provided yet. Details of the GWP* calculation are provided in Annex B.10 - we do not consider its caculation to be so complex as to make this a prohibitive barrier to its use in climate policy in itself.	Government of New Zealand	Ministry for the Environment	New Zealand
83469	25	31	25	33	It would be appropriate to also explain the equity issues in one sentence. For example: "For example, application of the new GWP* and CGTP approaches at a national level runs the risk that historically high emissions of methane and other SLCFs are grandfathered into emissions credits to high historical polluters (Rogelj & Schleussner, 2019)."	Taken into account: we have revised and expanded the text that deals with grandfathering.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
3797	25	35	25	43	The text is technically correct, but that does not mean that "re-evaluation" is neither possible nor desirable (somehow "re-evaluation" comes as loaded with negative connotations, as written). Even using the GWP100 different choices on mitigation pathways could lead to "different peak temperatures" (line 37) as is made clear on page 23 lines 32-34. So the text here seems to read as a specific concern about the GWP* when, in reality, it is a general concern about all metrics. I also think this whole discussion sidesteps the "potentially inadvertant" impact of the evolving nature of the IPCC-recommended values of GWP100 for specific gases. Yet I read of no concern that those values have change quite significantly (more than 25% in the case of methane) over successive ARs even though these would also require a "re-evaluation of existing targets" (an assessment of costs, earlier in this box) in the context of Paris. I think the text needs to try a little bit harder to ensure that criticisms aimed at certain metrtics aren't also relevant to (say) GWP100. I also think the "potentially inadvertant" needs purging. The page 23, line 32-34 text makes it clear that staying with GWP100 also risks potentially-inadvertant outcomes, especially if mitigation of CO2 emissions are substituted for apparently-equivalent reductions of SLCFs emissions.	Taken into account; we added text that makes clear that re-evaluating GHG metrics and policy goals is not a bad thing and would be fully consistent with ensuring climate policy is informed by the best available science. We do disagree that changing metric values necessarily require the same re-evaluation; it would not be wrong of course to do such re-evaluation, but changing metrics themselves (i.e. changing what aspect of climate change we care about) is a different level of change compared to changing the numerical value that reflects our best available knowledge of the quantity we care about. Updating metric values belongs to the latter change, whereas changing from GWP100 to GTP100 or GWP* would be a change in the former. We added the word "fundamentally" to make clearer that such re-evaluation is particularly important where the metric itself might be changed. We have retained the phrase of "potentially inadvertent" changes since we consider this an important aspect of changing GHG metrics (as the debate about GWP100 vs GWP* illustrates).	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
24779	25	35	25	43	As the Paris Agreement does not specify a metric, and doesn't specify what it technically means by 'a balance of sources and sinks' then I do not see how a chnge to the Paris Agreement follows on from a change in metric. The Paris agreement states that 'the best available science' should be used. As an example, should a complete re-evaluation of targets take place when AR6 provides new values for GWP100? Given many countries don't even use AR5 values of GWP100. I do not think you can justify 'very high confidence' to this statement. I don't see a justification for the statement at all - this would be a decision for UNFCCC, not IPCC.	Rejected. A large number of studies have looked at climate outcomes for a given target, if met using different metrics, and they all find that the temperature outcome depends on the metric. So if a target is set on the assumption of one metric and then met using another metric, we have indeed very high confidence that this would change the climate outcome and stated level of ambition, and hence a re-eveluation of targets would be necessary to ensure to avoid this happening implicitly. We agree that Paris does not in itself prescribe a target, but nonetheless when individual country or business targets were set, they were entered into on the assumption or explicit statement of a given metric. It is indeed up to the UNFCCC, countries or companies to change those metrics if they wish, but we need to point out that this would implicitly and potentially inadvertently change climate outcomes.	Michelle Cain	cranfield university	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
83465	25	35	25	35	This important point, is, as far as I am aware, not assessed in WG1 7.6. Please double-check.	This is stated (though not in those exact same words) in WGI 7.6.3 and we feel it is important to re-state this here.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
85753	25	36	25	43	Consider adding a sentence to note that these problems can be avoided by expressing emissions targets by individual gas, or by grouping into baskets unaffected by metric choices (such as long- and short-lived gases). This could be seen as an interpretation of "other metrics" as decided in FCCC/PA/CMA/2018/3/Add.2)	Accepted, a sentence to that effect has been added (also consistent with WGI chapter 7).	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
74717	25	40	25	43	It is assumed here that global emission targets exist that have been formulated explicitly with GWP100 in mind. This is not the case: the Paris Agreement has a long-term temperature goal, but no specific emission target other than the Article 4 provision of "balance" "in the second half of this century" -- in order to meet the long-term temperature goal. It is not clear that only emission targets formulated with GWP100 are consistent with Article 4: indeed, Tanaka and O'Neill, 2018, point out that it is possible to meet the long-term temperature goal of limiting warming to well below 2C without achieving net zero emissions measured by GWP100 before 2100. Schleussner et al (2019) argue for a GWP100-based interpretation of Article 4, but using a limited range of scenarios designed to prove their point (including some rather bizarre ones, such as a scenario in which Article 4 is deemed to be achieved by reaching net zero emissions in a single year followed by an emissions rebound). The advantage of warming-equivalent emissions is that warming peaks when net zero emissions are achieved, so the date of net zero largely determines peak warming (impressively demonstrated by Schleussner et al, 2019, in a figure, 2b, that rather undermines the rest of their argument). Hence there is no inconsistency with interpreting Article 4 in terms of warming-equivalent emissions, since it is not clear how it was intended to be interpreted in the first place, and such an interpretation would be more consistent, not less, with the opening phrase "in order to meet the long-term temperature goal".	Rejected; our text does not claim that global emission targets are formulated explicitly with GWP100 in mind; but GWP100 was the dominant metric when the Paris Agreement was agreed by all countries. It is unambiguous that interpreting Article 4.1 using fundamentally different metrics change the global climate outcome, and hence such a choice would need to involve a re-evaluation of what global climate outcome countries wish to achieve through the Paris Agreement. In addition, many individual country and company targets have been adopted with this metric either implicitly or explicitly in mind. And meeting those same numerical targets but using a different metric would undoubtedly change the climate outcome and ambition of those targets. Such a change may be intentional, but it would be non-transparent and may be inadvertent without explicit consideration, as our text states.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
74731	25	40	25	43	This sentence appears explicitly designed to close down any further discussion of greenhouse gas metrics, which is highly prescriptive. I suggest a more balanced sentence, noting that alternatives to GWP100 may have some utility and their use need not imply wholesale and disruptive replacement: "Rather than simply replacing one emission metric with another, the option of dual reporting, for example of CO2-equivalent emissions using GWP100 to provide continuity and CO2-warming-equivalent emissions to indicate impact on global temperature, could avoid an implicit change to currently stated levels of mitigation ambition while simultaneously supporting stocktakes of progress toward a long-term temperature goal (very high confidence)."	Taken into account. We do not see evidence that the existing text is seeking to close down further discussion of GHG metrics. However, we agree with the reviewer that providiing information on at least the expected contributions of individual gases to existing targets would reduce ambiguity (as also noted in Denison et al 2019, and in the WGI contribution to AR6) and have added a sentence accordingly.	Myles Allen	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
78853	25	40	25	43	I don’t think it is factually correct (and certainly not very high confidence) to say that changing the emission metrics requires a refomulation of existing emission targets. If emission targets are based on IAMs with simple climate models, then GWP-100 would actually require more reformulation of targets than GWP*. Similarly carbon budgets based on TCRE will give a fixed remaining cumulative CO2 emission that is independent of the metric chosen since the SLCF accounting is based on their contribution to radiative forcing - see Rogelj papers.	Rejected - we consider it unambiguous from the cited literature that changing the GHG metric to meet a pre-determined emissions target would change the climate outcome. The text makes clear that a re-evaluation would be necessary if governments wish to ensure that such a change is transparent and intentional (it may well be).	William Collins	University of Reading	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
78855	25	44	26	3	Calling this "best-performing metric" is a value judgment rather than an assesment (I accept this is the phrase Tanaka uses). In Tanaka et al. 2020 the optimum ratio was found to be around 50. So compared to 7 (GTP100) and 84 (GWP20) GWP100 (28) was the closest, but "best-performing" overstates the case.	Taken into account; we have changed the wording to say that GWP100 "performs well enough" from a mitigation perspective. We trust that together with the assessment provided in the earlier parts of this box this choice of wording is justified and traceable.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
3799	25	46	26	3	"made … for consistency" - this is fair enough but it comes with the danger of "inadvertant consensus". Paris uses GWP100, therefore AR6 does, and Paris will see that AR6 uses it and think it is a justification for doing so. For transparency, I believe that at line 1-2, the fair statement "This choice does not constitute a recommendation to use GWP100 for any specific policy application ..." should be modified to be clearer: "This choice does not constitute a recommendation to use GWP100 for any specific policy application, the Paris Agreement included. ...	Rejected; while we see the rationale for actively going against the "inadvertent consensus" we consider that the wording proposed by the reviewer would be policy prescriptive since the use of GWP100 is a choice that countries have already made. We have modified the wording elsewhere in this para to further reduce the sense of endorsement that the reviewer may be concerned about.	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
78857	26	1	26	3	I agree that using a value of around 28 is not an innappropriate ratio to use in a cost-effectiveness methane mitigation perspective, but that is not the same as saying that in a more general sense that 1 kg of methane emission is equivalent to 28 kg of CO2, for instance as used in the first ES point.	Taken into consideration and raised with the chapter 2 author team as a whole to ensure that the notion of "GWP100 works well enough from a cost-effectiveness perspective" is not represented as "1 tonne of emission of CH4 can be regarded as equivalent to 28 tonnes of CO2".	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
83467	26	1	26	3	This can be written in a more neutral fashion: "This choice does not constitute a recommendation to use GWP100 for specific policy applications as the most appropriate choice depends on the policy goal and technical use of the metric."	Taken into account; we don't see a large difference between formulations but we consider ours more appropriate since there is no single policy application where we consider that IPCC is in a position to recommend use of GWP100 (or any other metric).	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
84117	26	1	26	3	I agree that using a value of around 28 is not an innappropriate ratio to use in a cost-effectiveness methane mitigation perspective. The phrasing of this paragraph seems to suggest in a more general sense that GWP100 is "best-perfoming" and therefore methane emissions can be equated to CO2-eq - for instance in the first two ES points in this chapter that don't relate to mitigation strategies.	Taken into account; we have revised the wording to tone down the "best performing" expression in response to another comment from the same reviewer. We will also raise with the chapter 2 author team the representation of GWP in the chapter as a whole, including its executive summary.	William Collins	University of Reading	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
80601	26	4	26	11	The decision to report emissions and mitigation options for individual gases in their original units (as in Figure 2.4b) adds transparency. Additional consideration of co-emissions would provide additional relevant information to decision makers. (The only mention of "co-emission" in Chapter 2 is on 2-33 line 8 in the context only of short-lived climate forcers.) As described in Dreyfus et al. (in preparation), this ignores the well-known correlation between coal combustion and co-emission of CO2, SO2, and black carbon (e.g., Hayhoe et al., 2002; Wigley, 2011). When this relationship was considered by Feijoo et al. (2019), they observed near-term warming and a significant deviation from the established transient carbon response relationship. How do the different metrics discussed in this box address (or not) the issue of co-emission and impacts on near-term warming identified in the literature? CITATIONS: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Hayhoe K., Kheshgi H.S., Jain A.K., & Wuebbles D.J. (2002) Substitution of Natural Gas for Coal: Climatic Effects of Utility Sector Emissions, Climatic Change 54(1): 107–139. Accessed at https://doi.org/10.1023/A:1015737505552. ("Using the electric utility sector as an example, changes in emissions of CO2, CH4, SO2, and BC resulting from the replacement of coal by natural gas are evaluated, and their modeled net effect on global mean-annual temperature calculated. Coal-to-gas substitution initially produces higher temperatures relative to continued coal use. This warming is due to reduced SO2 emissions and possible increases in CH4 emissions, and can last from 1 to 30 years, depending on the sulfur controls assumed. This is followed by a net decrease in temperature relative to continued coal use, resulting from lower emissions of CO2 and BC."). See also Wigley T.M.L. (2011) Coal to gas: the influence of methane leakage, Climatic Change 108(3): 601. Accessed at https://doi.org/10.1007/s10584-011-0217-3. 607 ("In summary, our results show that the substitution of gas for coal as an energy source results in increased rather than decreased global warming for many decades — out to the mid 22nd century for the 10% leakage case. This is in accord with Hayhoe et al. (2002) and with the less well established claims of Howarth et al. (2011) who base their analysis on Global Warming Potentials rather than direct modeling of the climate. Our results are critically sensitive to the assumed leakage rate. In our analysis, the warming results from two effects: the reduction in SO2 emissions that occurs due to reduced coal combustion; and the potentially greater leakage of methane that accompanies new gas production relative to coal. The first effect is in accord with Hayhoe et al. In Hayhoe et al., however, the methane effect is in the opposite direction to our result (albeit very small). This is because our analyses use more recent information on gas leakage from coal mines and gas production, with greater leakage from the latter. The effect of methane leakage from gas production in our analyses is, nevertheless, small and less than implied by Howarth et al."). Feijoo F., Mignone B.K., Kheshgi H.S., Hartin C., McJeon H., & Edmonds J. (2019) Climate and carbon budget implications of linked future changes in CO2 and non-CO2 forcing, Environmental Research Letters 14(4): 044007. Accessed at http://iopscience.iop.org/article/10.1088/1748-9326/ab08a9/meta	Comment not relevant to text	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
80745	26	4	26	11	The decision to report emissions and mitigation options for individual gases in their original units (as in Figure 2.4b) adds transparency. Additional consideration of co-emissions would provide additional relevant information to decision makers. (The only mention of "co-emission" in Chapter 2 is on 2-33 line 8 in the context only of short-lived climate forcers.) As described in Dreyfus et al. (in preparation), this ignores the well-known correlation between coal combustion and co-emission of CO2, SO2, and black carbon (e.g., Hayhoe et al., 2002; Wigley, 2011). When this relationship was considered by Feijoo et al. (2019), they observed near-term warming and a significant deviation from the established transient carbon response relationship. How do the different metrics discussed in this box address (or not) the issue of co-emission and impacts on near-term warming identified in the literature? CITATIONS: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Hayhoe K., Kheshgi H.S., Jain A.K., & Wuebbles D.J. (2002) Substitution of Natural Gas for Coal: Climatic Effects of Utility Sector Emissions, Climatic Change 54(1): 107–139. Accessed at https://doi.org/10.1023/A:1015737505552. ("Using the electric utility sector as an example, changes in emissions of CO2, CH4, SO2, and BC resulting from the replacement of coal by natural gas are evaluated, and their modeled net effect on global mean-annual temperature calculated. Coal-to-gas substitution initially produces higher temperatures relative to continued coal use. This warming is due to reduced SO2 emissions and possible increases in CH4 emissions, and can last from 1 to 30 years, depending on the sulfur controls assumed. This is followed by a net decrease in temperature relative to continued coal use, resulting from lower emissions of CO2 and BC."). See also Wigley T.M.L. (2011) Coal to gas: the influence of methane leakage, Climatic Change 108(3): 601. Accessed at https://doi.org/10.1007/s10584-011-0217-3. 607 ("In summary, our results show that the substitution of gas for coal as an energy source results in increased rather than decreased global warming for many decades — out to the mid 22nd century for the 10% leakage case. This is in accord with Hayhoe et al. (2002) and with the less well established claims of Howarth et al. (2011) who base their analysis on Global Warming Potentials rather than direct modeling of the climate. Our results are critically sensitive to the assumed leakage rate. In our analysis, the warming results from two effects: the reduction in SO2 emissions that occurs due to reduced coal combustion; and the potentially greater leakage of methane that accompanies new gas production relative to coal. The first effect is in accord with Hayhoe et al. In Hayhoe et al., however, the methane effect is in the opposite direction to our result (albeit very small). This is because our analyses use more recent information on gas leakage from coal mines and gas production, with greater leakage from the latter. The effect of methane leakage from gas production in our analyses is, nevertheless, small and less than implied by Howarth et al."). Feijoo F., Mignone B.K., Kheshgi H.S., Hartin C., McJeon H., & Edmonds J. (2019) Climate and carbon budget implications of linked future changes in CO2 and non-CO2 forcing, Environmental Research Letters 14(4): 044007. Accessed at http://iopscience.iop.org/article/10.1088/1748-9326/ab08a9/meta	Comment not relevant to text	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
81673	26	4	26	11	Really important narrative - suggest include in the SPM - also suggest referencing the LCA literature regarding the importance of publishing the data on the different GHG (and not just showing the GWP100 value), and the benefits of using more than one GHG metric as a counterpoint/show the impact of different time horizons and gases i.e. UNEP 2016 Global Guidance on LCA indicators Vol 1 pages 58 – 73 (and particularly pg 70)	Taken into account; the treatment of GHG metrics as part of the SPM will be raised with the SPM author team. Discussion of LCA is too detailed for this box and the relevant statements are already part of the GHG metric discussion in Annex B.10.	Government of New Zealand	Ministry for the Environment	New Zealand
84121	26	4	26	7	The policy to report "emissions and mitigation options for individual gases where possible", is a welcome transparent strategy. However in nearly all (all?) instances in this chapter the individual gases emissions are not reported as mass of gas, but converted to CO2-eq.	Taken into account; the authors of this box have finite influence over the way authors of other chapters report emissions and mitigation options. The TSU has re-iterated the guidance to all chapters to report individual gases wherever possible.	William Collins	University of Reading	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
20589	26	11	26	12	We suggest inserting a new paragraph along these lines: Ultimately, as noted in [SOD WGI §7.6.3] and earlier in AR5, it remains a matter for policy-makers to decide which metric to use because they have the social licence to make the normative judgements regarding timescale, variable choice and functional form that underpin emission metric choice. Whatever the metric chosen, ensuring that disaggregated information on different greenhouse gas and other climate forcers is available in the development of policy and tracking of emissions will enable alternative assessments to be made using other metrics when so desired. Furthermore, irrespective of the choice of metrics, limiting the increase in global average temperature to well under 2°C or to 1.5°C will require reaching net-zero CO2 emissions in the coming decades and deep reductions in other greenhouse forcers, including short-lived climate forcers such as methane or black carbon	Rejected; we consider that this information is already stated transparently in this box, and this box did not assess mitigation pathways in detail (which is provided in chapter 3).	Government of France	Ministère de la Transition écologique et solidaire	France
3813	26	15	26	15	"different future target years" perhaps add "or alternatively emissions in later years for a given target year" since you discuss the dynamic-GTP quite extensively.	Accepted and added	Keith Shine	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
85919	26	16	26	17	Suggest clarification is needed: The values for fossil methane exceed those for biogenic methane because fossil methane also adds CO2 to the atmosphere upon its decay." The major decay pathway for methane, whether fossil or biogenic, is reaction with hydroxyl radicals in the atmosphere. This text seems to suggest this set of reactions produces different products for fossil methane than for biogenic methane.	Taken into account: to limit the length of this caption, we refer readers to the WGI assessment for this and other details.	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
15207	26	21	34	5	It is suggested to add the discussion of greenhouse gas emissions per capita at the global level.	Noted. We went forth and back on this suggestion. Our main focus on per capita emission levels is in the section on regional emission trends and drivers, where this seems most useful. Nevertheless, we have added a result figure in the online supplementary material, where we flag per capita emission trends by gases. We also discuss per capita emissions in the section on regional emissions trends.	Government of China	China Meteorological Administration	China

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
75657	26	21	32	37	The draft text fails to report the recent unexpected and extraordinary increase in global methane levels, an event not foreseen by the AR5 report nor by the models undergirding the Paris Climate Agreement. As such, this increase is a particular salient development that should be highlighted in Chapter 2. Saunois et al 2016 report that "Unlike CO2, atmospheric methane concentrations are rising faster than at any time in the past two decades and, since 2014, are now approaching the most greenhouse-gas-intensive scenarios….Additional attention is urgently needed to quantify and reduce methane emissions. Methane mitigation offers rapid climate benefits and economic, health and agricultural co-benefits that are highly complementary to CO2 mitigation." Jackson et al 2020 report that "Increased emissions from both the agriculture and waste sector and the fossil fuel sector are likely the dominant cause of this global increase highlighting the need for stronger mitigation in both areas. Our analysis also highlights emission increases in agriculture, waste, and fossil fuel sectors from southern and southeastern Asia, including China, as well as increases in the fossil fuel sector in the United States." Starting in 1990s, the growth in global methane levels began to slow down, and global methane became relatively stable over the period of 2000-2006. A resurgence of global methane was not anticipated and came as a surprise (Nisbet et al., 2019. Turner, Frankenberg, and Kort, 2019. Underwood, 2019.) Crucially, methane levels were considered stable in the pathway models prepared for the Paris Climate Agreement (Nisbet et al., 2019). Nevertheless, global methane levels resumed rapid growth starting in 2007. Growth accelerated further starting in 2014 and extending through 2018 (Nisbet et al., 2019. Turner, Frankenberg, and Kort, 2019. Underwood, 2019). This exceptional growth appears to have continued in 2020 NOAA Earth System Research Laboratory Global Monitoring Division. https://esrl.noaa.gov/gmd/ccgg/trends_ch4/. The two biggest 1-year jumps over the last 20 years occurred in 2014 and 2015, when the resurgence in global methane that began in 2007 accelerated even further. The most recent six years has recorded the five biggest jumps over the last 20 years. The sustained growth of the last six years was last observed in the 1980s when the Soviet Union's gas industry was developing very rapidly and methane emissions were thought to be poorly controlled (Nisbet et al., 2019). The durability of this emerging trend was questioned at first, and years of rapid growth were seen as anomalies (Turner, Frankenberg, and Kort, 2019). However, the period of resumed growth in global methane levels now stands at 13 years (2007-2019) compared to the 7-year period of stable methane levels (2000-2006). And preliminary data from 2020 indicates that the trend of extraordinarily high growth now stands at 6 years. In this light the era of stable global methane levels is increasingly seen as the anomaly, and growth in global methane seen as the resumption of a long-standing pattern (Turner Frankenberg, and Kort, 2019). This emerging consensus is highlighted in two recent high-profile papers published in 2019 representing the consensus views of a large array of experts in the field (Nisbet et al, 2019. Turner, Frankenberg, and Kort, 2019. Underwood, 2019). The threat posed by this resumption in methane growth is dramatic. A group of 23 scientists reported "Thus even if anthropogenic CO2 emissions are successfully constrained to a RCP2.6-like pathway, the unexpected and sustained current rise in methane may so greatly overwhelm all progress from the other reduction efforts that the Paris Agreement will fail."(Nisbet et al, 2019) Drivers in the category of increased emissions include emissions from intensive agricultural practices, emissions from oil and gas operations, and increased emissions from wetlands responding to global warming. A significant number studies	There are different aspects to this answer. First, we have taken a cross-gas perspective. In this regard we flag that F-gases show the second largest absolute increases, but relative increases are comparatively modest as other gases have grown faster. Second, we still highlight the absolute increases from methane - also in the ES - TS and SPM. We also stress that levels are unprecedented. Third, there is an importanmt differences with N2O in terms of anthropogenic and natural contributions, which can lead to differences in concentration trends and anthropogenic emissions trends.	Cutting Hunter	Climate Nexus	United States of America
75657	26	21	32	37					
72451	26	24	26	24	It is puzzling that none of the Table or Figure mentionned do actually show the slowdown in the "rate of emissions growth". A much more efficient way of showing this would be to draw the variations of the rate of emissions growth between the various time periods (e.g. decades or yearly) considered. This could also help in summarizing the subsenquent text where individual yearly rate of emissions growth are given.	Noted. This would be one way. We ultimately decided to add the growth rates in the Figure. In the SPM we add a little table with that information.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
8079	27	1	27	7	Table 2.5: Please correct: the sector AFOLU comprises more than forestry and other land use. Where are the emissions from agriculture attributed to?	We have clarified our language on CO2 from LULUCF vs GHGs from AFOLU. Definitions have been added that should address the concerns raused here.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
24889	27	1	27	6	Please add "The AFOLU CO2 estimates in this table are not necessarily comparable with country GHG inventories (see Chapter 7)".	Accepted. We added a caveat sentence to each of the figure and table captions for clarity.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
30455	27	1	27	7	CH4 should be removed, is discussed in next section. Paragraph is very difficult to read with too many acronyms.	Rejected. This paragraph discusses the contribution of each gas, so we cannot remove CH4. We assume that this comment actually refers to a different part of the text.	Steven Smith	PNNL/JGCRI	United States of America
30457	27	1	27	7	Looks like categories are not harmonized between CEDS and EDGAR. I suspect AWB on fields is included in EDGAR, it should probably be removed - then categories would be comparable.	We do not know which table this comment refers to.	Steven Smith	PNNL/JGCRI	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
54651	27	1			In Table 2.5, the CO2 AFOLU has 5.4 +/- 2.7 repeated twice.	We updated the data to 2019 anyway. No longer the case.	Government of United States of America	U.S. Department of State	United States of America
84119	27	1	27	16	This table and discussion would be much more informative if the absolute emissions for CH4 and N2O were stated, rather than multiplying by GWP-100. The previous page indeeds says "The WGIII contribution to the AR6 reports emissions and mitigation options for individual gases where possible".	Rejected. As we also want to report total GHG in this table, it would be confusing for the reader not to have gases reported in GWP-100 values. Converting back is simple (except for f-gases).	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
53353	27	8	27	9	"This is higher than at and point in human history before (medium confidence)". Please consider adding a reference. This is an important point.	Accepted. We have added a reference, but also modified the language to make it consistent with a high confidence statement.	Florin Vladu	UNFCCC Secretariat	Germany
18037	27	13	27	13	It was unclear to me where the values 3.7 and 5.9 Gt came from, they do not seem to relate to the numbers in the table, I would have calculated '7 of the 9 Gt' rather than '3.7 of the 5.9 Gt'.	Noted. These numbers indeed does not come from the table, but we also do not claim it.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
18039	27	15	27	16	Please consider including the absolute change rather than just the percentage change. If this is done then it is shows that the absolute increase grew but the percentage increase fell.	Accepted. We added the absolute number as well. We use much clearer language now so that it should not be confusing anymore.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
489	27			11	Check the emissions of 1990 (38) is different from the emissions in the table (39)	Accepted. Thanks for noticing.	Kim Hana	KAIST	Republic of Korea
16089	27			11	Check the emissions of 1990 (38) is different from the emissions in the table (39)	Accepted. Thanks for noticing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
80593	27				What species are included under “Fluorinated gases”? Are CFC/HCFC/halons included? As shown in Figure 2 of Velders et al. (2007), emissions of CFCs and other ozone depleting substances in between 1970 and 1990 reached over 9 GtCO2e in GWP100 terms. Including CFC/HCFC/halons in the average annual GHG emissions from 1990–1999 would increase from 40±4.0 to approximately 44.8 GtCO2eq (GWP-100), based on calculations using NOAA and AGAGE data in addition to EDGAR v5. Citation: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Velders G.J.M., Andersen S.O., Daniel J.S., Fahey D.W., & McFarland M. (2007) The importance of the Montreal Protocol in protecting climate, Proceedings of the National Academy of Sciences 104(12): 4814–4819. Accessed at http://www.pnas.org/cgi/doi/10.1073/pnas.0610328104	We list the species in the supplemtary material to the chapter and have added a reference to the respective table. We focus on what is commonly covered in GHG emission inventories: HFCs, PFCs, SF6 and NF3. However, we note prominently the exclusion of CFCs and HCFCs in the new section on f-gases and include a figure that cover their development over time. Which f-gases are included is now prominently highlighted at the beginning of the section.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
80737	27				What species are included under “Fluorinated gases”? Are CFC/HCFC/halons included? As shown in Figure 2 of Velders et al. (2007), emissions of CFCs and other ozone depleting substances in between 1970 and 1990 reached over 9 GtCO2e in GWP100 terms. Including CFC/HCFC/halons in the average annual GHG emissions from 1990–1999 would increase from 40±4.0 to approximately 44.8 GtCO2eq (GWP-100), based on calculations using NOAA and AGAGE data in addition to EDGAR v5. Citation: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation). Velders G.J.M., Andersen S.O., Daniel J.S., Fahey D.W., & McFarland M. (2007) The importance of the Montreal Protocol in protecting climate, Proceedings of the National Academy of Sciences 104(12): 4814–4819. Accessed at http://www.pnas.org/cgi/doi/10.1073/pnas.0610328104	We list the species in the supplemtary material to the chapter and have added a reference to the respective table. We focus on what is commonly covered in GHG emission inventories: HFCs, PFCs, SF6 and NF3. However, we note prominently the exclusion of CFCs and HCFCs in the new section on f-gases and include a figure that cover their development over time. Which f-gases are included is now prominently highlighted at the beginning of the section.	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
18041	28	1	28	1	Consider using the Y-axis grid lines 0.8,1.0, 1.2, 1.4,1.6 as the 1.0 value is of particular interest.	Accepted. Highlighted the value of 1 in the new version of the figure	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
18043	28	1	28	1	Please consider including an F-gas plot as well to complete the picture as their importance is increasing.	Accepted. We added f-gases	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
30459	28	1	28	1	While this statement is true, it is misleading. It is true for individual measures, but in aggregate, air pollution control will always increase climate forcing (because the net effect of air pollutants is warming, see WG I),which is a critical point. The health impacts of air pollution are enormous, and there are not likely to be that many "tradeoffs" here - history indicates that the near-term priority will be to improve air quality as much as possible in highly polluted regions.	This parz is not about air pollution. We cannot answer this comment.	Steven Smith	PNNL/JGCRI	United States of America
72531	28	1	28	11	I see Figure 2.4 (a) includes Fgas, but there's no corresponding uncertainty estimates of Fgas in Figure 2.4 (b).	Accepted. We added an f-gas inset.	Yun Hang	Emory University	United States of America
75513	28	1	28	11	Can a figure showing the actual mass of GHG in Gt Yr-1 be included. This is what matters and it would avoid the complexity apparent in the waterfall diagram.	There is a large interest in aggregated numbers. We decided to report the main table in CO2eq units. We added a figure in the supplementary material to the chapter, where we report in mass units.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75515	28	1	28	11	Can fossil metahne be highlighed in this chart as is done for CO2. As indicated policies that address methane are significantly different depending on the sources.	Rejected. While we appreciate the issue we cannot show this level of detail here.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
75517	28	1	28	11	The "waterfall diagram" highlights a problem with a changing metric. This is difficult for policy including on key ares such as determination of net-zero, GHG balance, and scales of negtaive emissions required. Are there options to address this?	It is important to note that the impact of metric changes could be seen as exaggerated as we focus on a single year. Overall, the trends will not change significantly when a metric is changed. Only solution to solve this problem is not to use an emissions metric. For net zero discussions other metrics like GWP* are more suitable (see cross-chapter box). Given the multiple dimensions relevant in working group III such as time, sectors, gases, regions, using a metric is often the only way of presenting information concisely in this report.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
84123	28	1	28	1	Figure 2.4, panel a: The variation between WG I AR reports should not be used as any indication of the uncertainty in the emission metrics. The uncertainties are specifically assessed in these reports and are of the order of 30%. However the wider point is that the larger uncertainty is in which metric to use. For instance the use of GTP100, GWP100 and GWP20 as in Tanaka et al. 2020 would give a much clearer illustration of how the different fractions depend on metric choice.	Noted. We do not use this Figure to discuss uncertainties in emissions metrics - rather as an indication how GWP-100 has been changing - as previous reports have used other GWP values. We mainly use this figure also to explain differences in CO2eq values reported in AR5. But we have also added a paragraph on uncertainties in metrics in the uncertainties section as well as the supplementary material.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
84125	28	1	28	1	Figure 2.4, panel: The percentages here are not useful as they only apply to a very specific metric, they don't account for the uncertainty in that metric ~ 30% and don't account for the uncertainty in using different metrics. The contribution from methane would only be 5% using GTP100 or would be ~ 50% using GWP20.	Noted. We clarify the challenges with metrics in the cross-chapter box. We also acknowledge this in the main substance, where we show warming using a simple climate model. It is important to keep the focus on changing GWP-100 values here as the metric is used in national GHG emissions reporting and in previous WG3 reports.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
85921	28	1	28	11	Comments on Figure 2.4: (1) Consider adding data for fluorinated gases to subplot b since emissions of fluorinated gases are increasing rapidly and now account for around 3% of global GHG emissions. A separate y-axis with a different scale may be needed. (2) The title above subplot a reads "trends in global greenhouse gas emissions and the impact of alternative GWP metrics." It is not clear how subplot a shows the impact of alternative GWP metrics. According to the figure caption the second, fifth, and sixth assessment reports all used the same metric (GWP-100). (3) It is stated that the error bars show 90% confidence intervals. Do the shaded regions in subplot b also show 90% confidence intervals? Please clarify. (4) In subplot b it would be useful to state what the units are. Are the graphs really 'normalised' to 1990; or 'referenced' to 1990. Also note misspelling of 'normalised'	Accepted. We added an inset on F-gases. Yes, this is the 90% confidence intervals for the respective estimates. It is not necessary to describe the units, because of the normalization procedure. Both from native and CO2eq units, the same trajectory would be derived.	Government of Australia	Department of Industry, Science, Energy and Resources	Australia
24891	28	2	28	10	Please add "The AFOLU CO2 estimates in this figure are not necessarily comparable with country GHG inventories (see Chapter 7)".	Noted. We add this discussion in the main text as well as Figure 2.2.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
53355	28	2	28	3	Clarify that AFOLU refers to net emissions or mention "GHG emissions and removals" in line 2.	Accepted. We now refer to CO2-LULUCF rather than CO2-AFOLU in line with Working Group 1.	Florin Vladu	UNFCCC Secretariat	Germany
84127	28	12	28	21	The fact that the total CO2-eq emissions vary depending on the precise value of the metric used is an excellent illustration of why this is not a very useful quantity! It is so much more instructive to quote the individual gases in their original masses.	Noted. It is always a difficult balance to strike and there are very different demands both from the scientific and policy community. Working Group III has to report in a variety of dimensions including gases, time, sectors, regions. This can only be done concisely using metrics. This is also in line with national GHG emissions reporting under the UNFCCC and wide parts of the WGIII literature.	William Collins	University of Reading	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
75519	28	17	28	21	How has this calculation impacted on the actual emissions of CH4 and N20 that occurred?	It does not impact the actual emissions in native units. However, it is important to establish transparency for report users why values in AR5 and AR6 might be different in terms of CO2eq. We acknowledge the challenges with using a common unit for multi-gas emissions baskets.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
75521	28	17	28	21	What message is provided to policy by this? Can this be stated clearly?	This comment has no specific policy focus other than establishing transparency across IPCC reports. We further improved the language.	Government of Ireland	Department of Communications, Climate Action and Environment, Climate Mitigation and Awareness Division	Ireland
18045	28	19	28	19	I assume 'nitrous dioxide' should be 'nitrous oxide' otherwise more discussion is required.	Absolutely. Thanks. Corrected.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
18047	28	23	29	25	Please consider giving the absolute values in CO2eq as well as the percentages.	Accepted. Added absolute numbers	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
54653	28	24	29	2	Emissions of CFCs and HCFCs are not included in the F-gas total, despite being long-lived fluorinated GHGs. If these gases were included, the emission total would be approximately two times larger than 1.8 Gt CO2-eq (Montreal protocol's 2018 Ozone Assessment) and the relative increases quote for F-gases in the text would be reduced. If emissions from CFCs and HCFCs were considered on their own, they would allow the point that emissions of some classes of GHGs have decreased in recent years.	Accepted. We make transparent throughout the chapter was is included in our estimates. We now also explicitly highlight that a substantial share of F-gas emissions is not reported in the previous section on uncertainties.	Government of United States of America	U.S. Department of State	United States of America
53357	28	25	29	1	Regarding the growth of fluoride gases it is important clarifying if Montreal gases are included or not	Accepted. We do that at various places of the chapter now.	Florin Vladu	UNFCCC Secretariat	Germany
80595	28				It appears that AR6 WGIII authors have relied on the AR5 WGIII approach to generate figure 2.4 on trends in total anthropogenic GHG emissions 1990-2018. However, this approach appears to repeat the omission of CFC/HCFC/halons and non-methane tropospheric ozone. What is the rationale for omitting these anthropogenic GHG emissions? As described in the forthcoming paper by Dreyfus et al., when these species are included, non-CO2 GHG contribution in 1990 increases to 42% as in the table below in CO2e AR5 GWP100. Citation: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation).	Noted. We make transparent throughout the chapter was is included in our estimates. We now also explicitly highlight that a substantial share of F-gas emissions is not reported.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
80739	28				It appears that AR6 WGIII authors have relied on the AR5 WGIII approach to generate figure 2.4 on trends in total anthropogenic GHG emissions 1990-2018. However, this approach appears to repeat the omission of CFC/HCFC/halons and non-methane tropospheric ozone. What is the rationale for omitting these anthropogenic GHG emissions? As described in the forthcoming paper by Dreyfus et al., when these species are included, non-CO2 GHG contribution in 1990 increases to 42% as in the table below in CO2e AR5 GWP100. Citation: Dreyfus G.B., Y. Xu, S. O. Andersen, N. Borgford-Parnell, D. Shindell, V. Ramanathan, G. Velders, D. Zaelke (in preparation).	Noted. We make transparent throughout the chapter was is included in our estimates. We now also explicitly highlight that a substantial share of F-gas emissions is not reported.	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
24893	29	2	29	6	It could be also noted that the trend for CO2 AFOLU reported here is in contrast with the one from country GHGIs (see Chapter 7, fig 7.5). I would not suggest that one trend is corrent and the other one is wrong, but the difference is wroth noting.	Noted. We added some text earlier on in the chapter that refers to the different methods. CO2-LULUCF is so uncertain that I would not be comfortable to state anything about a trend. We refer to chapter 7 and liaised with the chapter team to ensure consistency.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
20177	29	23	29	38	Please 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.	Accepted. We added the recent literature that was not available at the time of the submission of the Second Order Draft.	Nikas Alexandros	National Technical University of Athens	Greece
63463	29	26	29	27	it would be useful to acknowledge that near-term impacts are also uncertain due to the uncertainty of the pandemic, including uncertainty on future nearterm lockdown restrictions"	Accepted. We have reworded this carefully.	Government of Canada	Environment and Climate Change Canada	Canada
18049	29	37	29	37	Paris-compatible carbon budgets' is vague please specify both the 1.5 and 2 degree C budgets for clarity.	Accepted. Key point here are not so much the carbon budgets than limiting warming well below 2°C. This is much clearer.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
25111	29	37	29	38	Is the year missing in this sentence? Assume it is 2020?	Accepted. We added 2020 and changed the language in a way that reflects the new date that has become available in the meantime.	Minal Pathak	WGIII TSU, Ahmedabad University	India
30643	29	37	29	37	It would be better to explain "Paris-compatible carbon budgets" more .	We removed most of the language and speak now more directly about specific temperature goals.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
54655	29	37	29	38	Make clear that the statement refers to 2020 only, if true.	Accepted and done.	Government of United States of America	U.S. Department of State	United States of America
72533	30	1	30	2	Figure 2.5 is so cool, especially the COVID-19 part that provides a natural experiment for testing carbo emission. I am wondering is there any new data available now to show trends after 2020 June? Besides that, I would suggest to move the second figure of panel one to panel two that focuses on carbon emissions during COVID-19.	Accepted. We have updated the data to cover the enitre year and also added other data sources.	Yun Hang	Emory University	United States of America
43255	30	2	30	7	The sheet that indicates daily global emission and indicates transport, does it refer to public and private?	References is made to the transportation sector as a whole - as elsewhere in the section.	Government of Chile	Ministry of Environment	Chile
54657	30	2	30	7	In Figure 2.5, if possible, it would be great to include related information for AFOLU even though the time step might be different. It's a critcal mitigation pathway that is currently absent from this figure that includes many other pathways.	Rejected. There is no similar data available for AFOLU as far as I am aware of.	Government of United States of America	U.S. Department of State	United States of America
4927	30	19	30	21	The meaning of the sentence at lines 19-20 has been repeated at lines 20-21. Delete one or the other sentence	Accepted and corrected.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
54659	30	19	30	20	The point of the sentence is repeated twice.	Accepted and corrected.	Government of United States of America	U.S. Department of State	United States of America
78305	30	19	31	12	Remaing carbon budget discussions here coudk be problematic and need cohrence with Chapter 3 and WG I. The uncertainty ranges quoted do not reflect the full range which includes further uncertainties not amenabel to a formal statistical treatment, (WG I Ch 5).	Noted. We highlight scenario uncertainties hier to reflect different mixes of GHG emissions. We cite final carbon budgets numbers from WG1, but use information from WG3 scenarios in most of the rest of the chapter.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
83035	30	19	31	12	The enormous uncertainties in the WG1 carbon budget calculations and the many substantial changes in the WG1 methodology (between SR1.5 and AR6) might warrant to avoid the countdown language used here	Noted. We have focussed this discussion further and mainly undertake a simple comparison between carbon budget nubers and historical emissions.	Geden Oliver	German Institute for International and Security Affairs	Germany
83479	30	19	31	28	Ensure to update with latest remaining carbon budget assessment from WG1 Ch5.	Accepted. And done	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
27565	30	20	30	21	Delete "Between 1850 and 2018 total cumulative CO2 emissions FFI and AFOLU were 2400±390 GtCO2.", it is a repetition to previous sentence.	Accepted. Done - we deleted one of the sentences.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
63465	30	23	30	23	change "than" to "as"?	Accepted	Government of Canada	Environment and Climate Change Canada	Canada
27567	30	29	30	31	The "current NDC trajectories" incorporate the new and updated NDCs of Parties submitted at the end of 2020? This needs to be clarified.	We deleted the sentence.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
18051	31	2	31	3	Unclear what the statement 'a 2 degrees C budget is not binding' means.	Noted. We removed most of this language as well as the relevant element in the figure.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
54661	31	3	31	3	What is meant by "not binding" here?	Noted. We removed most of this language as well as the relevant element in the figure.	Government of United States of America	U.S. Department of State	United States of America
18053	31	5	31	5	For clarity please add '2% and 5% of the 2018 level are 2067 and 2038'	We removed this language and the respective part of the figure.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
54663	31	5	31	5	The sentence on this line does not appear to be complete.	We removed this language.	Government of United States of America	U.S. Department of State	United States of America
18055	31	7	31	7	Meeting the carbon 'budget' - it is not clear which budget is being discussed, it also depends on what % reduction is made each year. Please can this be made explicit e.g. 'Meeting the 1.5 degrees C budget with a 2% or a 5% annual reduction of the 2018 levels or a 2 degrees C budget with a 2% reduction of the 2018 level will require .... '	We removed this language and the respective part of the figure.	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
71171	31	13	31	14	Please introduce a dotted line for the year 1990 in Panel a), since this is referred to in Panel b).	Accepted.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
83481	31	13	31	28	Ensure to update with latest remaining carbon budget assessment from WG1 Ch5.	Accepted.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
78307	31	14	31	17	Overshoot is a temperature metric not a cumulative emissions metric	Language in the chapter and panel has been removed.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
24895	31	15	31	27	Please add "The AFOLU CO2 estimates in this figure are not necessarily comparable with country GHG inventories (see Chapter 7)".	Rejected. We flag this earlier on in te chapter as well as in the new figure 2.2. We do not need to add this to all figures showing CO2-LULUCF.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
43043	31	28		29	This is a significant risk: “Despite reduced emissions growth for the period 2010-2018 compared to the previous decade, CO2 emissions still track rather at the mid-to upper range of baseline scenarios across the various IPCC mitigation scenario ensembles.”	I am not sure what the suggestion made by this reviewer comment is.	Graeme Taylor	BEST Futures	Australia
18057	31	29	31	29	Please consider changing this statement. In terms of absolute numbers there has been an increase in growth.	Rejected. Here we are talking about how scenarios compare to historical evidence. Changes in growth have already been discussed before.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
299	32	5	32	5	The reference Forster et al., 2020 refers to chapter 7 of AR6 WGI, but the emission of SLCFs is addressed in chapter 6.	Accepted. The chapter 7 reference is added.	Sandro Fuzzi	ISAC CNR	Italy
76381	32	9	32	9	Here something is missing or does not make any sense	Accepted. Thanks. We clarified the sentence.	Emilio Sessa	Carbon Credits Consulting	Italy
78309	32	9	32	24	The implications of this across WGs are significant and need further engagement with WG I.	Noted.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
301	32	15	32	48	Tall this summary does not report any reference for the reported statements, which does not seem a correct procedure according to the IPCC principles.	Noted. This section mainly provides some descriptive data from inventories as a handshale with WG1 AR6 report. SLCFs and the related literature are not core for this chapter and engaged with in chapter 6 of WG1. We make this clear now.	Sandro Fuzzi	ISAC CNR	Italy
64933	32	15	32	24	SSP narratives are not introduced. Refer to chapter 1 box 1.1?	Noted.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
72535	32	24	32	25	It's very hard to read Figure 2.7 one page 32. I would suggest to split them into two panels.	Rejected. We need a space efficient figure here.	Yun Hang	Emory University	United States of America
491	32		19	23	This part is repeated. So it would be good for authors to remove it.	Accepted. We streamlined the paragraph.	Kim Hana	KAIST	Republic of Korea
16091	32		19	23	This part is repeated. So it would be good for authors to remove it.	Accepted. We streamlined the paragraph.	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
53361	33	0	33	0	It should be helpful to mention at a given point which SLCFs are reported to UNFCCC and which ones are estimated as CO2eq, either directly (CH4) or indirectly and partially(NMVOC, CO, etc.)	Rejected. This is beyond the scope of this brief treatment here.	Florin Vladu	UNFCCC Secretariat	Germany
54665	33	1			Are biomass burning emissions considered in Figure 2.8? Assuming it isn't, a graph should be included showing the trend in biomass burning emissions. The narrative description of Figure 2.8 should be extended significantly, considering that this is the only place non-GHG emissions are discussed in this chapter. Recommend giving more background information as to why certain emissions change. What regions in the world and which sources are responsible? So far the paragraph only describes what is visualized in the figure but does not explain why those changes are happening.	This section mainly serves as a handshake for the in-depth WG1 assessment on the topic. As such we keep it brief and descriptive.	Government of United States of America	U.S. Department of State	United States of America
84129	33	1	33	48	This section needs to reference WG I chapter 6. This needs checking to ensure it is consistent with WG I text.	Accepted.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
86211	33	1	34	6	The trends in SLCFs emissions are discussed inWG1 Chapter 6 (6.2.1) (and CEDS is discussed against more recent observations of trends) and trends in abundances are discussed in 6.3, please check consistency.	Noted. We ppoint the reader to discussions in chapter 6 now.	Sophie Szopa	LSCE	France
86209	33	4	33	5	The assessement of the effect of emissions of SLCFs on temperature is done in WG1 Chapter 6 (section 6.4.2), please add this reference.	Accepted. We point the reader to chapter 6 and refer to the Figure in this section on warming contributions contributed by authorrs from WG1.	Sophie Szopa	LSCE	France
12671	33	6	33	7	Add wildfire to this list of short-lived emissions sources: "...co-emitted during combustion processes in power plants, cars, trucks, airplanes, but also during wildfires and from household activities such as traditional cooking with open biomass burning..."	Accepted	Donald Falk	University of Arizona	United States of America
86129	33	8	33	9	Important' may raise questions abotu why not in most of the Figures and data – rephrase / clarify implications?	Accepted. We have rephrased the respective text passage.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
80621	33	9	33	11	Note the recent study by Vohra et al. (2021) explicitly linking premature mortality to particulate pollution from the combustion of fossil fuels. Vohra K., Vodonos A., Schwartz J., Marais E.A., Sulprizio M.P., & Mickley L.J. (2021) Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem, Environmental Research 110754. Accessed at https://www.sciencedirect.com/science/article/pii/S0013935121000487. ("We estimated a total global annual burden premature mortality due to fossil fuel combustion in 2012 of 10.2 million (95% CI: -47.1 to 17.0 million)."). Note also evidence linking particulate pollution to higher risk of mortality from COVID-19, e.g. Pozzer A., Dominici F., Haines A., Witt C., Münzel T., & Lelieveld J. (2020) Regional and global contributions of air pollution to risk of death from COVID-19, Cardiovascular Research. Accessed at http://academic.oup.com/cardiovascres/advance-article/doi/10.1093/cvr/cvaa288/5940460.	We added the Vohra reference, but the Pozzer et al. is too specific for the genral purposes here.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
80765	33	9	33	11	Note the recent study by Vohra et al. (2021) explicitly linking premature mortality to particulate pollution from the combustion of fossil fuels. Vohra K., Vodonos A., Schwartz J., Marais E.A., Sulprizio M.P., & Mickley L.J. (2021) Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem, Environmental Research 110754. Accessed at https://www.sciencedirect.com/science/article/pii/S0013935121000487. ("We estimated a total global annual burden premature mortality due to fossil fuel combustion in 2012 of 10.2 million (95% CI: -47.1 to 17.0 million)."). Note also evidence linking particulate pollution to higher risk of mortality from COVID-19, e.g. Pozzer A., Dominici F., Haines A., Witt C., Münzel T., & Lelieveld J. (2020) Regional and global contributions of air pollution to risk of death from COVID-19, Cardiovascular Research. Accessed at http://academic.oup.com/cardiovascres/advance-article/doi/10.1093/cvr/cvaa288/5940460.	We added the Vohra reference, but the Pozzer et al. is too specific for the genral purposes here.	Gabrielle Dreyfus	Institute for Governance & Sustainable Development	United States of America
30461	33	15	33	26	There is a confusing shift here from discussing the impact of air pollution on climate (which is large) to talking about the impact of air pollutant control measures on GHG emissions (which is small). Separate these.	Accepted. We altered the text.	Steven Smith	PNNL/JGCRI	United States of America
30463	33	15	33	26	This paragraph needs to be re-written. Emissions out to 2019 are highly uncertain for these species and the statements here are presented as too definitive. The largest source of BC emissions is residential biofuels and diesel road vehicles and there is not driver data for either of these out to 2019 (and both are uncertain, particularly biofuel consumption.). OC emissions are not being reduced to control ozone. CH4 should probably be removed from this section (is discussed above). Expectations about future NMVOC trends are not appropriate here, particularly given the very large uncertainty and possible underestimates of NMVOC emissions in current inventories (e.g., Volatile chemical products emerging as largest petrochemical source of urban organic emissions, McDonald etal 2018). There are few NH3 control measures anywhere, including much of the developed world.	Accepted. We have toned down the language.	Steven Smith	PNNL/JGCRI	United States of America
30465	33	15	33	26	the statement here about industrial BC needs to be more cautious. Only EDGAR shows such as large contribution from industry. This is not the case in either CEDS or GAINS (which are largely independent estimates of BC/OC emissions.)	Accepted. We have adjusted the text accordingly.	Steven Smith	PNNL/JGCRI	United States of America
65055	33	15	33	26	The term "rich world" should be avoided and rephrased. The whole paragraph needs revision. It describes first the trends in Europe and North America and then it mentions "global" but the transition to global is unclear. The text doesn't speak exactly to what is being presented in Figure 2.8 which is in fact showing two emissions estimates with different trends of the changes in the last 5 year, e.g. for CH4. The text and Figure 2.8 need to be reconciled. Reference (now missing) should also be made to Figure 2.8.	Accepted.	Valentin Foltescu	Climate and Clean Air Coalition Secretariat, UNEP	India
25113	33	17	33	17	Would you consider an alternative for 'rich world'? Developed countries?	Accepted. We avoid this term now.	Minal Pathak	WGIII TSU, Ahmedabad University	India
25115	33	17	33	19	Would it be worth adding that 'however levels of Nox and BC and have increased in a number of developing countries'	We rather tried to condense the text.	Minal Pathak	WGIII TSU, Ahmedabad University	India
54667	33	17	33	17	Is "rich" a technical term? It seems vague. Is there a better choice?	Accepted. We avoid this term now.	Government of United States of America	U.S. Department of State	United States of America
54669	33	22	33	24	There are indications of NMVOC decreases since the 1980s on hemispheric to global scales, based on global atmospheric concentration data, glacial snow-pack data (firn-air), and in apparent contradiction to the EDGAR emission trends.	Accepted. We acknowledge uncertainties in inventories now.	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
54671	33	26			"The third category highlights NH3, which still shows a strong climbing trend from the AFOLU sectors since there are relatively few control measures in place in the developing world." The reason NH3 emissions are increasing, while most other SLCF emissions are not, is because NH3 emissions are linked to population growths due to its direct link to food production, via animal husbandry and fertilizer use.	Noted. We have streamlined the text a lot. NH3 is no longer discussed.	Government of United States of America	U.S. Department of State	United States of America
30467	33	27	33	48	Here and elsewhere chapter authors should harmonizing language. The terms developed/developing are not used so often in the literature now as they are static, can be considered pejorative, and overly broad.	We had to remove this part for space reasons.	Steven Smith	PNNL/JGCRI	United States of America
54673	33	27			Many acronyms need to be defined at first use: APC, LAM, AME, etc.	We had to remove this part for space reasons.	Government of United States of America	U.S. Department of State	United States of America
64935	33	27	33	48	define acronyms (APC, LAM, AME, DEV, EEA etc…)	We had to remove this part for space reasons.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
71173	33	27	33	29	Please write out the Region abbreviations when mentioned the first time, now it's difficult for the reader to follow.	We had to remove this part for space reasons.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
493	33		6	28	Capitalization. Short-Lived Climate Forcers, abbreviations for regions need to be articulated before using. (APC(Asia Pacific). This kind of reginal discussion needs to be placed in the following sub-chapter(2.2.3)	We had to remove this part for space reasons.	Kim Hana	KAIST	Republic of Korea
16093	33		6	28	Capitalization. Short-Lived Climate Forcers, abbreviations for regions need to be articulated before using. (APC(Asia Pacific). This kind of reginal discussion needs to be placed in the following sub-chapter(2.2.3)	We had to remove this part for space reasons.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
53363	34	0	34	0	Please consider adding information on the comparison between CH4 emission trends from EDGAR and reporting by Parties to the UNFCCC.	We had to remove this part for space reasons.	Florin Vladu	UNFCCC Secretariat	Germany
30469	34	1	34	5	CH4 should be removed, is discussed in next section. Paragraph is very difficult to read with too many acronyms.	We kept it in for comprehensiveness.	Steven Smith	PNNL/JGCRI	United States of America
72537	34	1	34	2	Could you please add year index to the first panel of Figure 2.8? It looks like SO2 estimates are very different between EDGAR and CEDS. It would be helpful if there's a dashed line in the figures of second panel indicates year of 2015.	We believe that the index works fine.	Yun Hang	Emory University	United States of America
61571	34	6	39	6	In the text and the figures in this section 'Africa and the Middle East' are lumped together as a region. It is requested to report Africa seperately from the Middle East. This is the approach taken in section 2.4.2. These regions are not comparable as a whole as they are drastically different environments, economies, emissions, mitigation potential. By lumping them together Africa is unfairly seen as a more significant emitter than in reality.	Accepted. Following the new region categorisation provided by the TSU, we now split Africa and Middle East in the highest level (6 region categorisation).	Kent Buchanan	Department of Environmental Forestry and Fisheries	South Africa
72453	34	6			Section 2.2.3 would gain in having a reflexion based on average GHG emission growth per capita. It would be much more significant than comparing countries as China and Australia or Germany have extremly different population sizes.In Figure 2.9, having such a diagram equivalent to those in panels b) to e) would have a very important graphic impact as well. Showing that China and India have the highest absolute GHG emission growth is indeed an information but as these 2 countries represent more than 1/3 of the world population, it would be interesting to compare them to other less populated countries.	Rejected. We think that country-comparable growth rate information is already provided concisely in panel b of Figure 2.10, which shows average annual GHG emissions growth. In this depiction, large population countries are juxtaposed with smaller population countries, e.g. Australia, Korea, Canada. (Due to space constraints, we cannot include all countries here.) Since we already provide a single year snapshot of per capita emissions in panel d, we think a further depiction of per capita emissions growth rates would add only marginal information to the plot - while adding significantly to its size.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
86131	34	6			Might be good to have some coordination with Chapter 1 on this section, as that has some complementary data, notably in Figures 1.3 (whcih we aim to develop to include al gases) and 1.6. Since the amount of data one could potentially report is almost unlimited it would help to decide what are the main messages to be illuminated?	Noted, thanks.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
86133	34	6			From my own background knowledge, I think two of the most important insights are (a) per-capita GHG emissions tend to grow along with basic industrialisation, up to income levels of around $10k/cap by when most countries have established basic infrastructure; and (b) the relationship at higher income levels has become much more diverse and varied with even rich countries (?? and consumers??) at very different emission levels for the same wealth per capita. But beyond Fig.1.6, I am not sure we have the data in AR6 to really illustrate whether thats right.	Noted, thanks.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
3241	34	12	34	25	There are no references to the source of the information presented here. Please, add. (it is only about SLCFs right?)	Accepted. We now reference the data used in every figure. Please also note that the data used in the text is introduced already in section 2.2.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
54675	34	12	34	25	This paragraph about the geographic distribution of emission trends is a little uneven. There is emphasis on small contributions, but no mention of Europe or the US. Also, on line 19, it's not clear which region is being referred to, Eastern Europe or West-Central Asia?	Accepted. We had originally excluded Developed Countries and Eastern Europe and West-Central Asia (which is a single regions, defined by the TSU) from this paragraph, because they had reduced emissions since 1990 (contributing a negative change to global emissions growth). But following this comment, we introduce them again with the sentence: "Two regions, Developed Countries, and Eastern Europe and West-Central Asia, reduced emissions overall since 1990, by -1.6 GtCO2eq and -0.8 GtCO2eq, respectively. However, emissions in the latter region started to grow again since 2010, contributing to 5% of the global GHG emissions change (0.3 GtCO2eq)."	Government of United States of America	U.S. Department of State	United States of America
37521	34	21	34	25	A historical perspective of GHG emission trends is missing in the section. The section only captures 2010-18 and briefly 1990-2010. It would be useful to give which countries have contributed to emission trends starting 1850 for a 10-20 years time slices each. Discussion starts with the statement that regional contributions have shifted since 1990s and developing countries have increased their share of emissions since 2000. This is 'telling the half truth'. Full truth should be stated. Please clearly bring out the role of countries/ group of countries in emission trends from historical past to present. At each stage of development what was the emission behaviour of economies in the past, should be clearly put forth.	Accepted. Thanks for this comment. We address it with a new figure (figure 2.10) and associated text, which shows different perspectives on equity and responsibility, both for the latest year (2019), and a long historical time series (1850-2019). In particular we higlight the role of least developed countries in contributing to cumulative emissions.	Government of India	Ministry of Environment, Forests and Climate Change	India
27569	34	23	34	25	Delete "Still, two countries (China, India) contributed more than 60% to the net increase in GHG emissions during 2010-2018, while ten countries (China, India, Russian Federation, Indonesia, Iran, Saudi Arabia, Brazil, Korean Republic, Canada) jointly contributed about 85%.", as the paragraph is on regional analysis.	Rejected. We keep this text, as the paragraph is on growth trends, from both regional and national perspectives (as also reflected in Figure 2.9)	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
37509	34	23	34	25	China's contribution to the increase during this period is still the largest and should be mentioned seperately. The scale of increase is very different in case of China and India as well.	Accepted. Thanks. We change to highlight the individual contributions of each country.	Government of India	Ministry of Environment, Forests and Climate Change	India

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
43507	34	25	34	25	Please add "United States" after Canada. (https://www.ucsusa.org/resources/each-countrys-share-co2-emissions)	Rejected. This sentence refers to countries which contributed to a net increase in GHG emissions (2010-2018). Since the United States had a small net decrease over the same period, it is not included. It does, however, have one of the largest GHG emissions per capita, as shown in Figure 2.9.	sadegh zeyaeyan	Head of national center for forecasting and weather hazards management of Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
50413	34	25	34	25	Please add "United States" after Canada. (https://www.ucsusa.org/resources/each-countrys-share-co2-emissions)	Rejected. This sentence refers to countries which contributed to a net increase in GHG emissions (2010-2018). Since the United States had a small net decrease over the same period, it is not included. It does, however, have one of the largest GHG emissions per capita, as shown in Figure 2.9.	Government of Iran	Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
54677	35	7	35	7	Adding "and also have" before "many" would improve the readability of this sentence.	Accepted. Thanks.	Government of United States of America	U.S. Department of State	United States of America
27571	35	10	35	16	Is the analysis presented in the paragraph considering impacts of COVID-19?	No - the analysis presented is for the time period 2010-2019, which does precludes the COVID-19 events of 2020. We present text and a figure on COVID-19 in section 2.2.2.1 instead.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
3243	35	22	35	23	That is not only because of the collapse of the Soviet Union, but as well some measures in energy effectiveness. It is not correct to mark total reductions only to the economy depression after Soviet Union. Please, correct.	Accepted. Good point, thanks. We have removed this text. In addition, we rename these countries to "former members of the Eastern Bloc"	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
5077	35	22	35	23	Why was the Soviet Union collapse responsible for the largest share of cumulative GHG emissions?j	We have deleted this text following an update in the analysis (specifically, countries with steep reductions in the 1990s, but increases in the 2010s were excluded, such as the Russian Federation).	Lina Hollender	n/a	Germany
495	35		10	16	This paragraph does not fully capture the contents of the figure 2.10. SDG dimensions (sanitations etc.) need to be articulated.	This figure has been removed following other comments and replaced with a new figure showing different perspectives on equity and responsibility.	Kim Hana	KAIST	Republic of Korea
16095	35		10	16	This paragraph does not fully capture the contents of the figure 2.10. SDG dimensions (sanitations etc.) need to be articulated.	This figure has been removed following other comments and replaced with a new figure showing different perspectives on equity and responsibility.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
15209	36	1	36	1	It is suggested to replace Fig. 2.9 c with the change in emission intensity.	Rejected. Thanks for this suggestion. We chose instead to keep panel 2.9c, as it directly supports text in section 2.2.3 on contributions to net increases in GHG emissions since 2010.	Government of China	China Meteorological Administration	China
72539	36	1	36	2	I would suggest to reduce the font size of Figure 2.9 (a), and make its label colors darker, especially for yellow and green.	Accepted. Thanks for this suggestion. Please note the figure will be professionally re-drawn for the final report, with standardised font sizes and colouring.	Yun Hang	Emory University	United States of America
54679	36	2	36	10	Caption of Figure 2-9 needs to clarify which gases or classes of GHGs are included in these totals.	Accepted. Thanks for this suggestion. We add the following text to the caption: "LULUCF CO2 emissions are included in panel a, based on the average of three bookkeeping models (see data explanation in section 2.2 introduction), but are excluded in panels b to e due to a lack of regional resolution."	Government of United States of America	U.S. Department of State	United States of America
74789	36	2	36	10	Grouping of Africa and Middle east is misleading to African Policy makers. we therefore strongly suggest that Africa e separated from middle east in the regional trends and in the per capita emissions diagram/figure indicating level of Africa emission. The grouping of countires should follow UN regional categorizaton to enable policy makers correctly visualize and make informed decisions.	Accepted. Thanks for this comment. As suggested, and following the new regional categorisation provided for WG3 by the TSU, we split Africa from Middle East in the highest level (6 region) aggregation. The relevant section text has been changed throughout.	Government of Kenya	Kenya Meteorological Service	Kenya

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
86135	36	5	36	8	Consider separating top panel as a separate Figure? I think this very interesting – perhaps could be framed and illustrated in terms of the „E20“ – highest emitters? Consider separating the top panel (possibly it coudl be paired with Fig 2.4?) so as to have a separate focus of data on the „E20“ or whatever emitters?	Rejected. We prefer to keep the regional perspective and top emitters in the same figure as these are complementary perspectives.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
18059	36	15	37	15	In Fig 2.10a are the 6 groups the same as the 6 groups in Fig 2.9a? Does not say in Fig 2.10a what countires they are.	This figure has been removed following other comments and replaced with a new figure showing different perspectives on equity and responsibility.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
27573	36		36		Figure 2.9 to present land-use emissions as for international aviation and shipping.	Rejected. We prefer to incorporate land-use emissions within regions for the top panel of this figure (as is currently the case). The highly diverging regional contributions to global land-use emissions are an important justification for this (shown in SOD Figure 2.14).	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
43393	36		36		The graphs (panels) "b" and "c" on this page are misleading. This is because the annual growth rate of a country's emissions may be high, but its emissions are small compared to large emitters especially historically. In addition, for example, a 100 percent increase in emissions from low-emitted countries could be equivalent to a 10 percent increase in emissions from high-emitted countries. So these graphs need to be modified to reflect the role of countries in greenhouse gas emissions during the post-industrial revolution and rank countries accordingly.	Rejected. Thanks, this is an important issue. For this very reason, we have included panels d and e, which show emissions relative to population and GDP, respectively. This allows the reader to contextualise e.g. the average and absolute growth rate of India (panels b + c), with its low current per capita emissions (panel d). Further, we now show additional perspectives on current and historical contributions to global emissions in Figure 2.10.	sadegh zeyaeyan	Head of national center for forecasting and weather hazards management of Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
43395	36		36		The gragh (panel) "e" should be deleted, because the index used depends on the value of the national currency (exchange rate) and cannot be used as a basis for comparing and ranking countries. Unless GDP statistics are used in terms of "US Dollars purchasing power parity (PPP)".	Rejected. The GDP data is constant international purchasing power parity (PPP, USD 2011), as suggested by the reviewer. Therefore we keep this panel in its current format.	sadegh zeyaeyan	Head of national center for forecasting and weather hazards management of Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
50299	36		36		The graphs (panels) "b" and "c" on this page are misleading. This is because the annual growth rate of a country's emissions may be high, but its emissions are small compared to large emitters especially historically. In addition, for example, a 100 percent increase in emissions from low-emitted countries could be equivalent to a 10 percent increase in emissions from high-emitted countries. So these graphs need to be modified to reflect the role of countries in greenhouse gas emissions during the post-industrial revolution and rank countries accordingly.	Rejected. Thanks, this is an important issue. For this very reason, we have included panels d and e, which show emissions relative to population and GDP, respectively. This allows the reader to contextualise e.g. the average and absolute growth rate of India (panels b + c), with its low current per capita emissions (panel d). Further, we now show additional perspectives on current and historical contributions to global emissions in Figure 2.10.	Government of Iran	Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
50301	36		36		The gragh (panel) "e" should be deleted, because the index used depends on the value of the national currency (exchange rate) and cannot be used as a basis for comparing and ranking countries. Unless GDP statistics are used in terms of "US Dollars purchasing power parity (PPP)".	Rejected. The GDP data is constant international purchasing power parity (PPP, USD 2011), as suggested by the reviewer. Therefore we keep this panel in its current format.	Government of Iran	Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
71175	36		36		"Developed countries" should not be classified as a region.	Rejected. We follow the region categorisation provided by the IPCC Technical Support Unit and Buraeu and are unable to recategorise these countries, or rename the region.	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
20369	37	1	37	1	I do not understand the units in panel a. Are they really a logarithm of national CO2 emissions per year? If so, please present them without the logarithm (as it makes interpreting the magnitude much harder), but just using log scale in the figure. Why I can't find the rapid rise of emissions in China since 2000? I'd expect that to be visible in group 6, if I interpret the figure correctly. Panel b doesn't display any units, so it's impossible to interpret what the figures mean. Are these percentages?	Following this round of review, we have decided to remove this figure.	Tommi Ekholm	Finnish Meteorological Institute	Finland
54681	37	1	37	5	Figure 2.10 seems important but it is very hard to understand, panel B in particular. What is ppp? What is the x-axis? What's the relationship of different GDP to emissions? The figure either needs to be better explaiend or modified, probably both.	Following this round of review, we have decided to remove this figure.	Government of United States of America	U.S. Department of State	United States of America
64937	37	1	37	4	Figure 2.10 is difficult to interpret as country names in different groups are not provided. The log scale in upper panel gives a false impression of the data	Following this round of review, we have decided to remove this figure.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
71177	37	1	37	4	In Figure 2.10 the headings for the regions are missing. Please replace numbers with Region names. Now it's unclear what the 1-6 numbers refer to.	Following this round of review, we have decided to remove this figure.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72541	37	1	37	1	Missing "0" in Figure 2.10 (a)?	Following this round of review, we have decided to remove this figure.	Yun Hang	Emory University	United States of America
54683	37	2	37	4	The caption for Figure 2.10 is not adequate for such a complicated figure. Some of the units on the graphs don't make sense. For example, panel b shows population and the title says it is "fraction of global population". Not sure from the title whether the other quantities are also fractions of global total values.	Following this round of review, we have decided to remove this figure.	Government of United States of America	U.S. Department of State	United States of America
20371	38	1	38	1	This is a simple, clear and interesting figure. Please indicate what is the limit between "short-term" and "long-term" emissions decline, i.e. the difference between groups 1 and 2? For Macedonia, please note the new name: North Macedonia.	Following this round of review, we have decided to remove this figure.	Tommi Ekholm	Finnish Meteorological Institute	Finland
45769	38	1	38	8	Fig. 2.11 We assume the red line is the fitted trend line. Please add to caption. Some of the trend lines in nonlinear behaviour after peak CO2 don't seem meaningful (e.g. Albania). Please explain.	Following this round of review, we have decided to remove this figure.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
61095	38	1	38	8	Figure 2.11: The Group I countries: (countries that only recently peaked in emissions following a period of growth). It is not clear why 'since peak year' is taken as reference. Have the emissions in these countries really peaked and will not come back? How IPCC asessed this? Also, Some countries in this group have shown a net increasing trend in emissions since 1990 e.g Cyprus, Ireland, Portugal, Spain and the USA.	Following this round of review, we have decided to remove this figure.	LOKESH CHANDRA DUBE	TERI School of Advanced Studies	India
84131	38	1	38	1	What units are these graphs in? If they are GWP-100 weighed that needs to be stated.	Following this round of review, we have decided to remove this figure.	William Collins	University of Reading	United Kingdom (of Great Britain and Northern Ireland)
86137	38	1			Fascinating data; it woudl also be interesting if can find a way to flag if possible how many of these accepted [reduction?] targets under the Kyoto Protocol.	Following this round of review, we have decided to remove this figure.	Michael Grubb	UCL - Institute of Sustainable Resources	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
20535	38	2	38	2	This is an interesting and valuable graphic, but it raises a question about the scale on the vertical axis that is presumably different for each box	Following this round of review, we have decided to remove this figure.	Government of France	Ministère de la Transition écologique et solidaire	France
54685	38	2	38	8	Figure would be more informative if maximum emission value was included for each country (in parentheses along with the % decline perhaps) and an indication in the caption of how the scaling in the plot was applied. Some consistency in display seems important lest equal declines be visualized differently (e.g., compare the apparent size of decline in the UK to that in the US).	Following this round of review, we have decided to remove this figure.	Government of United States of America	U.S. Department of State	United States of America
6109	38				In terms of demonstrating decoupling, Fig. 2.11 can be deceiving since it only plots emissions over time (but not against GDP). For example, Spain's emissions appear to peak around 2007 and then uptick towards the end of the period (2014 so?). Of course, Spain's GDP per capita fell steadily from 2007-2013 (and then increased slightly from 2014-2015). So, Spain's emissions and GDP may still be moving in concert—i.e., no decoupling—and thus, the emissions decline may be only temporary. I believe the same may be said of Portugal. Further, for many of the former-Soviet/East-Europe countries, the after-1990, more recent (e.g., from 2000) trend appears either positive, e.g., Albania, Azerbaijan, Kyrgyz Rep., Georgia, Tajikistan or flat, e.g., Belarus, Latvia, Lithuania, Poland, Russia.	Following this round of review, we have decided to remove this figure.	brantley liddle	independent consultant	United States of America
71179	38		38		Emissions are not "declining" in all of these countries. In some cases they are flat or even increasing, butare below the level of a few decades ago.	Following this round of review, we have decided to remove this figure.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
61097	39	1	39	6	Historical GHG emissions growth rates' is given for the period 2010-18 which is not 'histirial' but 'recent'. Narrative should be corrected. True Historical growth rates should also be included for the period 1850-2018.	Accepted. Thanks, a good point. We change the figure caption to "Recent average annual GHG emissions changes of countries (left panel) versus rates of reduction in 1.5 and 2 degree mitigation scenarios". However, it is not possible to add a much longer time period of 1850-2018, as the purpose of the figure is to contrast recent efforts to reduce emissions with the scale of effort required to achieve climate goals of different stringency. We show a new figure with a longer historical perspective now in Figure 2.10.	LOKESH CHANDRA DUBE	TERI School of Advanced Studies	India
49695	39	8	40	8	Indirect emissions by transport should also cover the total petroleum well-to-refinery emissions and emissions caused by the crude oil extraction. Or is this covered under another sector? See here: https://www.chalmers.se/en/departments/see/news/Pages/Crude-oil-carbon-footprint.asp	Rejected. A full well-to-refinery accounting of transport emissions is out of scope for chapter 2, which aims to cover direct, indirect and consumption-based emissions across all sectors. Please check instead the transport chapter (Ch 10).	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
27575	39	9	39	11	The presented shares add up to 101. Please revise. (also for Figure 2.14).	Accepted, and fixed. Thanks.	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
79417	39	9	39	31	This section drastically underestimates the GHG emissions from "buildings" and should be revised accordingly. Currently, the setion states emissions of buildings as being 6%, or 13% if considering scope 2 emissions. However, the annual "Global Status Report for Buildings and Construction", issued by UNEP and the Global Alliance for Buildings and Construction (GABC), specifically investigates the share of GHG emissions from buildings (residential and non-residential). In the 2019 report (analysing 2018 emissions) the authors found direct emissions to be 6% for residential buildings (similar to the current SOA draft states) plus another 3% for non-residential buildings, and further indirect emissions of 11% for residential and 8% for non-residential buildings, respectively. The study furthermore shows that in 2018 11% of global GHG emissions are attributed to the "construction sector", hence again related to buildings construction and opertation. Overall, this drastically changes the picture as it shows the importance of building construction and operation in being responsible for a staggering 39% of global GHG emissions in 2018! [See: Figure 2 in Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme (2019): 2019 global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector. https://www.worldgbc.org/sites/default/files/2019%20Global%20Status%20Report%20for%20Buildings%20and%20Construction.pdf)	Rejected. Thanks for raising this point. It is risky to compare fractions of global emissions, as the cited report may have a different composition of total global emissions (e.g. excluding land-use CO2), as well as different global warming potentials (GWPs) applied to the underlying gases. However, when we look at Figure 8 in the cited report, the totals for direct and indirect emissions in the buildings sector are the same as ours (~9.8 GtCO2 in 2018). This is expected, as the cited data in the report (IEA) is also used to construct EDGAR, which we use here. Regarding the additional construction related emissions, this is out of scope for chapter 2 and is dealt with in chapter 9. Indeed this changes the contribution of the buildings sector substantially (while reducing that of the industry sector).	Martin Röck	KU Leuven	Austria
27577	39	17	39	18	Ensure consistency with data presented in Figure 1.13.	Accepted, thanks. Ch2 is coordinating with Ch1 on this figure to share the data and region aggregation.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
51595	39	28	39	30	"Overall, some of the fastest growing sources of sub-sector emissions from 2010 to 2018 have been international aviation (+2.7%)" Why refer to "international" aviation only and exclude domestic flights? The growth of emissions from the whole sector is even larger : Chapter 10, p. 60 lines 7-8, says the growth of CO2 emissions of aviation for the period 2010-2018 was about 4% per year.	Accepted, thanks. We now include figures for both international and domestic aviation, which indeed are the two fastest growing sub-sectors according to the latest data we have.	eric lombard	Stay Grounded	France
85359	39	28	39	28	Missing a reference to the source of data used.	Accepted. Thanks. Our primary data source for this section is noted at the beginning of 2.2. However we now reference the data in every figure and bring further references into the text.	Neil Dickson	ICAO	Canada
9537	39				Sectoral GHG emission trends: there is not an analysis or reference to farming trends/contribution and the different between intensive and extensive practices.	Rejected. Thanks. This is out of scope for chapter 2, which deals with overall global, national and sectoral trends. Please refer to the AFOLU chapter (Ch7)	Blanca Casares Guillén	EfecTo TP	Spain
71181	39		39		"Developed countries" should not be classified as a region.	Rejected. Thanks. We follow the region categorisation provided by the IPCC Technical Support Unit and Buraeu and are unable to recategorise these countries, or rename the region.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
3245	40	1	41	7	Please highlight the Waste sector more clearly	Our figure design has changed somewhat and subsectors are no longer visually represented. However, the newest version of our data and this figure indicate that waste is 3.9% of global emissions. This is indicated in the figure.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
64939	40	1	40	1	typo : top left panel "heath" instead of "heat"	Accepted and fixed, thanks.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
71183	40	1	40	8	In Figure 2.13 the unit in the Figure is given as Gt CO2, but in the Figure caption below you refer to GHG emissions -so I guess the unit here should be Gt CO2eq?	Accepted and fixed, 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
86139	40	1			My comment to SPM on this Fig: If possible define Other Energy, and Industry, on the chart itself? AND – surprised that cement is not more, pls confirm if this includes process emissions	Regarding cement, the totals refer to process emissions only and sum to 1.45 Gt CO2 in 2018. This is very close to the estimate of ~1.5 Gt CO2 by Andrew (2019) that draws from multipe data sources. We now include in the caption "Note that cement refers to process emissions only, as a lack of data prevents the full reallocation of indirect emissions to this sector."	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
7699	40				The CO2 issue by each country must be evaluated with its evaluation manner and apply for control of annual CO2 issue.	Noted, thanks.	Leila Rashidian	Meteorological	Iran
9849	40				Looking at the data displayed in figure 2.13, disaggregating data into indirect emissions as resulted by electricity & heat as well as subsectors is very useful. We can see that transport and buildings indirect emissions due to energy add some substantial amount approximately 3-4 %. Road and residential has been the prominent subsectors contributing to GHG emissions . These data suggests that better urban planning need to be one of the priority actions.	Noted, thanks.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
78311	41	0	53	0	The amount of material devoted to consumption-based approaches is quite large considering the formal status of territorial emissions. Section 2 only gets going at p.26 so the material devoted is pretty similar	Noted, thanks.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
8081	41	1	41	7	Figure 2.14: Please correct: AFOLU is "agriculture, forestry and other land-use", delete "change". Land-use change is implicitly included in the estimates. Mixing AFOLU and LULUCF like this indicates lack of competence of the author of the text.	Accepted. After a cross-chapter process to clarify our use of terminology, we now use "LULUCF CO2"	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
86141	41	1			If not mistaken this is the first use of the 2nd tier egional breakdown (10 regions). Somewhere, there shoudl be a table of the regional breakdown categories (lifted from Annex A) – maybe around here?	Noted	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
86145	41	1			Very helpful for clarifying thanks!	Thanks!	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
24897	41	2	41	7	Please add "The AFOLU CO2 estimates in this figure are not necessarily comparable with country GHG inventories (see Chapter 7)".	Noted. We have addressed this comment earlier on in the chapter already and provide the necessary context in the chapter now.	Giacomo Grassi	Joint Research Centre, European Commission	Italy

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
71185	41	9	52	12	Consumption-based emissions Two main improvements are needed to this section: 1) The constant use of the term "accounting" in this section is problematic because it implies unwarranted parity between consumption-based estimation and approaches that are more traditionally associated with the concept of accounting (and 'being accountable for'), in terms of their legal status, accuracy and robustness. The act of accounting for one's own direct emissions on a territorial (as a country) or combustion basis (like in an emissions trading system) is very different from a consumption-based approach which requires greater use of assumptions, including in relation to factors beyond the direct control of the entity being 'accounted'. This difference needs to be stated clearly at the start of the section. 2) The section makes no mention of the concept of TCBA (technologically-adjusted consumption-based accounting) and other approaches aimed at addressing some of the shortfalls with CBA. In particular, one problem is that under CBA, countries who reduce their own territorial emissions but are signficant exporters are 'penalised' (since the reductions embodied in exports are credited to their trading partner). The TCBA method is an attempt to address this.	partly accepted. 1) we follow the convention to use CEB accounting. 2) we add discussion of TCBA.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
53365	41	11	43	22	This is a very interesting and importantant section.What may be missing is the quantitative comparison between the territorial approach and the consumption approach. Please consider adding that informaiton.	Accepted. we added comparisons of the decoupling of PBE/CBE vs GDP. but can’t go much details due to limits of spaces. we also added discussions of PBE and CBE under figure 2.18.	Florin Vladu	UNFCCC Secretariat	Germany
8231	41	12	43	3	Please raise the benefits and disadvantages for the 3 main methods: Consumption, Production and Territorial emissions	Accepted. they have been discussed in the text.	Frida Zahlander	DanChurchAid	Denmark
86143	41	12	41	18	I think swap order in this para: - Consumption drives emissions, useful to understand the upstream impacts of the various consumption - This also brings in accounting that includes international trade	rejected. this paragraph is in good order.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
71187	42	1	42	6	In Figure 2.15 the third circle seems incomplete. I think "Export production" should be written in the white quarter? And it is also not clear what "Imported electricty/heat" refers to -shouldn't it not only be "imports"? Or am I missing something?	we deleted the figure to save space.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72455	42	1	42	1	I do not understand this figure and what it is supposed to represent. Indeed the present quality of the figure is low but still I do not get the take-home message from this figure although I do understand the take home-message from the text. This figure needs some reworking or simply to be removed as, in its present state, it does notadd much to the text.	We deleted this figure to save space.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
72543	42	1	42	1	I would suggest to add colors to Figure 2.15.	We deleted this figure to save space.	Yun Hang	Emory University	United States of America
54687	42	7	42	19	The discussion of production-based emission reporting includes territories as part of the discussion but includes as an example of territories international shipping/aviation. That would be considered bunker fuels under UNFCCC reporting and could be better represented as international activities as opposed to territories (which would represent emissions from territories as part of a countries geographic boundaries).	Accepted. We provided clearer definitions of different scopes of emission accounting.	Government of United States of America	U.S. Department of State	United States of America
20537	42	12	42	19	It should be added that unlike PBE, there are no internationally agreed methodology to calculate CBE at the country level. This is a major drawback for mainstraiming the use of this indicator in policy making (although France will set carbon budgets based on CBE from 2023 onwards)	accepted and revised.	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
45771	42	12	42	19	Please show the relevance of this good overview and thoughts on consumption based accounting for border adjustments. Border adjustments are only WTO compatible if they put a price on consumption, they follow the "destination principle" (e.g. Mehling at al 2019, Cambridge University Press, Designing Border Carbon Adjustments for Enhanced Climate Action, https://doi.org/10.1017/ajil.2019.22; and OECD, International VAT/GST Guidelines: Guidelines on Neutrality, (2011), https://www.oecd.org/ctp/consumption/guidelinesneutrality2011.pdf. This idea is not sufficiently understood in the debate on Carbon Border Adjustments (and not in chapter 13.7 of this report)	accepted. The border adjustment are mentioned in the box below.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
86823	42	14	42	19	With regards to the phrase "This reflects a shared understanding that a wider system boundary going beyond territorial emissions is important to avoid outsourcing of pollution and to achieve global decarbonisation. CBE allow to identify new policy levers through providing information on a country's trade balance of embodied emissions, household's carbon implications of their lifestyle choices, companies' upstream emissions as input for supply chain management, and cities' often considerable footprints outside their administrative boundaries (Feng et al. 2013; Davis and Caldeira 2010).", it is worth to note there is no multilateral consensus on the affirmations expressed on the "shared understanding that a wider system boundary going beyond territorial emissions is important", neither there is a multilateral agreement on the concept of territorial emissions, consumption-based emissions and/or production-based emissions, and this should be clarified in the text. These concepts are highly sensitive and could have an extra-territorial application (in particular production-based emissions) that goes beyond international law. In addition, there has to be caution to include international transport in the equation, as this could mean penalizing the production of far-distant countries, without duly considering the life cycle of the products and overemphasizing the transport component. Thus, we suggest deleting the whole phrase paraphrased above.	We have revised the box and statement to make it clearer. Consumption-based emissions include the complete life-cycle effects of products without overestimating the effects of transport.	Government of Argentina	Ministry of Environment and Sustainable development of Argentina	Argentina
71189	42	29	42	29	It is misleading to say that countries such as China have a 'relatively small share' of cumulative emissions. Firstly because the share is not so small, and secondly because it is increasing rapidly and sensitive to the choice of cut-off period.	Accepted. We revised the text. The cut-off period is until the most recent data we have. We meant to say China, India and Brazil have relatively smaller shares of cumulative emissions, compared to their annual emission currently.	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
86825	43	5	43	20	With regards to "Box 2.1 Policy relevance of production-based (PBE) and consumption-based (CBE)", all the table should be deleted, as both PBE and CBE are not multilaterally agreed approaches.The content of the table, including certain policy instruments mentioned in it, are highly debated and controversial, and have no international consensus, such as the border carbon adjustment mechanism, "embodied emissions in product performance standards and labelling", "embodied emissions in trade", and carbon pricing and taxation measures. Therefore their reference should be avoided, even more considering their trade implications and possible inconsistency with WTO rules.	Rejected. We decided to keep this box after discussion with the group. but we have made substaintial revisions. 1) it is not prescriptive to remove all the boxes/tables and box 2.1 is highly relevant to our chapter; 2) the IPCC was tasked to discuss CBE and the table of content was agreed upon by the convention of parties; 3) there is a substantial amount of literature on CBE and trade and associated policies (thus the table); 4) countries are discussing implementation of policies such as border tax adjustment (e.g. EU - will find literature to support) and other policies (will add literature); 5) moreover, CBE have been popular at subnational level e.g. cities (c40, will mention some others here), and companies (many carbon footprint calculators e.g. BP - any others?)(for carbon reporting and supply chain management) and carbon labeling (e.g. Tesco in the UK); and consumers (huge number of carbon calculators); and voluntary carbon offset schemes (again based on CBE).	Government of Argentina	Ministry of Environment and Sustainable development of Argentina	Argentina
54689	43	6	43	8	The policy discussion of PBE and CBE includes "Commitments in international climate policy negotiations" under CBE, but that should be under PBE. It is not clear how CBE would fit under international climate negotiations (like the Paris Agreement) while PBE does fit under those negotiations.	Accepted. This sentence has been moved to PBE.	Government of United States of America	U.S. Department of State	United States of America
8301	43	8	43	9	It is incorrect to argue that consumption-based emissions accounts can guide the design of trade policy. The logic of imposing domestic carbon prices on import-related emissions is flawed, as it doesn't take into account shifts of production and consumption patterns in trade partners. See Jakob et al (2013, ERE) e.g. https://doi.org/10.1007/s10640-013-9638-y	There is substantial amount of literature especially with regard to but certainly not exclusive to trade and embodied emissions (see also section 2.4). We do not argue here one way or the other but just list to which policy discourses CBE are contributing to without making a case for a specific design. This would go beyond the scope of this box.	Michael Jakob	MCC Berlin	Germany
86147	43	8			Separate or clarify (a) domestic / general; (b) internaitonal dimensions. People so often slip into assuming its all about international trade when often its not. In terms of relevance – and perhaps, clarifications - might also be worth looking at the Carbon-CAP policy paper: Grubb M., Doug Crawford-Brown, Karsten Neuhoff, Karin Schanes, Sonja Hawkins & Alexandra Poncia (2020) Consumption-oriented policy instruments for fostering greenhouse gas mitigation, Climate Policy, DOI: 10.1080/14693062.2020.1730151	Reject: the box mainly consists of list of uses of the different accounting frameworks with trade only being two out of eleven potential applications of CBE. Moreover, section 2.4 and 2.3.4 clearly show the contribution of trade to emissions.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
8233	43	10	43	11	"Discussion the inequality in consumption and emissions"….please raise the discussion, rather then leaving it blanc and open as of now. What has been the discussion?	accept. it should be listed as one bullet point.	Frida Zahlander	DanChurchAid	Denmark
54691	43	10	43	20	A policy discussion of CBE should also include discussion about the static nature of product-based estimates and mitigation accounting aspects. The static nature of product-based estimates makes it difficult to reflect changes over time (e.g., a country improves emissions of exporting industry so product-based estimates would need to be updated constantly). Also, if a country reduces imports of a specific product, it does not necessarily lead to reductions in production-based emissions from the exporting country; if the exporting country has a cap and trade, for example, reductions in one industry group could just be taken up by another.	Reject: global MRIO provide now time series that reflect changes of carbon intensity of sectors (not products) over time. In other words, they are as frequently updated as the national accounts upon which the MRIOs are based. Thus the consumption-based accounting approach is as static or dynamic as the production based approach.	Government of United States of America	U.S. Department of State	United States of America
8303	43	16	43	19	Perhaps also consider the sharing scheme propsed by Jakob et al. (2021)? https://doi.org/10.1016/j.gloenvcha.2020.102207	Accepted and cited in box 2.1, but didn't go into the details as the responsibility is not the focus of our chapter.	Michael Jakob	MCC Berlin	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
497	43		5	11	Very good box. However, it should be more specific. E.g., Commitments in international climate policy negotiations - it was discussed, however, in reality, national emissions of the Parties follow PBE or TE. In addition, what does Line 10 mean? Is it one of the bullets for CBE?	accept and revised.	Kim Hana	KAIST	Republic of Korea
16097	43		5	11	Very good box. However, it should be more specific. E.g., Commitments in international climate policy negotiations - it was discussed, however, in reality, national emissions of the Parties follow PBE or TE. In addition, what does Line 10 mean? Is it one of the bullets for CBE?	accept and revised.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
4929	44	1	45	6	It would be interesting how CBE changed in 2020 during lockdows. I would suggest the authors to attempt to gather data about this	Accepted but can't go into details due to data limitation. We have added one sentence "In 2020, COVID-19 and lockdown has reduced global PBE significantly (Le Quéré et al., 2020), as well CBE (Shan et al., 2020b)."	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
5213	44	1	44	13	The datas presented in the figure refers to the êriod 2010-2015, i.e. before the Paris Agreement. It does not show the result of the policies implemented since 2015. Woul it be possible to update the data and present the period 2015-2019? Thank you.	accept. we updated the data and figures to 2018. this is the most updated data we could ever find.	Michel SIMON	Retraité/ Pdt d'association	France
8235	44	1	45	6	How come you are only focusing on CBE in the analysis of the regional trends, even if you have discussed multiple different methods in the previous section? Please justify how come in this section to increase your legitimacy.	accept. section 2.3 is about CBE. territorial emissions have been discussed in section 2.2. the reasoning of discussing PBE has been added in section 2.3.1.	Frida Zahlander	DanChurchAid	Denmark
54693	44	1	44	9	CBE seems a very useful concept, but it would seem important to make more clear the differences in emission by nation for CBE vs. PBE. Comparing Figure 2-16 to 2-9 doesn't seem entirely appropriate. Perhaps add another figure showing comparable quantities side by side? That might be accomplished by Figure 2-18, so consider linking these sections better to help the reader look ahead, or perhaps the section on EET should come before the discussion of CBE.	Rejected. There is insufficient space to add an additional figure and we think the comparison is achieved in Figure 2.18 (now 2.17) as you noted. Also, we would keep EET after CBE (in Figure 2.17), as EET is only a part of CBE.	Government of United States of America	U.S. Department of State	United States of America
43397	44		44		The graphs (panels) "d" and "e" on this page are misleading. This is because the annual growth rate of a country's emissions may be high, but its emissions are small compared to large emitters especially historically. In addition, for example, a 100 percent increase in emissions from low-emitted countries could be equivalent to a 10 percent increase in emissions from high-emitted countries. So these graphs need to be modified to reflect the role of countries in greenhouse gas emissions during the post-industrial revolution and rank countries accordingly.	The countries presented in the figure are top 18 CBE emitting countries. Thus there is no problems in terms of the relatively size of emissions. we didn't include small emitting countries. the panels "d" and "e" (now "c" and d") show exactly what the ref wants. The figure could reflect the role of countries GHG emissions.	sadegh zeyaeyan	Head of national center for forecasting and weather hazards management of Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
43399	44		44		The gragh (panel) "g" should be deleted, because the index used depends on the value of the national currency (exchange rate) and cannot be used as a basis for comparing and ranking countries. Unless GDP statistics are used in terms of "US Dollars purchasing power parity (PPP)".	emission intensity is removed.	sadegh zeyaeyan	Head of national center for forecasting and weather hazards management of Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
50303	44		44		The graphs (panels) "d" and "e" on this page are misleading. This is because the annual growth rate of a country's emissions may be high, but its emissions are small compared to large emitters especially historically. In addition, for example, a 100 percent increase in emissions from low-emitted countries could be equivalent to a 10 percent increase in emissions from high-emitted countries. So these graphs need to be modified to reflect the role of countries in greenhouse gas emissions during the post-industrial revolution and rank countries accordingly.	The countries presented in the figure are top 18 CBE emitting countries. Thus there is no problems in terms of the relatively size of emissions. we didn't include small emitting countries. the panels "d" and "e" (now "c" and d") show exactly what the ref wants. The figure could reflect the role of countries GHG emissions.	Government of Iran	Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
50305	44		44		The gragh (panel) "g" should be deleted, because the index used depends on the value of the national currency (exchange rate) and cannot be used as a basis for comparing and ranking countries. Unless GDP statistics are used in terms of "US Dollars purchasing power parity (PPP)".	emission intensity is removed.	Government of Iran	Islamic Republic of Iran Meteorological Organization (IRIMO)	Iran
71191	44		44		"Developed countries" should not be classified as a region.	Reject. We follow the instruction of the IPCC committee and use the classfication from UN. please note that Africa will be seperate from the middle east in the revised version.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
37399	45	1	45	6	It is not clear why consumption based emissions (CBE) and emissions intensity are coupled together in the analysis. Since developed countries have higher CBE, it is almost as if the emissions intensity indicator is included there to show that this is higher in developing countries. While this is true, it is because of higher manufacturing in these countries, which is not discussed in this paragraph to give any context. Emissions intensity is a result of production and therefore should be seperately analysed.	Accept and have deleted emission intensity.	Government of India	Ministry of Environment, Forests and Climate Change	India
51977	45	3	45	6	Panels (d-g) show a snapshot of the main narrative on emissions trends. Consider showing a broader and most recent period. Showing the top-emitting countries with the highest CBE between (2010 and 2018), with highlights on 2018 for panels (F and G), will change the ranking significantly and provide consistency for the chapter.	Partly accept. we updated the figure with more recent data (until 2018). we redraw this figure based on the PBE figure in section 2.2 to keep consistent.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
78313	45	7	46	4	Urban emissions weren't singled out in Section 2.2 Why give it so much coverage here?	accept. this part is removed in section 2.3.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
54695	45	10			Explain terminology "C40 cities".	this part is removed. This comment is no more applicable.	Government of United States of America	U.S. Department of State	United States of America
71193	45	10	45	40	There are at least four places where "C40" appears unmotivated. What does it refer to? Should it be removed?	this part is removed. This comment is no more applicable.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
15211	45	18	45	18	In the sentence “Per capita CBE vary widely across cities. For example, Hong Kong had the largest per capita CBE of 34.6 ±6.3 tons.”, Hong Kong is a Special Administrative Region of China, not an independent country. The current statement is seriously wrong. It is suggested to change “Hong Kong” to “Hong Kong, SAR of China”.	this part is removed. This comment is no more applicable.	Government of China	China Meteorological Administration	China
48173	45	28	45	29	Nanping and Hohhot are not very representative, so it is suggested to replace them.	this part is removed. This comment is no more applicable.	Yang Wang	Beijing Climate Center	China
51979	45	31	45	33	Consider highlighting the 'local warming trends.' The paper "Staying Cool in A Warming Climate: Temperature, Electricity and Air Conditioning in Saudi Arabia" (Howarth et al,2020) examines the impact of local warming trends on cooling demand and emissions in the case of Saudi Arabia.	this part is removed. This comment is no more applicable.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
499	45		14		Moran et al (Moran et al. 2018) -> this in-citation needs to be corrected.	this part is removed. This comment is no more applicable.	Kim Hana	KAIST	Republic of Korea
16099	45		14		Moran et al (Moran et al. 2018) -> this in-citation needs to be corrected.	this part is removed. This comment is no more applicable.	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
54697	46	5	48	18	Decoupling is an important issue, but here is only discussed in terms of consumption-based emissions. Given the uncertainties associated with estimating CBE, some discussion of this decoupling with other emission metrics (PBE, for example) seems worth having, to understand or demonstrate that this decoupling isn't just an artifact of the CBE calculation.	accept. we added the decoupling results of PBE in the table with biref dicussion/comparisons with CBE.	Government of United States of America	U.S. Department of State	United States of America
45773	46	6	46	11	The report does not sufficiently describe why decoupling CBE from GDP is desirable at the national level even if it cannot be achieved at the global level. Especially with regard to the point of shifting environmental burdens. Please clarify.	Accept. we added some discussion here. shifting emissions could achieve decoupled emissions from GDP, but is not the only way.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
70123	46	9			(Vadén et al. 2020) https://www.sciencedirect.com/science/article/abs/pii/S1462901120304342	accept and added. "However, a number of studies found that it is feasible to achieve decoupling at the national level and reasons for decoupling (Deutch, 2017; Habimana Simbi et al., 2021; Li et al., 2019; Roinioti & Koroneos, 2017; Schandl et al., 2016; Shan et al., 2021; Shan, Fang, et al., 2020; Vadén et al., 2020; Ward et al., 2016; Zhao, Zhang, & Shao, 2016)."	Rayner Andersen	Department of Fisheries and Oceans	Canada
20123	46	12	46	16	The paragraph should state that "absolute decoupling is not sufficient to avoid consuming the remaining CO2 emission budget, limit global warming under 1.5°C or 2°C and avoid climate breakdown. "The notion of "strong enough absolute decoupling" should be introduced : "In order to reach climate objectives, the recuction of GHG emissions has to occur fast enough. This means that decoupling should not only be absolute, but also strong enough. In other words, the entire world should reach strong enough absolute decoupling (Hicken and Kallis 2019 - https://www.tandfonline.com/doi/abs/10.1080/13563467.2019.1598964?journalCode=cnpe20 , Espen and Rockstrom 2018 - https://www.sciencedirect.com/science/article/abs/pii/S2214629618304018). The more GDP grows, the more decoupling has to occur fast. Some autors conlude that such strong enough aboslute decoupling is unlikely to be reached with a global GDP growth level as high as 3% per annum (Hicken and Kallis 2019 - https://www.tandfonline.com/doi/abs/10.1080/13563467.2019.1598964?journalCode=cnpe20).	accept and added. “Absolute decoupling is not sufficient to avoid consuming the remaining CO2 emission budget under the global warming limit of 1.5°C or 2°C and avoid climate breakdown (Stoknes and Rockström, 2018; Hickel and Kallis, 2020). Even if all countries decouple in absolute terms this might still not sufficient and thus can only serve as one of the indicators and steps toward fully decarbonizing the economy and society.”	Noé Lecocq	Inter-Environnement Wallonie	Belgium
86149	46	13	46	14	Maybe add to footnote the cases – which seem to be very few, but not none?	reject. our results show that it is not very few. 43 countries have achieved absolute decoupling from 2010 to 2015.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
20539	46	24	46	26	This raises a question on the use of the term "decoupling" especially when qualified by "absolute" is justified since if it is not maintained over time is is better seen as merely a temporary decorrelation - the same message is given in lines 11-13 on the next page. The question that remains unanswered by this section - and the use of such information elsewhere including in the SPM - is whether sustained absolute decoupling - including at a national level - is possible. It would be wise to give that message or nuance the references to decoupling to indicate the continuing uncertainty on what is possible.	partly accept. the decoupling is a temporary status, but we want the decoupling could exist as longer as possible. for example, we should reduce global emissions for a long time, towards carbon neutrality. otherwise, we can't achieve the 1.5 degree C target. we will add some discussion about the period of decoupling. The more interesting question is even if it is possible, it is sufficient. We have added the discussion.	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
45775	47	1	47	4	Please provide more explanation on this figure in its caption, including on "CBE %" and "GDP%" - percentage of what? and the different sections indicated by the different colours. In addition, please provide information on the criteria for the classification developed countries, taking into recent approaches since the classification from the UNFCCC of 1992 is not relevant anymore, and how this group relates to other groups.	The figure has been deleted. Comment no more applicable	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
64941	47	1	47	3	Figure 2.17 is complex to understand for a synthesis report. As the data for the different broad regions are very dispersed, the regional color dots don't help the understanding. Would another color code such as GDP/capita or CBE/capita groups lead to clearer results ?	The figure has been deleted. Comment no more applicable	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
71195	47	5	47	5	Table 2.6 is difficult to read with all the lines. Please remove lines within groups.	accepted and revised.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
78315	47	5	47	5	There was no equivalent in Section 2.2	the decoupling is discussed in section 2.3. we added discussions and comparisons with PBE decoupling in our section.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
86151	47	5			Split columns for 2010 and 2015 might be easier to follow? Or even arrow ... I wonder how useful the „Max“ ad „Min“ are as presumably outlier or very small countries?	accepted and revised. We kept the max and min value to show the huge heterogeneity of countries.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
37401	48	4	48	13	Absolute and relative decoupling of emissions is attributed to efficiency improvements alone. However there is literature that has shown that it is also structural changes in the economy and a shift to tertiary sectors of production that plays a big role in such decoupling. This literature on structural decomposition of factors leading to reduced emsissions has not been cited. Some references that could be included are the following: 1) Xu, X. Y., & Ang, B. W. (2013). Index decomposition analysis applied to CO2 emission studies. Ecological Economics, 93, 313-329., 2) For China: Ang, B. W., Xu, X. Y., & Su, B. (2015). Multi-country comparisons of energy performance: the index decomposition analysis approach. Energy Economics, 47, 68-76. 3) For India: Kanitkar, T., Banerjee, R., & Jayaraman, T. (2015). Impact of economic structure on mitigation targets for developing countries. Energy for Sustainable Development, 26, 56-61.	Accepted and added.	Government of India	Ministry of Environment, Forests and Climate Change	India
48175	48	11	48	12	“A number of countries, such as China, India and Japan, experienced relative decoupling of GDP and CBE over the period of 2010 to 2015”.This sentence lacks specific literature support.Supporting documents: Lenzen et al., 2013.	this is from our calculation.	Yang Wang	Beijing Climate Center	China
53715	48	11	48	12	“A number of countries, such as China, India and Japan, experienced relative decoupling of GDP and CBE over the period of 2010 to 2015”. Please add a reference to support this sentence.	this is from our calculation.	ZHENG XINZHU	China University of Petroleum (Beijing)	China

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
70061	48	14	48	16	The original text says: "Another 52 countries, mainly fast-growing developing countries, such as Brazil and Bangladesh, have experienced no decoupling between GDP and emissions from 2010 to 2015, meaning the growth of their GDP is closely tied with domestic consumption and production of emission-intensive goods." Is not possible to view in the GPD of Brazil, during the period of 2010 to 2015, something that indicates a fast economical growing. In the considered period, the average GPD was 1,4%, varying from a 7,5% (2010) to a -3,8% (2015), according to the Brazilian Institute of Geography and Statistics, an official body of the Brazilian government. In the case of Brazil, I suggest that the affirmation of "have experienced no decoupling between GDP and emissions from 2010 to 2015" may be reviewed to became the report more precise. Official data are available at: https://agenciadenoticias.ibge.gov.br/media/com_mediaibge/arquivos/7531a821326941965f1483c85caca11f.xls	accept and the text has been deleted.	PEDRO CORTES	University of Sao Paulo - USP	Brazil
77425	48	17	48	18	In case there will not be any substantive improvement in energy efficiency. If energy efficiency will be achieved for the production of emission-intensive goods then there could be an improvement. Therefore, this sentence could be revised.	accepted and revised.	Özge Önenli	Engie	Turkey
86153	48	19			Into this section I wonder about a mini box on the Acronyms, its tough going even for me ... And somehow, need to be really clear when one is talking about trade in total – all transfers crossing border traced presumably through MRIO – compared with aggregate (eg. South-North)	rejected. We explain them all in the text.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
79895	48	20	48	44	Great progress was made on AR6 on scientific data and estimates provided at a regional level. Some initiatives such as the UNFCCC Regional Collaboration Centres helped to facilitate among other technical support the clarity, transparency and understanding of the NDC processes by Countries. Further, it would be ideal to stress the evolution and data on the regional coalitions (e.g. Carbon Pricing of the Americas CPA-Carbon Pricing, and/or LAC Alliance of voluntary GHG Management Programmes (national carbon footprint programmes and the Climate Neutral Now initiative))	Rejected – Outside the scope of the chapter.	Carlos Ruiz Garvia	UNFCCC	Panama

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
86827	48	20	50	48	With regards to the whole section 2.3.4 "Emissions embodied in trade", and the ideas expressed in it ("As global trade patterns have changed over recent decades, so have the emissions embodied in trade (EET) (Jiang & Green, 2017). EET refers to emissions associated with production of traded goods and services and is equal to the difference between PBE and CBE (Wiebe and Yamano 2016). EET includes two parts: emissions embodied in imports (EEI) and emissions embodied in exports (EEE). For a given country or region with CBE higher than PBE, the country is a net importer with a higher EEI than EEE, and vice versa."), it is worth to note that the concept of "emissions embodied in trade" is controversial and has no multilateral consensus, being not included in the Agenda 2030, the UNFCCC nor the Paris Agreement. Trade contributes to growth, development, innovation, and job creation, even more in the context of the need to ensure an inclusive and sustainable post-pandemic recovery, and trade cannot be penalized. On the contrary, it is key to ensure food security and poverty erradication, being the overriding priorities of the international community. In addition, the UNFCCC establishes that measures to combat climate change, including unilateral ones, should not constitute disguised restrictions to international trade or discriminatory or arbitrary discrimination, and this should be reflected in the document. Thefore, we propose to delete this whole section, as the concepts included in it are controversial and not multilaterally agreed.	Rejected. We are discussing the substantial literature on emissions embodied in trade. We do not in any way argue against trade and agree with your assessment on the benefitial effects of trade. This section on CBE is in this report for a number of reasons: 1) the IPCC was tasked to discuss CBE and the table of content was agreed upon by the convention of parties; 2) there is a substantial amount of literature on CBE and trade and associated policies; 3) countries are discussing implementation of policies such as border tax adjustment (e.g. EU - will find literature to support) and other policies (will add literature); 4) moreover, CBE have been popular at subnational level e.g. cities (c40, will mention some others here), and companies (many carbon footprint calculators e.g. BP - any others?)(for carbon reporting and supply chain management) and carbon labeling (e.g. Tesco in the UK); and consumers (huge number of carbon calculators); and voluntary carbon offset schemes (again based on CBE).	Government of Argentina	Ministry of Environment and Sustainable development of Argentina	Argentina
45557	49	1	49	1	Whi is the total of embodied CO2 in exports not equal to the total of embodied CO2 in imports?	accepted. the figure is revised based our latest calculation up to the year 2018. now there are no big gap between net export and net import. however, as we only include 116 countres from the GCP dataset, the exported and imported emissions are not 100% equal.	Kornelis Blok	Delft University of Technology	Netherlands
54699	49	1	49	15	The total annual CBE are greater than the total PBE in the figure, indicating some double counting in the CBE. It would be good to indicate that as part of global CBE accounting. Could be mentioned in Section 2.3.5 on variability.	accepted. We redid the calculation and revised the figure.	Government of United States of America	U.S. Department of State	United States of America
64943	49	1	49	1	I find Figure 2.18 very interesting, is it possible to have it cover also the 2015-2018 period ?	accepted. the figure is revised based our latest calculation up to the year 2018.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
86155	49	18	49	19	Ouch. 40% of national footprints imported ... implies that imports (net??) account for 0.4/0.6 = two-thirds addition to domestic emissions .. Wow	We have double checked the references.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
501	49		9	10	in-text citation: the authors may already know the issue.	rejected. the broader readers needs these information.	Kim Hana	KAIST	Republic of Korea
16101	49		9	10	in-text citation: the authors may already know the issue.	rejected. the broader readers needs these information.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
71197	49		49		Add a disclaimer in the text of the section on shortcomings with respect to methodology and data for CBA. In this figure, the shaded blue areas appear considerably larger than the shaded red areas. Doesn't this imply that the exported and imported emissions transfers do not equal each other? And doesn't this in turn imply a serious shortcoming in our ability to measure/ estimate embodied emissions?	We updated the figure with CBE data from global carbon budget 2020. now there are no big gap between net export and net import. however, as we only include 116 countres from the GCP dataset, the exported and imported emissions are not 100% equal. The uncertainty of CBE accounting has also been discussed in section 2.3.1.	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
8305	50	1	50	9	The statements w.r.t. outsourcing and carbon leakage in this paragraph are strinkingly incorrect. Please check closely what can and cannot be inferred from consumption-based emission accounts and emissions embdied in trade. The main point here is to correctly account for emissions that are saved by exports. CBA simply does not do that.	partly accept.ed We carefully examined the definition of outsourcing, carbon leakage and so on. CBA could provide insights for trade embodied emissions. We deleted the stuff on carbon leakage.	Michael Jakob	MCC Berlin	Germany
10525	50	1	50	1	This would rather be "Le Quéré"	accepted and revised.	Philippe Waldteufel	CNRS	France
20541	50	8	50	9	It would be helpful to provide more clarification on the relationship between leakage as measured by net emissions transfers and the absolute impact on global emissions. The sentence as drafted suggests that this is necessarily an increase, but this is presumably measured against a counterfactual - it would be helpful to clarify how the relative efficiency of plants and processes (sometimes more recent in exporting countries) and carbon intensity of energy mix (possibly more intense in exporting countries?) play out, rather as in 2.4.5.	accepted. We have deleted the stuff on carbon leakage.	Government of France	Ministère de la Transition écologique et solidaire	France
27579	50	18	50	29	Is there more recent data to consider in these paragraphs?	The information (patterns of trade and emission transfer) needs input-output table, which is not avaiable for the year 2018. But we do present the latest CBE and trade embodied emissions until 2018 in figure 2.16 and 2.17.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
54701	50	23	50	29	Is there a reason these analyses could not extend to 2015 or 2018? This information is great but now a bit dated.	The information (patterns of trade and emission transfer) needs input-output table, which is not avaiable for the year 2018. We have extend the time span to 2018, see figure 2.16 and figure 2.17.	Government of United States of America	U.S. Department of State	United States of America
86157	50	35	50	37	Monir point-Slight „apples and oranges“? Transfers amongst all developing countries roughly equal to their aggregate exports South (bloc) to Norht (bloc)?	Rejected. This statement is from literature and we prefer to keep it for the accurately expression. "Since 2014, CO2 emission transfer between developing countries has plateaued and then slightly declined and seems to have stabilised at around the same level of transfers between non-OECD and OECD countries at around 2.4 GtCO2 yr-1 (Wood et al. 2019b)."	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
503	50		43		depend on -> depends; differ -> differs I20	accepted and revised.	Kim Hana	KAIST	Republic of Korea
16103	50		43		depend on -> depends; differ -> differs I20	accepted and revised.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
64945	51	5	51	9	There are 6 datasets in Table 2.7, not 5	Accepted - text revised	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
66189	51	5	51	7	Text states that "Five global accounts for consumption-based GHG emissions at the country level exist (Table 2.7)". At the same time, Table 2.7 lists six (no five) consumption-based account datasets. This should be clarified/corrected.	Accepted - text revised	Maksym Chepeliev	Purdue University	United States of America
64947	51	9	52	2	Using the same acronyms in Table 2.7 and Figure 2.19 would be helpful, acronym BRICS should be explained	Figure 2.19 has been removed due to country classification. So there is no inconsistent problem of the figure and table. BRICS is not allowed to mention. We removed it.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
66191	51	9	51	9	Table 2.7 references Peters et al. (2011) for the GTAP Data Base and reports available years to be 2004, 2007 and 2011 (this corresponds to the GTAP 9 Data Base). Peters et al. (2011), where using an older version of the GTAP 8 Data Base with 2004 and 2007 reference years, while the latest version of the GTAP Data Base (GTAP 10) has 2004, 2007, 2011 and 2014 reference years and 65 sectors (vs 57 sectors in the earlier versions). The latest GTAP 10 Data Base is described in Aguiar et al. (2019) (AGUIAR, Angel et al. The GTAP Data Base: Version 10. Journal of Global Economic Analysis, [S.l.], v. 4, n. 1, p. 1-27, june 2019. ISSN 2377-2999. Available at: <https://jgea.org/ojs/index.php/jgea/article/view/77>.). It is suggested to clarify/revise referencing of the GTAP Data Base.	Accepted - Aguiar et al was added. The Peters et al reference was retained because it explains how to turn the GTAP data into MRIO format. 2014 data year was added.	Maksym Chepeliev	Purdue University	United States of America
70073	51	9	51	10	OECD (Yamano and Webb 2018) is updated that it provides data up to 2015. Please see following site. http://www.oecd.org/sti/ind/carbondioxideemissionsembodiedininternationaltrade.htm	Accepted - The reference was updated and the end year set to 2015	Junko Ogawa	The Institute of Energy Economics, Japan	Japan
505	51		34		This sentence needs to be modified. In the regsion of 5-15% of what? Cannot get the meaning of the sentence. Also, not sure that the expression "stochastic variation of national CBE accounts" is correctly used.	Accepted - Clarified in the sentence that "stochastic relative standard variation of total national CBE" is meant.	Kim Hana	KAIST	Republic of Korea
507	51		11		This could apply to the chapter 2. I found several errors of in-text citations. Wood, Moran, et al. ? It should be Moran et al. If there is another Moran for 2019, in that case, it would be fine. Also, I believe the text will get some Egnlish proofreading. Tense, plural/singular ... grammars should be checked.	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
16105	51		34		This sentence needs to be modified. In the regsion of 5-15% of what? Cannot get the meaning of the sentence. Also, not sure that the expression "stochastic variation of national CBE accounts" is correctly used.	Accepted - Clarified in the sentence that "stochastic relative standard variation of total national CBE" is meant.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16107	51		11		This could apply to the chapter 2. I found several errors of in-text citations. Wood, Moran, et al. ? It should be Moran et al. If there is another Moran for 2019, in that case, it would be fine. Also, I believe the text will get some Egnlish proofreading. Tense, plural/singular ... grammars should be checked.	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
54703	52	1			Figure 2.19 is not really discussed in text, nor is it well explained in the caption. Is this figure necessary?	This figure has been removed due to country classification.	Government of United States of America	U.S. Department of State	United States of America
20543	53	1	53	1	Chapter 2-53, section 2.4 line 1. In the whole section, the term "drivers" is not accurate as the Kaya decomposition does not imply any causality. For instance, GDP per capita drives emissions if everything else remains equal but GDP per capita also influences the energy intensity of CO2. It is thus inaccurate to give the impression that when GDP per capita increases by 1%, CO2 emissions increase by 1%, as represented in the figures. A caveat could be added at the beginning of the section 2.4.1 line 6: We consider economic drivers independantly from one another, even if they interact with each other.	Accepted - Text revised in the first paragraph of Section 2.4.1. The Kaya decomposition equation is now also explained in the first figure in this section.	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
76899	53	2	54	3	Kaya only has 4 factors. As Energy/GDP is decreasing, and CO2/eneregy is also decreasing over the last years (it could hardly increase in a significant way), only two factors are changing in a way that increases emissions: GDP/capita and population. Thus claiming that population is "globally the second largest" is stating the obvious: it can only be the first or the second (and for that reason, it is also the second in almost all regions except for Africa). If you look at both positive and negative contributions, then population is the 3rd factor in magnitude (last panel of fig. 20). This a first reason why I would like to suggest reworking that sentence. In addition, the change in the "Kaya factors" at the World level could be misleading, especially for population: the fact that the World population increased by almost 50% since 1990 does not mean that it contributed to a global emission increase by 50%, because a substantial fraction of the population increase occurred in regions with low to moderate emissions. Thus while the last panel of figure 2.20 is technically correct, I think that it is important to note that its interpretation potential is limited: Kaya factors are meaningful on (economically, etc.) homogenous regions, which still isn't the case at the World level. For information, I made synthesis figure in which Kaya factors are calculated for each region in an additive manner and presented in a way that shows World totals. In this way, one gets Kaya contributions for the World that are interpretable at the global level while still being a sum of regional contributions. The contribution of population is still significant, but it is lower than suggested by % changes in global data. It also shows that modest population increases in wealthy countries have an impact on emissions roughly equal to high population increases in low emission regions. Even if the current figure is not changed nor supplemented, I hope that the text at the bottom of page 53 can be amended to indicate that the interpretation of global level changes is limited by the wide range of emissions/capita over the World, and be more careful wrt the role of population growth.	Accepted - Text was amended accordingly and the figure of the Kaya decomposition was changed to show a) trends of GHG emissions by subsectors 1990-2018 in absolute levels of emissions, b) share of total sector and per-capita GHG emissions by world region in 2018 and c) Kaya decomposition of CO2 emissions drivers (Lamb et al., 2021, updated).	Philippe Marbaix	Université catholique de Louvain	Belgium
9087	53	6			A comprehensive assessment of global and national emissions drivers could be cited: Xia et al. (2020). Drivers of global and national CO2 emissions changes 2000-2017. Climate Policy, doi: 10.1080/14693062.2020.1864267	Accepted - Article was cited where appropriate.	Xunzhang Pan	China University of Petroleum, Beijing	China
6111	53	7			Liddle (2015) estimated that the long-run carbon elasticity of affluence (GDP per capita)—the per cent change in emissions associated with a one per cent change GDP per capita—was statistically significantly below unity for OECD countries—at around 0.6 to 0.7—and was essentially unity (1.0) for non-OECD countries. For both groups of countries, the long-run population elasticity/coefficient was determined to be 1.0/unity—i.e., people and emissions change proportionately (as argued in O'Neill et al 2012). Liddle, B. 2015. What Are the Carbon Emissions Elasticities for Income and Population? Bridging STIRPAT and EKC via Robust Heterogeneous Panel Estimates. Global Environmental Change, Vol. 31, pp. 62-73.	Taken into account - Liddle 2015 has now been cited to support the statement on the "long-term trend".	brantley liddle	independent consultant	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
6113	53	15			There is evidence that innovation, structural change, and increased efficiency—likely in response to the energy crises of the 1970s and early-1980s—permanently changed energy demand in OECD countries (e.g., Gately 1992; Walker & Wirl 1993; and Gately and Huntington 2002). Further, there is evidence that non-OECD countries have benefited from these factors via leapfrogging—such countries have statistically significantly lower energy intensity of energy demand than OECD countries had in the 1960s and 1970s (Liddle and Huntington 2021). However, the more recent (i.e., from the 1990s) decline in economy-wide energy intensity of GDP (energy/GDP) may be a function of (i) business-as-usually economic growth and (ii) the fact that the energy intensity of GDP/income elasticity of energy demand is 0.7 in both OECD and non-OECD/middle-income countries (Liddle and Huntington 2020), and has stayed fairly constant (over 1996-2014) at that level (i.e., around 0.7) in middle-income countries (Liddle et al. 2020). In other words, energy intensity = energy/GDP and energy =f(GDP0.7), so energy intensity=f(GDP-0.3), i.e., it will decline with increases in GDP.	Taken into account - (Liddle and Huntington 2021) cited.	brantley liddle	independent consultant	United States of America
6115	53	15			Gately, D. (1992): 'Imperfect price-reversibility of US gasoline demand: Asymmetric responses to price increases and declines', The Energy Journal, 13(4), 179-207. Gately, D. and H.G. Huntington (2002): 'The asymmetric effects of changes in price and income on energy and oil demand', The Energy Journal, 23, 19–55. Liddle, B. & Huntington, H. 2021. There's Technology Improvement, but is there Economy-wide Energy Leap-Frogging? A Country Panel Analysis. World Development Vol. 140, 105259. Liddle, B. & Huntington, H. 2020. Revisiting the income elasticity of energy consumption: a heterogeneous, common factor, dynamic OECD & non-OECD country panel analysis. The Energy Journal, Vol 41 (3), pp, 207-229. Liddle, B., Smyth, R., & Zhang, X. 2020. Time-varying income and price elasticities for energy demand: Evidence from a middle-income panel. Energy Economics, Vol 86, 104681. Walker, I O, & Wirl, F (1993). 'Irreversible price-induced efficiency improvements: theory and empirical application to road transportation'. The Energy Journal, 14(4), 183-205.	Taken into account - (Azhgaliyeva et al. 2020) and (Liddle and Huntington 2021) cited.	brantley liddle	independent consultant	United States of America
86159	53	16			Annual ?	Accepted - text revised	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
71199	53	20	53	25	The rebound effect is discussed in a very .extensive and detailed extensive manner with several references in 9.9.2, it is recomended adding a link to that section	Accepted - text revised	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72297	53	20	53	25	The rebound effect is discussed in a very extensive and detailed extensive manner with several references in 9.9.2, it is recommended adding a link to that section.	Accepted - text revised	bertoldi paolo	european commission	Italy

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
83891	53	23	53	25	I recommend to slightly expand the comments on the rebound effect to indicate the increased attention given to economy-wide rebound effects, which have been found in sevearl models to exceed 50%, although the evidence base still needs to grow.. To this end, two recent reviews, one by Brockway et al (2021) and one by Colmenares et al. (2020) should be cited alongside the already cited Stern (2020) paper. The full references are: Brockway, P. E. et al. (2021) 'Energy efficiency and economy-wide rebound effects: a review of the evidence and its implications', Renewable & Sustainable Energy Reviews, 141, p. 110781. doi: 10.1016/j.rser.2021.110781. Colmenares, G., Löschel, A. and Madlener, R. (2020) 'The rebound effect representation in climate and energy models', Environmental Research Letters, 15(12). doi: 10.1088/1748-9326/abc214.	Taken into account - The references were added. For further details we refer to Section 9.9.2 as there would be not enough space here to elaborate further.	Gregor Semieniuk	University of Massachusetts Amherst	United States of America
63467	53	24	53	25	It would be insightful to clarify on the extent of the impact of the rebound effect. Could specific figures or examples be provided, e.g., "based on studies from xyz, the average rebound effect is..."? It would also be useful to include a line on the positive outcomes of the rebound effect, e.g., any measurable improvements in well-being?	Taken into account - For further details on the rebound effect we refer to Section 9.9.2 where it is extensively discussed in detail. There would be not enough space here to elaborate further.	Government of Canada	Environment and Climate Change Canada	Canada
509	53		7	10	in text citation issue, and also, "following a long-term trend" is not necessary (redundant), this section (including following pages) has a number of in-text citation issues.	Noted - The phrase "following a long-term trend" is needed to put short-term trends into perspective.	Kim Hana	KAIST	Republic of Korea
16109	53		7	10	in text citation issue, and also, "following a long-term trend" is not necessary (redundant), this section (including following pages) has a number of in-text citation issues.	Noted - The phrase "following a long-term trend" is needed to put short-term trends into perspective.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
72545	54	1	54	1	I would suggest to make lines colors darker and make labels text clearer.	Taken into account - Figures and labels were redrawn.	Yun Hang	Emory University	United States of America
76917	54	1	54	5	Figure 2.21: I would like to suggest adding the corresponding amounts of CO2 for each region panel. That would supplement the plots by indicating how much each region contribute to the total World emissions.(same remark as for figure 2.20, and it would also apply to 2.22)	Accepted - Figures and labels were redrawn accordingly.	Philippe Marbaix	Université catholique de Louvain	Belgium
86161	54	1			I appreciate Kaya identity but it seems a shame this doesnt illustrate trends in emissions per capita?	Accepted - Figures and labels were redrawn accordingly.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
66769	54	6	54	7	The use of "despite" in this sentence is a curious choice. Surely develpoing countries have higher emissions because they are starting from a lower growth rate? This sentence is indicative of a larger failing in this sentence. Nowhere in this high level CO2 Kaya decomposition does the discussion indicate that the starting point of different regions in terms of GDP might be salient in how we interpret the trends. A complementary treatment addressing how emissions correlate with economic indicators or poverty, or even just GDP/cap would help round out this discussion.	Accepted - The first part of the sentence was removed. Throughout this section, data and discussions on the per-capita and absolute emission levels across different regions was included.	Navroz Dubash	Centre for Policy Research	India
65647	54	13	54	14	"This was due to [..] fuel switching from coal to gas (mostly in North America, (Wang et al. 2020d)) [..]". Does the analysis account for the methane leakage in gas production as well or does it count only consumption based emissions? Do the emission reductions change significantly if leakages are ot aren't taken into account? It would be reasonable to discuss this issue in detail.	Taken into account - Made it clearer in the previous sentence that it refers to CO2 emissions only. No specific literature on methane leakage.	Eero Hirvijoki	Aalto University	Finland
511	54		12		In former section, PBE is diffferentiated from territorial emissions. So I don't think the word should be inserted with caution. Production based or territorial?	Accepted - Clarified whether production-based or territorial is meant throughout Sections 2.1 to 2.4.	Kim Hana	KAIST	Republic of Korea

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
541	54		1		All the similar figures showing the trends of relative changes in components of KAYA identity in chapter 2 need to have the same legends (capitalization issue as well). In figure 2.20, Energy/GDP, but in figure 2.23, figure 2.22, figure 2.24 energy_GDP	Noted. Thanks	Kim Hana	KAIST	Republic of Korea
16111	54		12		In former section, PBE is diffferentiated from territorial emissions. So I don't think the word should be inserted with caution. Production based or territorial?	Accepted - Clarified whether production-based or territorial is meant throughout Sections 2.1 to 2.4.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16141	54		1		All the similar figures showing the trends of relative changes in components of KAYA identity in chapter 2 need to have the same legends (capitalization issue as well). In figure 2.20, Energy/GDP, but in figure 2.23, figure 2.22, figure 2.24 energy_GDP	Noted. Thanks	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
28283	54		70		The discussion of a Kaya decomposition is helpful but there should be discussion of the limitations of using the simple four factor Kaya method, and the need for a more detailed decomposition method as described in Koomey, Jonathan, Zachary Schmidt, Holmes Hummel, and John Weyant. 2019. "Inside the Black Box: Understanding Key Drivers of Global Emission Scenarios." Environmental Modeling and Software. vol. 111, no. 1. January. pp. 268-281. [https://www.sciencedirect.com/science/article/pii/S1364815218300793]. There are also issues about how "energy" is defined that need to be explicitly treated. Most scenario modelers use direct equivalence for non-combustion primary energy and that can make it seem like there's an increase in end-use energy efficiency when in fact it's energy system losses that are going down. The more detailed decomposition method in Koomey et al. 2019 avoids this problem by showing terms for final energy intensity per unit of economic activity and an energy system loss factor (PE/FE).	Taken into account - There would not be enough space in the Chapter to discuss these technical issues but it was made clear which types of energy use were used in the Kaya Decomposition (primary energy supply for the energy systems sector, and total final energy consumption for the industry, transport, and buildings sectors) and Koomey et al 2019 was cited in the figure caption where final energy consumption was used.	Jonathan Koomey	Koomey Analytics	Canada
5079	55	4	55	5	"A change in China's prouction structure…" - change in what way?	Accepted - Clarified that the production structure changed such that there was relatively less heavy industry and more lower-carbon manufacturing in that time period.	Lina Hollender	n/a	Germany
37405	55	8	55	9	The evidence for India here is just based on one paper and it erroneously dismisses efficiency improvement as an important factor in the relative decoupling that India has achieved in its energy intensity and emissions. Add the following reference: Kanitkar, T., Banerjee, R., & Jayaraman, T. (2015). Impact of economic structure on mitigation targets for developing countries. Energy for Sustainable Development, 26, 56-61, which suggests that in the absence of energy efficiency improvements, emissions increase would have been more.	Accepted - Text was revised and two more references were added (incl. Kanitkar et al 2015).	Government of India	Ministry of Environment, Forests and Climate Change	India
37485	55	8	55	8	"In India low emission efficiency and expansion of production and trade caused growth of emissions"- How is low emissions efficiency defined when it differs from sector to sector? In some industrial sectors for example, energy efficiency in India is close to global best practices. Please change appropriately.	Accepted - Text was revised and two more references were added.	Government of India	Ministry of Environment, Forests and Climate Change	India
86817	55	17	55	19	The inclusion of "decoupling emissions from economic development" as an important mitigation strategy going forward goes beyond multilaterally agreed terms, including the UNFCCC and the Paris Agreement, and its scope and implications are unclear. We suggest replacing that phrase by "low-emission and climate resilient development in the context of sustainable development and the erradication of poverty", in line with Article 2 of the Paris Agreement.	Taken into account - The sentence was deleted.	Government of Argentina	Ministry of Environment and Sustainable development of Argentina	Argentina
64949	55	28	64	34	I found sections 2.4.2.1 to 2.4.2.4 too detailed compared to other sections of the chapter, they could be further synthetized	Accepted - We shortened this section…	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
64951	55	28	64	34	Figures 2.20 to 2.25 look similar, sometimes very similar, several could be suppressed in my view. For example I would replace Fig. 2.24 by an illustration of the relative roles of the different transport sectors (planes/shpis/cars/trucks/trains…). Moreover, having so many similar figures from the same litterature source does not seem adequate for a broad review.	Noted - We discussed the option of replacing figures but because of lack of consistent and comparable data for the whole time period up to 2019, we reverted back to keeping the figures similar for each sector. The figures were all updated to reduce the size while keeping all the important information. The advantage of having the same figure concept for each sector is that they are consistent and comparable across sectors.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
71201	55	28	66	34	General comment on 2.4.2 Sectoral drivers. In this section you discuss in qualitative terms the opportunities for decarbonization in each major sector. I'm missing quantifications. So how important are all these opportunities mentioned for the bigger picture? Perhaps this is something that will be much more comprehensively captured in the Chapter on Mitigation? If this is the case, then it would be good to refer the reader to that Chapter. Now the reader is left with a list of possibilities for each sector but without any understanding about the relative importance of these possibilities. At least, it would be good to get some idea about the approximate ballpark for the importance of the listed options in terms of emissions mitigation. I see now that a nice Figure with quantifications of the mitigation opportunities in the different sectors are included in Chapter 12 (Table 12.2), so perhaps a cross-reference would do the trick in Chapter 2.	Accepted - Referred to individual sector chapters and to Chapter 12.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
63469	55	29	55	33	It would be useful to include this very significant info. in the summary for policy makers section (i.e., energy sector remains largest contributor of GHG).	Noted - The comment was passed on to CLAs for consideration in the SPM.	Government of Canada	Environment and Climate Change Canada	Canada
513	55		4		A change -> changes or have->has	Accepted - text revised	Kim Hana	KAIST	Republic of Korea
515	55		6		Comma after In india	Accepted - text revised	Kim Hana	KAIST	Republic of Korea
517	55		14	15	rising income- sentence suffers from gramatical errors. No verb.	Noted - The whole paragraph was deleted to save space. (The initial response was: Rejected - The word 'offset' is the verb in past tense.)	Kim Hana	KAIST	Republic of Korea
519	55		15	16	IPCC report should be objective. However, I think the authors should be cautious when they explain the situation regarding the LDC or low-income countries. Significant increases in carbon intensities in this group are problems but income level increases are not. So, please consider modifying this sentence a bil not to dealing with the other drivers' contribution to the emissions in parallel with carbon intensities.	Noted - The whole paragraph was deleted to save space. (The initial response was: Accepted - The driving factors were correctly cited, but it was made clear that the level of total emissions in low-income countries are negligible compared to other world reagions.)	Kim Hana	KAIST	Republic of Korea
521	55		26	27	after globally, insert semi-colon	Accepted - text revised	Kim Hana	KAIST	Republic of Korea
523	55		34		have -> has	Accepted - text revised	Kim Hana	KAIST	Republic of Korea
525	55		34	43	First, the causal relationship between GDP and energy consumption (in turn CO2 emissions) has been a research topic. In this paragraph, the authors point out the per capita GDP is attributed to the contributor of CO2 emissions from energy consumptions. However, in following sentence, they talked about the mutual relationships. It needs to be clarified and explained in more specific way.	Rejected - The text reflects the results shown in Fig 2.21 and the literature. We think the phrasing is correct and clear and could not think of a way to express it differently.	Kim Hana	KAIST	Republic of Korea
16113	55		4		A change -> changes or have->has	Accepted - text revised	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
16115	55		6		Comma after In india	Accepted - text revised	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16117	55		14	15	rising income- sentence suffers from gramatical errors. No verb.	Rejected - The word 'offset' is the verb in past tense.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16119	55		15	16	IPCC report should be objective. However, I think the authors should be cautious when they explain the situation regarding the LDC or low-income countries. Significant increases in carbon intensities in this group are problems but income level increases are not. So, please consider modifying this sentence a bil not to dealing with the other drivers' contribution to the emissions in parallel with carbon intensities.	Accepted - The driving factors were correctly cited, but it was made clear that the level of total emissions in low-income countries are negligible compared to other world reagions.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16121	55		26	27	after globally, insert semi-colon	Accepted - text revised	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16123	55		34		have -> has	Accepted - text revised	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16125	55		34	43	First, the causal relationship between GDP and energy consumption (in turn CO2 emissions) has been a research topic. In this paragraph, the authors point out the per capita GDP is attributed to the contributor of CO2 emissions from energy consumptions. However, in following sentence, they talked about the mutual relationships. It needs to be clarified and explained in more specific way.	Rejected - The text reflects the results shown in Fig 2.21 and the literature. We think the phrasing is correct and clear and could not think of a way to express it differently.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
72547	56	1	56	1	Similar to last suggestion.	Taken into account - Figures and labels were redrawn.	Yun Hang	Emory University	United States of America
76919	56	1	56	5	Figure 2.20: I would like to suggest adding the corresponding amounts of CO2 for each region panel. That would supplement the plots by indicating how much each region contribute to the total World emissions. Percent changes from 1990 are useful, but they do not provide a complete view on the problem. The overal magnitude is useful too.	Accepted - A new panel (panel b) was added in each figure that shows the share of total sector emissions for each region as well as per-capita emissions for each region (and sector). Whilst this does not show absolute total numbers, the relative importance of regions and per-capita emissions is included, thereby addressing the issue of showing inequity of emissions across regions.	Philippe Marbaix	Université catholique de Louvain	Belgium
86163	56	1			Took me a while to realise this is first of series of sectoral versions. They take a lot of space. Consider moving to an Annex? Possibly could put a chart in text with global x sector, and refer across to Annex for the regional components?	Noted - We considered the option of moving figures to an Appendix, but refrained in the end because we think the figures contain important information. We made the figures smaller so they use less space. We deleted other text to make the section shorter.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
5215	56	9	56	9	The comment between bracket is not correct: As you implicitly refer to electricity production, renewables have not replaced fossil production. In most countries, their production came in addition, and has may be avoided to increase the fossil production capacity. I dont see a single example where Coal or gas fired plant have been shutdown and replaced by renewables. The case of China is illustrative: thanks to a strong development of nuclear and renewable generation capacity, the increase of fossil fired plants has been limited. In some countriess, the fossil share may have decreased because total production increased while yhe fossil production was more or less steady.	Accepted - Text revised to clarify that 'fossil share' means the 'relative amount of fossil fuels in the energy mix'	Michel SIMON	Retraité/ Pdt d'association	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
82605	56	9	56	9	The text defines improvements fossil share as "the substitution of fossil fuels by renewables". This should read "the substitution of fossil fuels by non-fossil sources" as all non-fossil sources, including nuclear as well as renewables, will reduce the fossil share.	Taken into account - In line with comment #5215 we have replaced the phrase with "relative amount of fossil fuels in the energy mix". This allows for all non-fossil sources.	Jonathan Cobb	World Nuclear Association	United Kingdom (of Great Britain and Northern Ireland)
10527	56	15	56	15	"by" is missing after "driven"	Accepted - text revised	Philippe Waldteufel	CNRS	France
76591	57	4	57	5	Limiting the cause of the increase of carbon intensity in Asia-Pacific to the closure of the Japanese nuclear plants following the Fukushima accident is at odds with other parts of the same chapter (from line 16 to line 20) mentioning a broader range of explanations	Accepted - text revised. Made it clear that this was only one reason.	Charlotte MIJEON	Réseau "Sortir du nucléaire" (organiszation affiliated to the French Climate Action Network)	France
15213	57	11	57	21	The statement about China's energy data in this paragraph does not tally with the facts. It is suggested to revise the content in line 14 to “The growth of coal emissions slowed after 2010, primarily due to a slowdown of economic growth and fewer coal capacity additions in China, and even declined between 2011 and 2019 (Friedlingstein et al. 2019a; Peters et al. 2020 ； China Energy Statistical Yearbook (2019).2020.10)” ； It is also suggested to change the last sentence of this paragraph to “Large ongoing and planned capacity increases in India, Turkey, Indonesia, Vietnam, South Africa and other countries have become the major drivers of the coal renaissance after 2014(UNEP 2017; Jan Christoph Steckel; Jérôme Hilaire; Michael Jakob; Ottmar; Edenhofer et al. 2018a).”	Accepted - text revised accordingly	Government of China	China Meteorological Administration	China
27581	57	22	57	29	Delete "Recent studies show that incumbent energy utilities have only in rare exceptions transitioned a sizable share of their portfolios towards renewable energy (Alova 2020; Green et al. 2020). It is rather new actors and interests driving these investments, often against considerable opposition and backlash from interest groups, particularly if implemented policies do succeed in scaling up renewable technologies (Moe 2015; Stokes and Breetz 2018). Fossil-based development pathways may also be chosen to meet the narrow goals of national and international interest groups, such as rent extraction or energy independence, and are shaped by issues such as lobbying, political ideology, and corruption (Lamb and Minx 2020; Jakob et al. 2020; Dorband et al. 2020; Roy and Schaffartzik 2021).", as these are not policy-neutral arguments.	Noted - The whole paragraph was deleted to save space. (The initial response was: Accepted - Deleted most of the paragraph, but kept the first sentence in a policy-neutral manner.)	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
5217	57	26	57	26	Insert an additional sentence: "As part of low carbon energies, it must be noticed taht nuclear is keeping a significant contribution to emissions mitigation. More tha 50 plants are under construction worldwide, promising a production capacity of ~60 Gwe and an annual prduction greater than 400 TWh/yr with CO2 emissions close to zero. In adddition, construction of over 150 units is under consideration in about 30 states."	Noted - The whole paragraph was deleted to save space. (The initial response was: Rejected - No citation from published literature available.)	Michel SIMON	Retraité/ Pdt d'association	France
27583	57	32	57	36	Delete "The focus of decarbonisation efforts in the energy systems sector needs to be on rapidly shifting to zero-carbon sources and actively phasing out all fossil fuels, rather than relying on the short-lived effects of fuel switching (Peters et al. 2020; Jackson et al. 2019). Energy demand reduction remains an important mitigation tool (Creutzig et al. 2016b), (Climate Action Tracker 2020), (ClimateWorks Australia 2020), (Falk et al. 2020).", as this is not a policy-neutral statement.	Taken into account - The sentence was 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
29497	57	32	57	34	The sentence "The focus of decarbonisation efforts in the energy systems sector needs to be on rapidly shifting to zero-carbon sources and actively phasing out all fossil fuels, rather than relying on the short-lived effects of fuel switching." is a political or normative statement and not a scientifically neutral sentence. It implies that you should remove the source of the emissions rather than removing the emissions by CCS or other carbon removal technologies. This sentence should be rephrased.	Taken into account - The sentence was deleted.	Government of Norway	Norwegian Environment Agency	Norway
51983	57	32	57	33	The statement "The focus of decarbonisation efforts in the energy systems sector needs to be on rapidly shifting to zero-carbon sources and actively phasing out all fossil fuels" undermines all carbon removals technologies such as CCU/CCS and limits the options for decisoin makers to carbon neutrality. Omit the sentence	Taken into account - The sentence was deleted.	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
86819	57	32	57	34	The mention to "the focus of decarbonisation efforts in the energy systems sector needs to be on rapidly shifting to zero-carbon sources and actively phasing out all fossil fuels" seem to go beyond the 2030 Agenda and its SDGs, in particular SDG 7. We suggest rewording it in a manner consistent with that Agenda and the SDGs, as follows: the focus on developing sustainable energy systems needs to on promoting clean and renewable energies".	Taken into account - The sentence was deleted.	Government of Argentina	Ministry of Environment and Sustainable development of Argentina	Argentina
64953	57	37	60	2	The industry sector section could briefly comment on the fast dynamics of F-gas emissions and their applications	Taken into account - Trends of F-gases are covered in Section 2.2.2.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
72549	58	1	58	1	Similar to last suggestion.	Taken into account - Figures and labels were redrawn.	Yun Hang	Emory University	United States of America
527	58		5	12	I got the logic, but the emissions (here) are not the CBE, therefore, the attribution of the changes in the emissions to the basic materials or consturction minerals and manufactured products needs to be checked. Or, if the sentences from line 13 to 15 are placed first, then the lines 5 to 7 come; it would be nicer.	Taken into account - The sequence of sentences was changed.	Kim Hana	KAIST	Republic of Korea
16127	58		5	12	I got the logic, but the emissions (here) are not the CBE, therefore, the attribution of the changes in the emissions to the basic materials or consturction minerals and manufactured products needs to be checked. Or, if the sentences from line 13 to 15 are placed first, then the lines 5 to 7 come; it would be nicer.	Taken into account - The sequence of sentences was changed.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
20065	59	27	59	33	Also in some cases (e.g. UK) improvements in emission intensity is driven by a shift from an industrial to a services-based economy rather than technological improvements (Koasidis et al., 2020) -Koasidis, 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.	Taken into account - Reference was included in support of the statement that there are "deep regional differences … and …large unexploited potentials".	Haris Doukas	National Technical University of Athens, Greece	Greece
36995	59	27			In reference to Figure 2.23 “Indeed, the ratio of industrial energy use to GDP has steadily declined since 2010 in all regions (Figure 2.23).” Figure 2.23 refers to buildings energy use, not industrial use.	Accepted - The sentence was deleted.	Roger Fouquet	LSE	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
20067	59	33	59	35	Technological improvements refer to implementation of BATs or in general? Also for the inability of BATs to assist in reaching long-term goals useful references are: -Fischedick, M., Marzinkowski, J., Winzer, P., & Weigel, M. (2014). Techno-economic evaluation of innovative steel production technologies. Journal of Cleaner Production, 84, 563-580. -Arens, M., Worrell, E., Eichhammer, W., Hasanbeigi, A., & Zhang, Q. (2017). Pathways to a low-carbon iron and steel industry in the medium-term–the case of Germany. Journal of Cleaner Production, 163, 84-98.	Accepted - References were added where appropriate.	Haris Doukas	National Technical University of Athens, Greece	Greece
529	59		37	39	Grammatical issue (too long subject). Commna should be removed. Makes and requires should be plural. Make and require.	Accepted - The sentence was simplified and the grammar corrected.	Kim Hana	KAIST	Republic of Korea
16129	59		37	39	Grammatical issue (too long subject). Commna should be removed. Makes and requires should be plural. Make and require.	Accepted - The sentence was simplified and the grammar corrected.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
72457	60	8	60	10	"Residential buildings accounted for the majority of this sector's emissions (64%, 6.4 GtCO2eq, including both direct and indirect emissions), followed by non-residential buildings (35%, 3.5 GtCO2eq)." What is then this 1% that is neither residential nor non-residential ? If there are only both residential and non-residential: make the budget 100% and shorten the sentence.	Taken into account - The 1% difference was solely due to rounding. This has been corrected.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
82527	60	14	60	15	IEA World Energy Outlook 2020 data is now available. Please check the latest version of the outlook.	Accepted - All relevant data in this section have been updated to 2019.	Jinsun Lim	International Energy Agency	France
531	60		1	2	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
16131	60		1	2	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
72551	61	1	61	1	Similar to last suggestion.	Taken into account - Figures and labels were redrawn.	Yun Hang	Emory University	United States of America
533	61		6	7	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
535	61		9	11	The COVID-19 impacts will influence the floor space per capita which could be temperary but somewhat will be permanent. Therefore, please avoide conclusive expression, if possible, adds the possibility of the COVID-impact on the floor area per capita.	Accepted - It was made clear that these findings refer to "before the COVID-19 pandemic". More recent data are not available.	Kim Hana	KAIST	Republic of Korea
537	61		14	15	Incorrect in-text citation, also in line 17	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
16133	61		6	7	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16135	61		9	11	The COVID-19 impacts will influence the floor space per capita which could be temperary but somewhat will be permanent. Therefore, please avoide conclusive expression, if possible, adds the possibility of the COVID-impact on the floor area per capita.	Accepted - It was made clear that these findings refer to "before the COVID-19 pandemic". More recent data are not available.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16137	61		14	15	Incorrect in-text citation, also in line 17	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
82525	62	1	62	1	IEA World Energy Outlook 2020 data is now available. Please check the latest version of the outlook.	Accepted - All relevant data in this section have been updated to 2019.	Jinsun Lim	International Energy Agency	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
51981	62	7	62	17	Consider final energy price as a driver towards improvements in building intensities. For example, in Saudi Arabia and other GCC countries, energy price reform was a significant driver to overall improvements in building energy intensity.	Accepted - text revised	Government of Saudi Arabia	Sustainability Advisor to the Minister Ministry of Petroleum and Mineral Resources	Saudi Arabia
71203	62	7	62	17	You could cite the following paper presenting the energy efficiency policy instruments abopted by the EU: 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 - Reference was added.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72299	62	7	62	17	You should cite the following paper presenting the energy efficiency policy instruments adopted by the EU: 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, https://doi.org/10.1016/j.enbuild.2020.110322. (https://www.sciencedirect.com/science/article/pii/S0378778820317229).	Accepted - Reference was added.	bertoldi paolo	european commission	Italy
15215	62	13	62	14	The statement “relatively ineffective to date” is unclear and does not adequately describe China's green building renovation policies and effects. It is suggested to modify the sentence to “The Chinese central government has made great efforts to promote green retrofit in billion m2 existing buildings by launching various policies, including command and control, economic incentives, and technology measures. Nevertheless, there is a big gap between the total rate of building green retrofit in the nation and the retrofit potential to be tapped in future.” See the following literature： Liu G, Tan Y, Li X. China's policies of building green retrofit: a state-of-the-art overview[J]. Building and Environment, 2020, 169: 106554.	Accepted - Sentence inserted (in shortened form)	Government of China	China Meteorological Administration	China
64955	62	32	64	34	The transport sector section could include a brief analysis of the impact of COVID and related lessons for the future	Taken into account - The effect of COVID on all sectors, including Transport is described in Section 2.2.2 around Fig. 2.5. We added a statement at the beginning of 2.4.2.4: "For effects of COVID-19 on transport sector emissions, refer to section 2.2.2."	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
72459	62	32			In section 2.4.2.4 on transport, it is indeed very interesting to discuss the various modes (road, air, sea) but it would also be interesting to discuss separately passenger and freight as the actions for mitigation on both are unlikely to be based on similar mechanismsn, cultural and social behaviors	Taken into account - For space reasons, section 2.4.2.4 can only provide a broad overview of main drivers. Details are discussed in the Transport chapter (Chapter 10).	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
85361	62	34	62	34	Missing a reference to the source of data used, and the scope of the coverage and accuracy for the statements.	Accepted - We have added a sentence at the beginning of Section 2.4.1 to identify EDGAR v5.0 as the databased used. For further details we refer to the publication by Lamb et al 2021.	Neil Dickson	ICAO	Canada
539	62		30	31	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
16139	62		30	31	Incorrect in-text citation	Accepted - This is being corrected during final editing.	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
72553	63	1	63	1	Similar to last suggestion.	Taken into account - Figures and labels were redrawn.	Yun Hang	Emory University	United States of America
6117	63	5			Recent evidence using a particularly large panel dataset from Liddle and Huntington (2020) suggests that the income/GDP per capita elasticity of road gasoline demand in OECD countries is less than 0.6, but this elasticity is unity or greater for both road gasoline and road diesel demand in non-OECD countries and is well over unity (i.e., 1.6 or higher) for road diesel demand in OECD countries. In other words, with the exception of road gasoline demand in OECD countries, road fuel demand increases at least as fast as the rate that GDP per capita increases. Liddle, B. & Huntington, H. 2020. 'On the Road Again': a 118 Country Panel Analysis of Gasoline and Diesel Demand. Transportation Research A: Policy and Practice, Vol. 142, pp, 151-167.	Accepted - Statement and references were added to the text.	brantley liddle	independent consultant	United States of America
543	63		7	8	There are so many in-text citation issues.	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
545	63		15		Does passenger-km mean per capita travel distance? Or the muliplying the summation of every passenger's travel distance? Please make it clear	Accepted - Clarified that it is the product of number of travellers and distance travelled.	Kim Hana	KAIST	Republic of Korea
16143	63		7	8	There are so many in-text citation issues.	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16145	63		15		Does passenger-km mean per capita travel distance? Or the muliplying the summation of every passenger's travel distance? Please make it clear	Accepted - Clarified that it is the product of number of travellers and distance travelled.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
9851	64	1		5	In the case of Southe ast Asia countries, car dependency has been growing together with higher motorbike use. Not only for private use, it has also been growing due to online transport applications such as uber and gojek. Such online transport becomea a competitor of public or mass transit for intercity travel.	Accepted - Added 'on-demand private transport services' to sentence.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
20069	64	4	64	5	For non-OECD countries fuel demand is also expected to rise by 77% by 2050 in a reference case: EIA. (2019). International Energy Outlook 2019, https://www.eia.gov/outlooks/ieo/pdf/ieo2019.pdf	Accepted - Added statement and reference.	Haris Doukas	National Technical University of Athens, Greece	Greece
8237	64	18	64	22	When raising the growth of emissions from aviation, it is my opinion that it would be out of interst for the reader to also get the share of freight vs individuals using it as a way of transportation	Taken into account - For space reasons, section 2.4.2.4 can only provide a broad overview of main drivers. Details are discussed in the Transport chapter (Chapter 10).	Frida Zahlander	DanChurchAid	Denmark
85363	64	18	64	18	This statement should be accompanied by a disclaimer as not considering the impacts of COVID-19. A reference to the ICAO conducted analyses would be beneficial to the text: https://www.icao.int/sustainability/Pages/Economic-Impacts-of-COVID-19.aspx	Taken into account - The effect of COVID on all sectors, including Transport is described in Section 2.2.2 around Fig. 2.5. We added a statement at the beginning of 2.4.2.4: "For effects of COVID-19 on transport sector emissions, refer to section 2.2.2."	Neil Dickson	ICAO	Canada
78317	64	23	64	35	This is chapter 5/10/13 material	Taken into account - The whole paragraph was deleted to save space.	Jim Skea	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
20071	64	24	64	28	This is also evident in cases where light-duty vehicle electrification is rapidly progressing (e.g. Norway) (Koasidis et al., 2020): -Koasidis, K., Karamaneas, A., Nikas, A., Neofytou, H., Hermansen, E. A., Vaillancourt, K., & Doukas, 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(14), 5832.	Noted - The sentence to which this comment refers has been deleted.	Haris Doukas	National Technical University of Athens, Greece	Greece
8239	64	25	64	28	When mentioning the increasing popularity of electrified motorisation, the issue with carbon intensive production (e.g. battery) should be mentioned	Noted - The sentence to which this comment refers has been deleted.	Frida Zahlander	DanChurchAid	Denmark
71205	64	28	64	30	The concluding sentence for the obstacles for elecrtrifide motorization is: "This suggests a key role for more stringent policies, as well as demand management policies to complement technological innovation, including remote working and meetings, mass transit and active transport (walking and cycling)". Shouldn't public/governmental support for infrastructure development (charging capacity) be mentioned here as a major obstacle for both electrification and hydrogenization of the transport sector?	Noted - The sentence to which this comment refers has been deleted. Instead the reader is referred to Chapters 5, 10 and 13 where details of transport electrification and policy options are being discussed.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
24899	64	36	64	41	Please add "AFOLU CO2 estimates included in this chapter are not necessarily comparable with country GHG inventories, due to different approaches to estimate the 'anthropogenic' CO2 sink (see Grassi et al. 2018 and Chapter 7)". Ref: Grassi et al., 2018: Reconciling global-model estimates and country reporting of anthropogenic 37 forest CO2 sinks. Nat. Clim. Chang., https://doi.org/10.1038/s41558-018-0283-x	Accepted - Sentence inserted.	Giacomo Grassi	Joint Research Centre, European Commission	Italy
547	64		4	5	rather than staring from a low baseline, please specify. The readers should be informed that travel in non-OECD so now (in 2017) is larger than in OECD.	Taken into account - The whole sentence was deleted to save space; the figure accompanying this section now shows the relative contributions of each world region to transport emissions as well as the relative increase from 2010 to 2019.	Kim Hana	KAIST	Republic of Korea
549	64		26		Incorrect in-text citation	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
551	64		31	32	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
16147	64		4	5	rather than staring from a low baseline, please specify. The readers should be informed that travel in non-OECD so now (in 2017) is larger than in OECD.	Taken into account - The whole sentence was deleted to save space; the figure accompanying this section now shows the relative contributions of each world region to transport emissions as well as the relative increase from 2010 to 2019.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16149	64		26		Incorrect in-text citation	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16151	64		31	32	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
8083	65	1	65	3	Figure 2.25: Please revise this figure. The explanation is too scarce, and averaging values from 2010 to 2018 should be done only if values for 2018 are presented.	Accepted - The figure and its caption have been updated. 2019 data were included.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
72555	65	1	65	1	Similar to last suggestion.	Taken into account - Figures and labels were redrawn.	Yun Hang	Emory University	United States of America
20587	65	10	65	10	Another reference that is worth studying is Vancutsen et al. (accepted in Science Advances), "Long-term (1990-2019) monitoring of tropical moist forests dynamics", https://doi.org/10.1101/2020.09.17.295774	Accepted - Reference included.	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
45777	65	10	65	10	Should please read "Ruminant livestock rearing…" instead of just "Livestock rearing…", since most of the following information relates to ruminants (see also Chapter 7 page 36 lines 1-3).	Accepted - Sentence revised.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
54705	65	11	65	13	Citation(s) needed.	Accepted - Citation added.	Government of United States of America	U.S. Department of State	United States of America
553	65		1		legends should be more informative, in addition, inconsitent capitalization needs to be modified.	Taken into account - The figures for this chapter were modified.	Kim Hana	KAIST	Republic of Korea
16153	65		1		legends should be more informative, in addition, inconsitent capitalization needs to be modified.	Taken into account - The figures for this chapter were modified.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
11729	66	13	66	15	There are very few countries where traditional diets have included a big consumption of vegetables, instead increased vegetable consumption is an indicator of affluence and goes in tandem with increase in meat consumption (Pradhan P, Reusser DE, Kropp JP (2016) Embodied Greenhouse Gas Emissions in Diets. PLOS ONE 11(7)). The global increase in consumption of vegetables has been more rapid than the total increase of consumption of animal foods (FAOSTAT). Consumption is a crucial driver for food systems and thus emissions from agriculture. But on consumption, few measures are highlighted in the report. This could be developed more and perhaps discussed in preparation work for the next report.	Taken into account - The reference was added and consumption as a driver was confirmed.	The Royal Swedish Academy of Agriculture and Forestry (Group Review)	Kung. Skogs-och Lantbruksakademien	Sweden
37523	66	15	66	20	The statement "Over the last few decades, low- and middle-income countries such as India, Brazil, Egypt, Mexico and South Africa have experienced such a rapid dietary “westernisation”" should be preceeded with a discussion how detrimental is the westernised diet behaviour for the gloabal climate system. This should clearly bring out an analysis of such behaviour, which countries have been following such behaviour for long and have added how much emissions to atmosphere. Following may be cited: Heller, M.C. and Keoleian, G.A. (2015), Greenhouse Gas Emission Estimates of U.S. Dietary Choices and Food Loss. Journal of Industrial Ecology, 19: 391-401. https://doi.org/10.1111/jiec.12174	Accepted - Additional explanation and the reference was added.	Government of India	Ministry of Environment, Forests and Climate Change	India
54707	66	22	66	23	Needs more than a single citation. This is a critical point. Also should say "The 1.5°C target set in the Paris Agreement ... " or something more specific than "The Agreement".	Taken into account - The whole paragraph was deleted to save space.	Government of United States of America	U.S. Department of State	United States of America
71207	66	22	66	34	The AFOLU sector is likely to be heavily affected by climate change in terms of unpredictability due to changing weather patterns etc. I would like to see a mentioning of this in the section 2.4.2.5 and a cross-reference to the WGI section where implications of changing weather patterns are treated.	Taken into account - The whole paragraph was deleted to save space.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
78319	66	22	66	22	Significance of what? PA or AFOLU?	Noted - The whole paragraph was deleted to save space. (The initial response was: Accepted - Sentence revised).	Jim Skea	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
54709	66	27	66	31	Some of the approaches listed are "nature-based solutions" so need to modify text accordingly.	Noted - The whole paragraph was deleted to save space. (The initial response was: Taken into account - The reference to 'nature-based solutions' was deleted to avoid ambiguities and confusion.)	Government of United States of America	U.S. Department of State	United States of America
70157	66	27			Millward-Hopkins et al. 2020). However, the authors of this study are very clear about assumptions and limitations made in producing these results - e.g. an instantaneous (and cost-free) conversion of the entire global building stock into advanced new buildings with very low heating and cooling energy requirements. In addition, the authors make it clear that incrementalist propositions such as green growth and green consumerism are inadequate to avoid significant levels of warming.	Noted - The whole paragraph was deleted to save space. (The initial response was: Rejected - This comment pertains to pg 67 line 27 not pg 66, but it is unclear what the reviewer's comment is.)	Rayner Andersen	Department of Fisheries and Oceans	Canada
86761	66	27			The reference to "plant-based diets" as a mitigation option should be removed as there is evidence that supports that meat based diets also contribute to carbon sequestration and mitigation.	Noted - The whole paragraph was deleted to save space. (The initial response was: Rejected - The literature clearly states that plant-based diets have lower carbon footprints than meat-based diets and are therefore a mitigation option. We also refer to "enteric fermentation mitigation", which is an option to reduce emissions from meat-based diets.)	Government of Argentina	Ministry of Environment and Sustainable development of Argentina	Argentina
54711	66	31	66	34	Need to cross-reference to Chapter 7 here.	Accepted - Cross-reference to Chapter 7 was added.	Government of United States of America	U.S. Department of State	United States of America
9035	66	36			Would you give the comparative graph between nations or regions about Poverty and inequality as drivers of GHG emissions.	Rejected - Due to space constraints and lack of adequate data, a figure for this section is not inserted.	Bayu Dwi Apri Nugroho	Universitas Gadjah Mada	Indonesia
25117	66	36	67	38	The title of Section 2.4.3 as 'Poverty and inequality' as drivers of GHG emissions is a little problematic. Poverty in particular isn't a driver in the conventional sense (like urbanisation or trade for example). There's already a section on inequality in 2.6 - suggest this text be moved there. Or framed differently maybe like Section 2.5 on Technological change as key to reducing emissions.	Accepted partially - The title has been changed but the text within not reframed substantially because the section is distinct from section 2.6. This section provides evidence on how eradicating poverty and energy poverty might affect emissions. In this sense, it covers how "changes" in poverty and inequality drive emissions rather than poverty and inequality as drivers per se. Keeping the current formulation and focus is important as there is still much misunderstanding on how access to modern energy services might affect emissions growth and how shifts in income inequality affect emissions. The title is edited but this section is retained as is because understanding of how poverty alleviation and changes in income inequality affect emissions is increasingly policy relevant.	Minal Pathak	WGIII TSU, Ahmedabad University	India

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
77741	66	36	67	39	This section could be strengthened by mentioning the important linkages between top-end wealth inequality and emissions. There are a number of channels here. With regard to income, only energy-intensive consumption is mentioned. The carbon-intensive consumption of high income individuals should be discussed, including the studies by Chancel & Piketty (2015), and Chancel's recent book. The role played by income inequality in driving status consumption and longer working hours should also be discussed (e.g. see the work of Juliet Schor & Andrew Jorgenson; Wiedmann et al. 2020). With regard to wealth inequalities, the political economy theories of James Boyce and Liam Downey, and Downey's sociological work, point to the role of wealth concentration in the ownership of carbon-intensive firms, the dominance of carbon-intensive supply chains, and the political influence of wealthy elites in the obstruction of climate policy (the Koch brothers being a prominent example but the influence of carbon-intensive capital over policy obviously goes much wider than that). Just because these relationships are difficult to study and measure does not mean they should be ignored; a more than sufficient amount of academic literature has addressed them (including but by no means limited to those cited here) to warrant discussion in this section of the IPCC report. Good starting points are: Knight, Kyle W., Juliet B. Schor, and Andrew K. Jorgenson, 'Wealth Inequality and Carbon Emissions in High-Income Countries', Social Currents, 4 (2017), 403–12; Downey, Liam, Inequality, Democracy, and the Environment (New York: New York University Press, 2015); Downey, Liam, and Susan Strife, 'Inequality, Democracy, and the Environment', Organization and Environment, 23 (2010), 155–88; Boyce, James K., 'Inequality as a Cause of Environmental Degradation', Ecological Economics, 11 (1994), 169–78; Boyce, James K., The Political Economy of the Environment (Northampton, MA.: Edward Elgar, 2002).	Rejected - There is a separate section 2.6 in the chapter that assesses the evidence on how affluence and top end income inequality relate to emissions. This comment is more relevant for section 2.6.	Fergus Green	Utrecht University	Netherlands
28881	66	37	66	38	Any reference to support the statement?	Accpeted - have inserted reference in support of the statement	Nathalie Hilmi	Centre Scientifique de Monaco	France
555	66		11		Incorrect in-text citation	Accepted - this comment refered to the citation style, which has been corrected now	Kim Hana	KAIST	Republic of Korea
557	66		31		Incorrect in-text citation	Accepted - this comment refered to the citation style, which has been corrected now	Kim Hana	KAIST	Republic of Korea
16155	66		11		Incorrect in-text citation	Accepted - this comment refered to the citation style, which has been corrected now	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16157	66		31		Incorrect in-text citation	Accepted - this comment refered to the citation style, which has been corrected now	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
71209	67	6	67	10	I find the stated relationships very interesting, but are there any explanations offered to why you observe them? E.g., it would be interesting to understand why higher income inequality is associated with lower carbon emissions or why more equal societies are more likely to place a higher value on environmental public goods? Is it linked to a more equitable distribution of education? Do these scholar offer some plausible explanations to these findings?	Accpeted - the sentence is now edited to communicate the point more clearly	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72461	67	14	67	16	The last part of the sentence: ", controlling for other important drivers (Baloch et al. 2020)." is cryptic. Precision should be added here.	Rejected - the point being made is relevant but has been edited to clarify further	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
64895	67	17	67	30	Recent research investigating final energy use at a household level in Nepal, Vietnam and Zambia shows that achieving basic needs (access to modern fuels, sufficient food, access to safe water, basic education) is associated with reduction in energy demand. This further streghten the argument of synergy between climate mitigation and elevating poverty. See Baltruszewicz et al 2021 https://iopscience.iop.org/article/10.1088/1748-9326/abd588/meta	Accepted - the reference Baltruszewicz et al., 2021 has been added and text that makes this point has also been inserted	Marta Baltruszewicz	University of Leeds	United Kingdom (of Great Britain and Northern Ireland)
64897	67	25	67	27	and due to switching from high energy intensive house fuels (e.g. charcoal, firewood) to modern fuels (gas, el) can result in reduction of total final energy use. The reductions are possible in a context of collective provisioning (in form of electricity, indoor sanitation, waste treatment, access to public transport) accessibility and reliability. See Baltruszewicz et al 2021 https://iopscience.iop.org/article/10.1088/1748-9326/abd588/meta	Accepted - a sentence has been added to clarify the reasons further.	Marta Baltruszewicz	University of Leeds	United Kingdom (of Great Britain and Northern Ireland)
4095	67	26	67	26	13-40 GJ/capita -> for what duration of time?	Accepted - To keep down the word count we have added per capita yr-1 to the estimate to indicate that this is an annual estimate	Tatsuki Ueda	National Agriculture and Food Research Organization	Japan
71211	67	26	67	27	Please insert what the current world energy consumption per capita is, because it is not clear what you mean by "much less than the current world average energy consumption". "Much less" could mean almost anything here.	Accepted - The text now includes reference to the current world average energy consumption of 80 GJ per capita in 2020	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
70125	67	27			) although to keep the HDI above 0.8 appears to require consumption in the range of 30 to 100GJ/capita (Rao et al., 2019) https://www.nature.com/articles/s41560-019-0497-9	Accpeted - citation to the paper is added and additional text reflecting the findings also inserted	Rayner Andersen	Department of Fisheries and Oceans	Canada
9037	67	40			Would you give the comparative graph between nations or regions about Rapid urbanisation as a driver of GHG emissions.	Taken into account - For space reasons, we do not elaborate on urbanisation trends but refer to Chapter 8 for detail (e.g. Section 8.1.4 is dealing with 'The urban century') and provides details on rapid urbanisation by region/country.	Bayu Dwi Apri Nugroho	Universitas Gadjah Mada	Indonesia
54713	67	40	68	38	Section 2.4.4 needs to link rapid urban growth to impacts on AFOLU resulting, for example, from increased demand for charcoal (e.g., in Zambia, Malawi, DRC, https://cgspace.cgiar.org/bitstream/handle/10568/69008/SILL_report_aug2015.pdf?isAllowed=y&sequence=1).	Rejected - Considered, but overall and globally, this is not a large driver of GHG emissions from urbanisation. Because of space limitions this aspect was not added.	Government of United States of America	U.S. Department of State	United States of America
85173	67	40	68	38	The focus of section 2.4.4. is "Rapid urbanisation", but I would urge the chapter to consider modifying this to "Speed and scale" or "Rapid and large-scale" or "Speed and Size". It needs to convey to the reader that it's not only the pace of urbanization, but it's the size of the urban transition that's underway. And here, size in two ways: many different places urbanizing concurrently around the world--in fact it has never been this "global" before. And size in terms of the absolute size of cities and city-regions is so immense that it is overwhelming resources, infrastructure and ability to govern. It's only half of the picture to highlight "rapid" without including the magnitude of urbanization.	Accepted - Reference to scale added twice and references added.	Karen Seto	Yale University	United States of America
559	67		18	19	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
561	67		19	25	I can understand what the authors are saying. However, this sentence "further ~mitigation efforts" seems groundless. In a former sentence, the authors talked about the negligible impact on carbon emissions. The following sentence, though ~ within bounds of projections. Between these two sentences, it seems out of focus.	Accepted - This text has now been edited to explain this more clearly	Kim Hana	KAIST	Republic of Korea
563	67		33	34	Irrelevant	Rejected - It is unclear what the reviewer considers irrelevant	Kim Hana	KAIST	Republic of Korea
565	67		43	45	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
567	67		45	47	Personally, I love this type of sentence, which provides the information of the layout of the manuscript. However, other sections did not use this type of sentences. So, the first paragraph needs modification.	Noted - We added explanatory sentences where it was necessary to distinguish the section from other sections in the report. However, this was not the case with all sub-sections.	Kim Hana	KAIST	Republic of Korea
16159	67		18	19	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16161	67		19	25	I can understand what the authors are saying. However, this sentence "further ~mitigation efforts" seems groundless. In a former sentence, the authors talked about the negligible impact on carbon emissions. The following sentence, though ~ within bounds of projections. Between these two sentences, it seems out of focus.	Accepted - This text has now been edited to explain this more clearly	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16163	67		33	34	Irrelevant	Rejected - It is unclear what the reviewer considers irrelevant	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16165	67		43	45	Incorrect in-text citation	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16167	67		45	47	Personally, I love this type of sentence, which provides the information of the layout of the manuscript. However, other sections did not use this type of sentences. So, the first paragraph needs modification.	Noted - We added explanatory sentences where it was necessary to distinguish the section from other sections in the report. However, this was not the case with all sub-sections.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
12005	68	1	76	1	The analysis of rates of change, especially re by markets and technologies in this section have not referenced the potential impacts of recent significant decisions by large multilaterals to move their operations to net-zero. Such market shifts by the largest businesses globally (e.g., Microsoft, Amazon etc.) might be expected to drive social, technological and energy production change. I suggest reference to this as an incentive for change is warranted.	Noted. Beyond scope of this assessment. It is too early to tell how serious recently announced emissions targets are and how they will affect emissions.	Paul Rouse	Carnegie Climate Governance Initiative (C2G) - The Carnegie Council for Ethics and International Affairs	United Kingdom (of Great Britain and Northern Ireland)
83477	68	3	68	15	Ensure to update with latest remaining carbon budget assessment from WG1 Ch5.	Accepted - Statement was updated with the latest remaining carbon budget assessment from WG1 Ch5 (IPCC 2021)	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
85181	68	3	68	15	Urban areas are expected to expand by 0.6–1.3 million km2 between 2015 and 2050, an increase of 78%–171% over the urban footprint in 2015. This urban land expansion will result in average summer daytime and nighttime warming in air temperature of 0.5 °C–0.7 °C, up to ~3 °C in some locations and will likely drive a substantive increase in air conditioning use and cold storage for food. See Huang et al., 2019. https://iopscience.iop.org/article/10.1088/1748-9326/ab4b71	Accepted - Sentence revised and reference added.	Karen Seto	Yale University	United States of America
85175	68	5	68	8	Please look at Chapter 8--our chapter LAs Gurney and Kilkis have developed new estimates of emissions trends due to urbanization and urban infrastructure development. The paper is still in review.	Taken into account - We refer to Chapter 8 for details.	Karen Seto	Yale University	United States of America
48177	68	16	68	18	Add the literature after the literature (Bai et al. 2019). Wang et al.2019.China's CO2 peak before 2030 implied from characteristics and growth of cities. Nature Sustainability, 2: 748-754.	Noted - The comment was initially accepted and the reference was included. However, because of space restrictions, the whole paragraph was deleted in the final version.	Yang Wang	Beijing Climate Center	China
71213	68	24	68	26	Since 2010, changes in production or industrial structure has become a more important downward driver of cities'PBE and CBE of Chinese cities. Would it be possible to be more specific about what drives these structural changes? Is it a phase-out of heavy industry combined with digitalization, or what is it?	Noted - The comment was initially accepted and the sentence revised to explain that there was a shift from primary and secondary industries towards the tertiary sector (services). However, because of space restrictions, the whole paragraph was deleted in the final version.	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
48179	68	30	68	30	Add the literature after the literature (Baiocchi et al. 2015). Wang et al.2019.China's CO2 peak before 2030 implied from characteristics and growth of cities. Nature Sustainability, 2: 748-754.	Accepted - Reference included.	Yang Wang	Beijing Climate Center	China
9853	68	31		33	This reference serves a supporting statement to our comment on page 40 chapter 2.	Noted [comment refers to comment #9849 on Fig. 2.13]	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
72463	68	39			In section 2.4.5. the reference dates given are most of the time out of the stated scope of the AR6 (2010-2018). This could be because no such studies exists for the target time period. If this is the case, it is important 1) to underline this fact as a limitation in our general understanding of GHG emissions evolution and hence of actions that need to be taken to reduce them and 2) to underline the necessity for more governmental/non-governmental supports for this type of research.	Accepted - Two sentences were added to support points 1) and 2).	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
8307	68	45	69	10	While I agree with the content of this paragraph,I find it slightly misleading. I begins by saying that "It has been stated that international trade has led to significant net growth of global CO2 emissions (Jiang and Guan 2017)". The fact that this is mentioned in the IPCC report migh lead readers consider this statement as true. Especially in connection with the next sentence, stating that "This happens if countries with relatively less carbon-intensive production increasingly import from countries where production is more carbon intensive (Jiborn et al. 2018)". The referenced paper exactly shows that this is NOT the case, i.e. in many cases imports have shifted to relativley lower carbn-intensive sectors if adjusting for differences technologies across countries.	Taken into account - For space reasons and because this discussion is the topic of Section 2.3 (cross-referenced), both sentences were deleted.	Michael Jakob	MCC Berlin	Germany
569	68		4	5	Incorrect in-text citation; there are mutliple in-text citation errors. Please correct them.	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
571	68		40	41	Personally, I love this type of sentence, which provides the information of the layout of the manuscript. However, other sections did not use this type of sentences. So, the first paragraph needs modification. For consistencies across the sections, it needs to be adjusted in parallel with other sections	Noted - We added explanatory sentences where it was necessary to distinguish the section from other sections in the report. However, this was not the case with all sub-sections.	Kim Hana	KAIST	Republic of Korea
16169	68		4	5	Incorrect in-text citation; there are mutliple in-text citation errors. Please correct them.	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16171	68		40	41	Personally, I love this type of sentence, which provides the information of the layout of the manuscript. However, other sections did not use this type of sentences. So, the first paragraph needs modification. For consistencies across the sections, it needs to be adjusted in parallel with other sections	Noted - We added explanatory sentences where it was necessary to distinguish the section from other sections in the report. However, this was not the case with all sub-sections.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
37525	69	26	69	36	"This is because the consumption of domestic products increased in many countries, in particular in China and India, leading to increased domestic and therefore global CO2 emissions." This needs to be substantiated with appropriate non-single source references. A comparison of domestic consumption behaviour in terms of per capita consumption in countries would be useful.	Accepted - References were added.	Government of India	Ministry of Environment, Forests and Climate Change	India
37511	69	29	69	31	this does not seem to be correct, and seems to present a biased and partial view of domestic production contibuting to increased emissions.	Taken into account - References were added in support of the statement.	Government of India	Ministry of Environment, Forests and Climate Change	India
37009	69	31	69	33	This may not be true always as emission intensity of India is closer to United States	Taken into account - The statement was clarified by adding 'at the aggregate level' and a reference supporting the statement was added.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
53717	69	33	69	33	Grammar error, "showed an increases" should be "showed an increase".	Accepted - Corrected.	ZHENG XINZHU	China University of Petroleum (Beijing)	China

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
86821	69	34	69	36	The whole sentence "This was because, as an indirect consequence of the trade war, some countries will increase emission, of which those from land-use changes in Brazil and Argentina far exceed the emission reductions due to reduced global production" must be deleted, as its content is not justified nor based on scientific evidence, while including false affirmations in the case of Argentina and land-use change.	Taken into account - The sentence was rephrased so as to not identify any individual countries. The reference was added.	Government of Argentina	Ministry of Environment and Sustainable development of Argentina	Argentina
8241	69	37	69	48	If countries would focus their production on what the country is most suitable to produce; based on sustainability (e.g. depending on elecitricity mix and natual resources), and not purely on economic gains - trade might actually decrease global emissions.	Noted - The last two sentences of this paragraph indeed leave open this possibility.	Frida Zahlander	DanChurchAid	Denmark
61611	69	40	69	41	"…transfers of and investment in low-carbon and renewable energy…". There is no need to increase the vagueness by including “renewable”, especially as the wording can mean low-carbon AND renewable (excluding at least some renewable energy sources as well as nuclear energy and CCS) or both low carbon (including nuclear and CCS) and renewable (including the wide variety of renewable energy sources, which are not all clean nor sustainable). Recommend to either remove “and renewable” as it is unnecessary or explicitly list all the technologies included: nuclear, CCS, BECCS, wind, solar, hydro, geothermal and those bioenergy and waste-energy sources that are sustainable and have a low climate forcing.	Accepted - Removed "and renewable". We also removed the word "energy", leaving only "low-carbon technologies". This may include non-energy technologies.	Rauli Partanen	Think Atom	Finland
65649	69	40	69	41	"[..] transfers of and investment in low-carbon and renewable energy [..]". The term "low-carbon" accounts for renewables, nuclear energy, and CCS. Either remove the "and renewable" as unnecessary or explicitly mention all three technologies.	Accepted - Removed "and renewable". We also removed the word "energy", leaving only "low-carbon technologies". This may include non-energy technologies.	Eero Hirvijoki	Aalto University	Finland
573	69		5	6	How about changing this question into more realistic one? Reduced trade?	Noted - The question is encompassing and indeed includes the sub-question how reduced trade may affect global emissions. We leave the question as is because it is more generic and allows for more cases to be considered.	Kim Hana	KAIST	Republic of Korea
575	69		16		Incorrect in-text citation: This should be Author(year) type. Line 28 as well.	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
577	69		42	48	Incorrect in-text citation- I am not going to point out the in-text citation errors anymore, believing that it will be reviewed finally.	Accepted - This is being corrected during final editing.	Kim Hana	KAIST	Republic of Korea
579	69		45	48	Regarding this, CBA (which might be enforced soon in the EU) could be mentioned as a political measures.	Taken into account - We refer to Section 13.7 on International interactions of national mitigation policies, which also includes border carbon adjustments.	Kim Hana	KAIST	Republic of Korea
16173	69		5	6	How about changing this question into more realistic one? Reduced trade?	Noted - The question is encompassing and indeed includes the sub-question how reduced trade may affect global emissions. We leave the question as is because it is more generic and allows for more cases to be considered.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16175	69		16		Incorrect in-text citation: This should be Author(year) type. Line 28 as well.	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16177	69		42	48	Incorrect in-text citation- I am not going to point out the in-text citation errors anymore, believing that it will be reviewed finally.	Accepted - This is being corrected during final editing.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16179	69		45	48	Regarding this, CBA (which might be enforced soon in the EU) could be mentioned as a political measures.	Taken into account - We refer to Section 13.7 on International interactions of national mitigation policies, which also includes border carbon adjustments.	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
78321	70	1	76	2	A lot of this section os quite forward and potentially duplicates Chapters 13 and 16. There is scope for editing down to focus on the recent trends and developmenst that are within the scope of this chapter.	Accepted.[partially] We now included additonal cross-references to Ch 13 where more detail is included on certain points. We have also read through the Ch 13 SOD and altough the topics are similar we did not find redeundant text that we could remove from sec.2.5 .	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
36991	70	38			As mentioned above, line 2-70-38 is the only mention of the long run demand for energy services. This paragraph should emphasise the demand for energy services that are likely to change substantially over the next few decades, either because of changing technology, declining costs or rising incomes. The demands for transport services may increase greatly due to automated vehicles (mentioned in 5-39-10). The demands for computing and communication are likely to increase dramatically with the development of 5G networks (and beyond) with dramatic implications for electricity consumption associated with data centres. An interesting development is the relationship between ICT companies and renewable energy production (Fouquet 2017). Also, particularly due to rising income in countries with warm average temperatures (aggravated by climate change), the demand for air-conditioning is likely to rise dramatically – mentioned in reference to 5-36-26 (below) - it is possible that as individuals in hot climates become more used to air conditioning, their thermal thresholds decline, creating huge latent demands for air conditioning and electricity consumption. Fouquet, R. (2017) 'Make low-carbon energy an integral part of the knowledge economy.' Nature 551(7682) S141.	Accepted. [partially]. We include more connection to energy servcies through the section. We also now cross-reference ch5/Demand and ch9/Buildings. But this chapter is meant to be empricial so we refrain from discussing the likely projections described in this comment.	Roger Fouquet	LSE	United Kingdom (of Great Britain and Northern Ireland)
27585	70	43	70	44	Delete "due in part to: the shift from carbon intensive fuels like coal to oil, gas, nuclear, and more recently renewables.", as other major factor such as energy efficiency improvement have contributed to reduced carbon intensity.	Accepted. This text is now deleted	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
63471	70	46	70	47	It would be important to be more explicit about the empirical data that supports this statement. Mainly, what was the pace of historical technological change and what does it need to be to facilitate the transition to a low-carbon economy?	Reject. SPM says we need to get to net zero by mid-century. Figure shows we only get down to 50MTCO2/EJ by 2050 with linear trend. Seems pretty straightforward that following a historical pathway does not take us to zero. We do drop this figure now.	Government of Canada	Environment and Climate Change Canada	Canada
72465	70	47	71	4	How is the linear trend calculated ? and why this choice ? The linear trend as it is shown and commented is more confusing than informative. There are at least three steps in the blue curve: 1) a ca. stable section, 2) a decreasing section that appears to end around 2000, and 3) a bell-shaped section. Section 2.5.1. will gain from having these 3 sections commented. Based on this, as one can probably consider that the 1st section stability is probably due to less low-carbon technology development compared to the other 2 sections, rather than constructing a linear trend that has a very limited meaning, I suggest that to add error margins around the linear trend and comment on these. There is something happening around 2000 and this must be commented as a fact and also in terms of what it can tell us about the future of developing technologies.	Accepted. We drop this figure from the FGD.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
585	70		21		I think this section needs to have some profound structural changes. First, compared to other sections, this section has very long introductary paragraphs which were not allocated to any sub-sections. Also, the title has not reflect effectively the contents of the subsection 2.5.1. The following subsection is quite long and has sub-sub sections. Together with 2.5.2, the layout of the section 2.5 needs to be re-constructured.	Rejected. Intro pargraphs are summarizes of much longer subsections that have been deleted for space constraints. The title in 2.5.1 is the main takeaway form the section. There is certainly more detail in some secitons of 2.5 than in others, but that reflects the content and the emphasis needed so do not think this is particualrly challneging for a reader.	Kim Hana	KAIST	Republic of Korea

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
16185	70		21		I think this section needs to have some profound structural changes. First, compared to other sections, this section has very long introductary paragraphs which were not allocated to any sub-sections. Also, the title has not reflect effectively the contents of the subsection 2.5.1. The following subsection is quite long and has sub-sub sections. Together with 2.5.2, the layout of the section 2.5 needs to be re-constructured.	Rejected. Intro pargraphs are summarizes of much longer subsections that have beeb deleted for space constraints. The title in 2.5.1 is the main takeaway form the section. There is certainly more detial in some secitons of 2.5 than in others, but that reflects the content and the emphasis needed so do not think this is particualrly challneging for a reader.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
8243	71	8	71	15	..Thirdly, lobbying from powerful corporations and the influence they have on the national politics (lock-in) might also affect the level of ability for each nation to transition into new technology	Reject. This topic of political support is included in the conecpt of exnovation and in the reference cited.	Frida Zahlander	DanChurchAid	Denmark
5081	71	19	71	20	"have tended to change" - in what way?	Accepted. We mean that the policies change rather than be durable and consistent. We now say they are "inconsistent" to be more specific.	Lina Hollender	n/a	Germany
581	71		4		To support the lines 1 and 2 sentence, the trajectory of zero-carbon energy system by mid-century needs to be added. Also, I think this figure is redundant or repeated while it does not provide additional information beyond what was provided in former sections.	Accepted. We drop this figure from the FGD.	Kim Hana	KAIST	Republic of Korea
583	71		11		avenue needs to be changed. (weird)	Accepted. Changed from "avenue" to a "means"	Kim Hana	KAIST	Republic of Korea
16181	71		4		To support the lines 1 and 2 sentence, the trajectory of zero-carbon energy system by mid-century needs to be added. Also, I think this figure is redundant or repeated while it does not provide additional information beyond what was provided in former sections.	Accepted. We drop this figure from the FGD.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16183	71		11		avenue needs to be changed. (weird)	Accepted. Changed from "avenue" to a "means"	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
6095	72	8	72	8	“Adoption of electric vehicles in Norway and China have also been rapid” —> the latter, according to Greenpeace report, coal is used as electricity production for electric vehicles in China	Reject. One cannot have zero-carbon transport without electric vehicles. Both adoption of vehicles and cleaning of electricity take time, a key point in this section. Of course vehicle adoption needs to start well before grids are fully clean.	Liwah Wong	EIT Climate KIC, EIT RawMaterials	Germany
20545	72	8	72	8	"adoption…vehicles": Nothing has been said about the negative impact of battery manufacturing on the environment of the countries in which the rare metals involved in their manufacture are extracted. Should not this issue be addressed?	Reject. Out of scope for this section. Covered in ch 6 on energy and 10 transport.	Government of France	Ministère de la Transition écologique et solidaire	France
77155	72	8	72	8	Consider rephrasing the statement as 'Adoption of electric vehicles in Norway and large cities in China have also been rapid' to differentiate the case of Norway, where nation wide numbers are clear, to China where, as far as I know, the case is most evident in specific towns such as Shenzhen, which is the case detailed in the chosen reference, Li et al., 2020.	Accepted. Changed to "cities in China."	Carles Pelejero	Institut de Ciències del Mar, CSIC	Spain
61613	72	9	72	12	Add Belgium, Switzerland, Finland as examples of rapid and significant decarbonization of the electricity grid with nuclear electricity (besides France and Sweden). The coal-phase-out of Ontario, Canada was also facilitated largely by a significant nuclear refurbishment-program, which should be mentioned. The reason for the rapid move to electric vehicles in Norway has been due to very significant government subsidies and favourable policy, which are possible due to Norway’s significant income from selling fossil oil and gas. As such, this might not be repeatable for most other, less wealthy nations.	Reject. France and Sweden are the best examples and we only wanted to provide 1-2 examples for each energy supply change. We do not see the rapid adoption of EVs in Norway as driven by oil and gas revenues, as other places of rapid adoption, e.g. China and cities in the EU have zero oil and gas revenues.	Rauli Partanen	Think Atom	Finland

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
77153	72	9	72	9	Consider adding the following reference to better substantiate the paradigmatic Norway case: Fridstrøm, L. (2021). The Norwegian Vehicle Electrification Policy and Its Implicit Price of Carbon. Sustainability, 13(3). https://doi.org/10.3390/su13031346	Accepted. We add that citation.	Carles Pelejero	Institut de Ciències del Mar, CSIC	Spain
65651	72	10	72	12	The coal retirements in Ontario, Canada, are primarily credited to the adoption of nuclear power (over 50% of electricity in Ontario is from nuclear). It would be fair to mention this explicitly in a similar manner as the successful transitions in Sweden and France are credited to nuclear.	Reject. The point here is about examples of rapid changes in enegry supply. The electricity provided by coal in Ontario was replaced in 2007-11 with a variety of sources, mainly hydro, gas. Nucelar had already been built out at that point so it is not a great example.	Eero Hirvijoki	Aalto University	Finland
76593	72	10	72	10	add "in the 70s and 80s" concerning nuclear power in France, since the quick pace of construction was limited to this period	Reject. This point is accurate but beyond the scope of this point to describe the period for each of the many examples in this paragraph, not just nuclear in france.	Charlotte MIJEON	Réseau "Sortir du nucléaire" (organiszation affiliated to the French Climate Action Network)	France
80321	72	15	72	17	Beyond the projects for future changes, there is a need to foster what is ready now, developing its applicability for the moment, even if they are of “small impact” as mentioned.	Reject. The point here is that these technologies are "small unit scale". That does not at all imply they will have a small impact. In fact, we mean the opposite, which is why we say they have the "potential for faster system change."	JUAN DIAZ	Association	United States of America
36997	72	19			It states “(Fouquet 2016) argues that when the economy grows quickly, an energy transition is likely to be led by changes in demand, while when the economy is steady, the supply-side matters more.” IT MIGHT BE MORE APPOPRIATE TO SAY: “(Fouquet 2016) argues that when the economy is industrialising, an energy transition is likely to be led by changes in demand, while when the economy is more developed, the supply-side matters more.”	Accept. Text revised as suggested.	Roger Fouquet	LSE	United Kingdom (of Great Britain and Northern Ireland)
10529	72	43	72	43	change "staring" to "starting"	Accept. Text revised as suggested.	Philippe Waldteufel	CNRS	France
587	72		12		typo: exemplars > examples	Reject. We mean exemplars not examples.	Kim Hana	KAIST	Republic of Korea
16187	72		12		typo: exemplars > examples	Reject. We mean exemplars not examples.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
54715	73	1			Table 2.8 could be removed, as it contains no additional information and the phrases used therein are not self-explanatory.	Accepted/partial. We modified the table to add clarity. We think the table adds a valuable summary of the text, wherein the detail is contained.	Government of United States of America	U.S. Department of State	United States of America
589	73		15		Tech?(technology) low-C? (low carbon) This table should be more informative and written in a more consistent and constructive way. The table contents are in bold?	Accepted/partial. We modified the table to add clarity. We think the table adds a valuable summary of the text, wherein the detail is contained.	Kim Hana	KAIST	Republic of Korea
16189	73		15		Tech?(technology) low-C? (low carbon) This table should be more informative and written in a more consistent and constructive way. The table contents are in bold?	Accepted/partial. We modified the table to add clarity. We think the table adds a valuable summary of the text, wherein the detail is contained.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
64957	74	1	76	7	Critical resource issues, as well as full lifetime efficiency and recycling issues are often raised about new energy technologies, I think that this should be commented	Reject.. These are out of scope. They are covered in chapter 6/energy.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
82603	74	1	76	7	Section 2.5.3 (Improvements in technologies enable faster adoption) is not a robust analysis. It is mostly focused on energy generating technologies and has a heavy emphasis on wind and solar generating technologies and their 'granularity' but it does not discuss how learning and cost reductions are made in mega-project technologies (eg nuclear, CCS). At the moment the text seems intent on judging which is better rather than determining how important cost reductions can be obtained for both. Regarding nuclear energy in particular, a recent OECD NEA report 'Unlocking Reductions in the Construction Costs of Nuclear A Practical Guide for Stakeholders' (https://www.oecd-nea.org/jcms/pl_30653/unlocking-reductions-in-the-construction-costs-of-nuclear) would make a very worthwhile addition to this analysis. This report goes into considerable detail of describing cost reductions possible between first of a kind, second of a kind and nth of a kind reactors. See especially figure 1 and box 1 for the multiple factors that drive this cost reduction. While no specific figures are given very large cost reductions are expected between the FOAK and SOAK reactors – on the order of 20 -40%. In fact the possible learning rate is extremely high and much higher than what can be expected between subsequent units in a factory production run. This directly contradicts the sentence in the draft IPCC report that "Smaller unit sizes, sometimes referred to as 'granularity', tend to be associated with faster learning rates". This may be true over multiple units, but not over a single one which is what the text infers. Another analysis to consider is 'Small Modular Nuclear Reactors: Parametric Modeling of Integrated Reactor Vessel Manufacturing Within A Factory Environment Volume 2, Detailed Analysis' (https://www.energy.gov/sites/prod/files/2016/01/f28/IIT-SMRIRVLearningvol2.pdf).	Reject. This section is primarily empirical. As such it notes the cost reductions where they have occurred. One cannot say the same for nuclear and CCS. If there were observed cost reductions there we would of course be eager to measure and hihglight them. and there have been dozens of reactors built since AR5 so there have been opportunities to reduce costs, we just do not see evidence of them. Future cost reductions in nuclear would be considered in ch6/energy.	Jonathan Cobb	World Nuclear Association	United Kingdom (of Great Britain and Northern Ireland)
5219	74	18	74	18	This statement is not correct. As a mnimum it should be noted that the ecnomical value of a solar or wind kWh must include the conséquence of intermittent production, i.e. the cost of storage or alternate source. When making price comparison, you must look at two comparable products. A fossil kWh is available when you need it, a solar kWh is available 15% of the time! Will you accept to pay tge same price for a product which is usully not available when you need it. That is why the comparison has to be based on the complete economic value. It is the point that the solar and wind lobbies always forget!	Accept, partial. The statement is accurate despite reviewer's concerns. Rest of comment is out of scope. Ch6/energy now includes a section on LCOE advantages and limitations. It also includes analysis of costs of intemittancy. We inlcude cross-references to ch 6.	Michel SIMON	Retraité/ Pdt d'association	France
45779	74	25			For readability reasons please include the meaning of the abbreviation "CSP", as it is mentioned for the first time in this chapter (see also abbreviation without clarification in Figure 2.28).	Accept. We now inlcude the explanation of CSP in 2.5.3.2, right before the figure.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
86165	74	28			Fom UK experience – I think a lot more now?	Reject. We include the latest international data. Cost reductions could have been faster in individual countries, including the UK but these numbers are global.	Michael Grubb	UCL - Institute of Sustainable Resources	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
72467	74	34			Fig. 2.28. Dashed lines are mentionned twice and this is confusing. Use different types or color of dashed lines	Accept.The pre-AR5 and postAR5 dashed lines are different colors. We now mention the colors in the caption.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
80493	74	34	74	35	Please clarify: what is the scientific reason for fitting two linear curves to the LCOE vs time for solar PV, onshore wind and off-shore wind pre AR5 and post AR5? I think I understand the reason for offshore wind (adaptation of on-shore wind turbines to the rougher environment), but for the other two, chosing AR5 as date between two fits seems arbitrary.	Reject. A major goal of the AR6 is to report what has changed since the last assessement, AR5. this is the reason for comparing the trends pre and post AR5.	Moritz Riede	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
591	74		4		supports -> support	Accept. Changed to support.	Kim Hana	KAIST	Republic of Korea
593	74		31		This section is based on only LCOE. (I am pro-renewable person to avoid the misunderstanding of my intention.) There are criticisms regarding this LCOE. The real cost of electricity should be system LCOE rather than the LCOE due to the intermittency of renewables. If the review of this is added, this will be much more informative.	Accept/partial. Out of scope. Ch6/energy now includes a section on LCOE advantages and limitations. It also includes analysis of costs of intemittancy. We inlcude cross-references to ch 6.	Kim Hana	KAIST	Republic of Korea
16191	74		4		supports -> support	Accept. Changed to support.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16193	74		31		This section is based on only LCOE. (I am pro-renewable person to avoid the misunderstanding of my intention.) There are criticisms regarding this LCOE. The real cost of electricity should be system LCOE rather than the LCOE due to the intermittency of renewables. If the review of this is added, this will be much more informative.	Accept/partial. Out of scope. Ch6/energy now includes a section on LCOE advantages and limitations. It also includes analysis of costs of intemittancy. We inlcude cross-references to ch 6.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
37011	74		74		LCOE may not be good measure to compare the renewable energy.	Accept/partial. Out of scope. Ch6/energy now includes a section on LCOE advantages and limitations. It also includes analysis of costs of intemittancy. We inlcude cross-references to ch 6.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37013	74		74		The concept of Energy ROI (EROI) rather a good factor to compare the performance of Renewables	Reject. Disagree. Costs of energy to produce renewable electricity are already included in LCOE so this measure does not add insight that is not already there.	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
71215	75	3	75	30	Section 2.5.3.3 is an interesting section about granular technologies. While you provide examples of what is NOT granular technologies (full-scale nuclear power, CCS, BECCS etc.), you never give examples of what you actually mean by "granular technologies". I think the text comprehension would benefit alot from a mentioning of a few such examples.	Accept. A very good point and we now include mention of enduse devices, pv, batteries and to some extent wind power.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
15139	75	11	75	11	change the ease of pre-mature to the easier use of pre-mature scrapping	Accept/partial. We mean "ease of early retirement" and have changed text to account for that.	Noverita Takarina	Universitas Indonesia	Indonesia
72469	75	20	75	22	"In a study of 41 energy technologies (Figure 2.29), unit size explained 22% of the variation in learning rates (Sweerts et al. 2020)". While I do trust the authors and reviewers of this study on the conclusion about the conclusion, i.e. "unit size explained 22% of the variation in learning rate", Figure 2.29 however fails to illustrate this sentence/conclusion and does not add anything to the text.	Reject. Many people acquire information visually and the added detail of the figure will inform them. In addition the added detail shows the extremely wide span of scales involved as well as distinctions between demand, supply, and storage.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
84505	75	20	75	23	The review on learning effects in prospective technology assessment may be useful as additional references in the synthesis (https://doi.org/10.1016/j.rser.2020.109937).	Accepted. We added the citation: https://doi.org/10.1016/j.rser.2020.109937	Siir KILKIS	The Scientific and Technological Research Council of Turkey	Turkey
15141	75	23	75	26	The sentence is too long. Please change it into two or three sentences	Accepted. We split this long setence into 2.	Noverita Takarina	Universitas Indonesia	Indonesia

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
15143	75	26	75	29	The sentence is change to 'Those outcomes can themselves support and give advantage due to faster transition by rapid technology via ...	Accept. We clarify sentence so it it now reads: "The resulting improved technology can support the faster transitions discussed above by promoting rapid technology adoption. "	Noverita Takarina	Universitas Indonesia	Indonesia
76651	75	28	75	30	Applying the granularity effect to a shift from large-scale to small-scale nuclear reactors is at odds with the current state of the art. SMR electricity cost remains higher than for a large reactor and will likely remain so. A recent (March 2021) report issued by Öko-Institut for the German Federal Office for the Safety of Nuclear Waste Management on SMRs states that significant cost savings due to greater modularity have not been observed in past reactor developments and are not expected in the future. It highlights the fact that specific construction costs are higher for SMRs than for large nuclear plants due to the loss of economics of scale. According to this report, about 3000 SMR would have to be produced to make SMR production feasible. Thus the structural cost disadvantage of low-power reactors is not expected to be compensated by learning or mass effect. (Sicherheitstechnische Analyse und Risikobewertung einer Anwendung von SMR-Konzepten(Small Modular Reactors), urn:nbn:de:0221-2021030826028).	Noted. Fair points but the claim is only that the benefits of modularity (not just costs) provide part of the reason for efforts to develop SMRs. You may disagree that SMRs will play a role and you may end up correct, but the evidence shows that several companies and governements are trying to develop them and that modularity is part of their justification.	Charlotte MIJEON	Réseau "Sortir du nucléaire" (organiszation affiliated to the French Climate Action Network)	France
15145	75	35	75	35	change 'learn' to learnt or learned	Reject. Wording is correct as is. Present tense.	Noverita Takarina	Universitas Indonesia	Indonesia
74161	76	9	77	2	Figure 2.30 and the narrative information does not clearly characterize the adaptablity of nuclear power to provide clean energy. Today, nuclear provides 35% of the world's carbon free energy and much of this generation in the U.S., France and today, China, was deployed in a short period of time. Additionally, advanced nuclear technologies, which are slated to be of a size from 50-300 MWe will be more readily deployable than large nuclear units and are targeted to be deployed at a price more akin to combined cycle gas units.	Reject. The empirical data which we show here indicate that nuclear has grown very slowly over the past two decades. It is possible that growth will be faster in the future but we do not see any recent evidence of that occurring. There is no doubt that nuclear provides clean electricity. The point here is that the technology show no recent evidence of adoption that indicates it is in a position to scale up dramatically.	Jeffrey Merrifield	Pillsbury Law Firm	United States of America
5083	76	15	76	15	"These adoption rates" - adoption of what?	Accept. This statement refers to most of the technologies in figure. We edit to "most of these technologies include adoption rates of 20% annual growth…"	Lina Hollender	n/a	Germany
20375	76	21	76	22	Regarding the sentence "In contrast ...": I interpret this to mean that scenarios calculated with IAM expect the rapid trend to decline in future years. There is an alternative explanation: that IAMs have not been able to anticipate the rapid decline in wind and solar PV costs and the ensuing growth in their generating capacity. Scenarios are not definitive forecasts of future. I think this sentence gives a wrong interpretation on the relationship between observed trends and scenarios.	Accept. We meant to convey your interpretation. We have revised to: "In contrast, IAMs indicate that they expect much lower rates of growth in future years for the set of technologies that has been growing fastest in recent years (wind and solar), without strong evidence for why this should occur."	Tommi Ekholm	Finnish Meteorological Institute	Finland
20373	76	24	76	24	This is an interesting figure, but could be improved for easier interpretation. Please add the meaning of the dots to the legend. The y-axis unit (logistic growth rate) is difficult to interpret: it doesn't even have a unit. Could it be improved. What is "electricity share", exactly? Please clarify.	Accept. We revised the caption to clarify these points. In particular we added: "Adding "Horizontal arrangement of dots within technology categories simply indicates count of scenarios at each growth rate."	Tommi Ekholm	Finnish Meteorological Institute	Finland
64959	76	24	76	27	I did not understand Fig. 2.30 what is the meaning of the horizontal axis for each energy? Where is the time/scenario dependency? How to distinguish the different mitigation scenarios?	Accept. We revised the caption to clarify these points. In particular we added: "Adding "Horizontal arrangement of dots within technology categories simply indicates count of scenarios at each growth rate."	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
86167	76	24			Fascinating diagram	Accept. We revised the caption to clarify these points. In particular we added: "Adding "Horizontal arrangement of dots within technology categories simply indicates count of scenarios at each growth rate."	Michael Grubb	UCL - Institute of Sustainable Resources	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
54717	76	25	76	27	In Figure 2.30, are these biomass-and-CCS scenarios cross-referenced to Chapter 7 (and vice versa)? They should be.	Accept. We revised the caption to clarify these points. In particular we added: "Adding "Horizontal arrangement of dots within technology categories simply indicates count of scenarios at each growth rate."	Government of United States of America	U.S. Department of State	United States of America
595	76		28		remove "that emerges"	Accept. We revised the caption to clarify these points. In particular we added: "Adding "Horizontal arrangement of dots within technology categories simply indicates count of scenarios at each growth rate."	Kim Hana	KAIST	Republic of Korea
597	76		23		This figure is not clearly explained in the text. With only figure with its legends or title, the meaning of this figure cannot be captured.	Accept. We revised the caption to clarify these points. In particular we added: "Adding "Horizontal arrangement of dots within technology categories simply indicates count of scenarios at each growth rate."	Kim Hana	KAIST	Republic of Korea
16195	76		28		remove "that emerges"	Accept. We revised the caption to clarify these points. In particular we added: "Adding "Horizontal arrangement of dots within technology categories simply indicates count of scenarios at each growth rate."	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16197	76		23		This figure is not clearly explained in the text. With only figure with its legends or title, the meaning of this figure cannot be captured.	Accept. We revised the caption to clarify these points. In particular we added: "Adding "Horizontal arrangement of dots within technology categories simply indicates count of scenarios at each growth rate."	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
71217	77	4	85	16	I'm a bit surprised by Section 2.6 Behavioral Choices and Lifestyles that it does not at all address the issue in the context of the food and agricultural sector, but only in the context of the energy and transport sectors with emphasis on the latter. I find this somewhat unbalanced. Considering the magnitude of the mitigation potential from human diet shifts in relation to the potential in the transport sector, the importance of changes in Behavioral Choices and Lifestyles for emission reductions in the food systems should be mentioned here and with a proper reference to Chapter 12.4, where the food system is looked at in more detail. It could be worth considering to complement the section with a Box on Human diet shifts in parallel to the Box 2.2 on the Sharing Economy in transport. I note that the Sharing economy is also discussed extensively in Chapter 5 pp 52-54, some overlap with Box 2.2.	Accepted. A reference has been added to chapter 12.4 and box 5.4 in chapter 5 on human diet due to lack of space.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
74759	77	4	84	50	The steps to formally maanage behaviourial choices and lifestyle should be elaborated	Rejected. Comment is not clear.	Debadutta Mohanty	CSIR - Central Institute of Mining and Fuel Research, Dhanbad	India
72471	77	7	77	10	references should be added to support this statement	Accepted: text has been severely changed and summary references/review articles have been provided.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
18061	77	9	77	9	Is it correct that 'driving' is specified here i.e. not also other transportation use? If so, and refers to just private car/other vehicle use, may be better described as "private transportation"	Accepted. Text is edited.	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
18063	77	17	77	19	Can the authors confirm whether this is "individuals" or "households"? The TS says "individuals" and the SPM says "emitters". There should be consistency.	The authors confirm that this refers to households.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
80413	77	17	77	19	Update sentence “Globally, households...depending on the study” to “Globally, households with income in the top 10% (income higher than 23$ PPP per capita per day) are responsible for 36% to 45% of GHG emissions, while those in the bottom 50% (income less than $3 PPP per capita per day) are responsible for only 13-15% of emissions depending on the study ”. (reasoning: a definition for “global wealthiest” and “bottom 50%” is needed to put this into perspective”)	Accepted. Text is revised.	Moritz Riede	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
83893	77	17	77	19	On the shares of who emits what part of global emission in footprints, a recent paper (Semieniuk and Yakovenko 2020) provides new evidence on the evolution of global footprint inequality from 1970 thorugh 2013 that is more comprensive than the cited Chancel and Piketty, and estimates that footprint inequality had only a very slight trend to more equality. The full reference is: Semieniuk, G. and Yakovenko, V. M. (2020) ‘Historical evolution of global inequality in carbon emissions and footprints versus redistributive scenarios’, Journal of Cleaner Production, 264, p. 121420. doi: https://doi.org/10.1016/j.jclepro.2020.121420.	Accepted. Reference is now included. Thank you.	Gregor Semieniuk	University of Massachusetts Amherst	United States of America
18065	77	19	77	19	What is the Oxfam reference? It is not included in the references section. I found an Oxfam media briefing on this topic but, given that it doesn't appear to add anything that isn't in the peer reviewed sourced, perhaps the Oxfam citation can be removed.	Accepted: it should be: Hardoon D (2015) Wealth: having it all and wanting more. Oxfam Wealth, Oxford	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
80407	77	19	77	19	The given reference “Hubacek et al., 2017” does not exist, but there are two, “Hubacek et al., 2017a” and “Hubacek et al., 2017b”. Which one is meant here?	Accepted: it is 2017a) which is : Hubacek, K., Baiocchi, G., Feng, K., Muñoz Castillo, R., Sun, L., & Xue, J. (2017). Global carbon inequality. Energy, Ecology and Environment, 2(6), 361–369. https://doi.org/10.1007/s40974-017-0072-9	Moritz Riede	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
80409	77	19	77	19	The given reference “Oxfam 2020” does not exist, but there is a “Oxfam 2015” in the reference list at the end (which however seems to point to something of 2020.	Accepted: it should be: Hardoon D (2015) Wealth: having it all and wanting more. Oxfam Wealth, Oxford	Moritz Riede	University of Oxford	United Kingdom (of Great Britain and Northern Ireland)
15147	77	21	77	21	For example, (Zhang et al. 2017) change to For example, Zhang et al. (2017)	Accepted. Text is edited.	Noverita Takarina	Universitas Indonesia	Indonesia
48229	77	26	77	26	What are 'necessities' here? Are there data on more affluent families/areas having more efficient materials? If so, is such efficiency relevant and impactful?	rejected. Misunderstanding of wording	Susana Hancock	University of Oxford	United States of America
15149	77	27	77	27	household emissions - please add whether the emissions in rural or urban only or both rural and urban	not distinguished between urban and rural	Noverita Takarina	Universitas Indonesia	Indonesia
599	77		5	26	I think this section is titled as introduction. But this part includes discussion regarding the relationship between the income and consumption patterns. The income is one of factors. So, please reconstruct and adjust the layout of this section.	Accepted. Income has been added as a separate factor	Kim Hana	KAIST	Republic of Korea

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
16199	77		5	26	I think this section is titled as introduction. But this part includes discussion regarding the relationship between the income and consumption patterns. The income is one of factors. So, please reconstruct and adjust the layout of this section.	Accepted. Income has been added as a separate factor	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
36989	77		83		As long as some fossil fuels are used to provide energy services, carbon dioxide will be emitted. Of course, efficiency improvements can also help decouple the relationship between the demand for services and the emissions generated. However, efficiency improvements lead to a reduction in the price of energy services and, therefore, encourage greater energy service consumption – known as the direct rebound effect (Chitnis et al 2020). The direct rebound effect tends to be lower in industrialised than in industrialising economies, yet is non-negligible in all countries (Fouquet 2014, 2016). Thus, the demands for heating, cooling, refrigeration, power appliances (including lighting, entertainment and computing devices) and transportation are crucial for determining the long trends in emissions (and should be clearly discussed more in chapter 2). One place for this discussion is in section 2.6 which covers lifestyle, but not fully how those lifestyles affect demands for energy services and, thus carbon footprints. Fouquet (2014) shows that the income elasticities of demand for energy services have tended to follow an inverse-U shape curve – that is, the income elasticities of demand rise at low levels of economic development, peaking at mid-levels of income and then declining to one and below. Thus, at low levels of economic development, energy service consumption tends to be quite responsive to per capita income changes; at mid-levels, consumption tends to be very responsive to changes in income per capita; and, at high levels, consumption is less responsive to income changes (Fouquet 2016). The income elasticities of demand for energy services are essential to understanding the long run trends in carbon dioxide emissions (while fossil fuels remain in the energy mix) and a discussion of how income elasticities of demand for energy services change as economies develop need to be included in chapter 2 and chapter 5. [1] As a reminder, the income elasticity of demand for an energy service indicates the percentage change in the consumption of the energy service for a one percent change in income. For example, an income elasticity of 0.5 (or 1.5) implies that, if income rises by 10%, consumption will increase by 5% (or 15%, respectively). Chitnis, M., Fouquet, R., and Sorrell, S. (2020) 'Rebound effects for household energy services in the UK.' The Energy	Noted. Due to space limitation, a reference to rebound effect discussion in chapters 9 and 16 is added.	Roger Fouquet	LSE	United Kingdom (of Great Britain and Northern Ireland)
71219	77		77		The finding that financial credit is positively related to emissions is interesting. Could it be that richer households have more access to credit? Also, it is worth linking this statement to other parts of the report dealing with solutions. Most of the low-emission solutions in the energy and buildings sector require a shift to a more capital intensive system rather than one based on fuel expenditure (heat pumps, batteries etc.)	rejected. had been deleted due to space.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
48231	78	0	78	0	It would be helpful to identify the outlying coutnries, as this graph is too hard to read and too hard to track countries across to far data points.	Accepted. Figure is revised.	Susana Hancock	University of Oxford	United States of America
3247	78	1	78	6	Please, check the explanation of blue and yellow dots in the figure. The meaning of the figure is complicated. It is recommended to simply the idea.	Accepted. Figure is revised.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
47319	78	1	78	1	figure 2.31 Please allocate a page for it to be more clear	Accepted. Figure is revised.	Khaled Mohamed Madkour	Ain Shams University, Cairo, Egypt	Egypt
54719	78	1			Figure 2.31 could be improved (or a different figure added) to visualize carbon footprint by activity and economic class. Within existing figure, the meaning of individual dots per country is not clear.	Accepted. Figure is 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
61615	78	1	78	6	Please revise figure 2.31 to be clearer, perhaps use logarithmic scale, as now it is impossible to make meaningful comparisons.	Accepted. Figure is revised.	Rauli Partanen	Think Atom	Finland
64961	78	1	78	6	The color codes in the figure and the caption are different, different shades of each color could be used to distinguish between income groups. I would prefer a comparison between the to 10% and bottom 50% income groups as discussed in the text	Accepted. Figure is revised.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
65653	78	1	78	6	Figure 2.31 needs a revision. Please use logarithmic scale for the per-capita-footprint axis. In its current form, it is rather impossible to make comparisons.	Accepted. Figure is revised.	Eero Hirvijoki	Aalto University	Finland
71221	78	1	78	6	Figure 2.31: Countries listed in Figure are difficult to read.	Accepted. Figure is revised.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
71223	78	1	78	6	Figure 2.31: The Figure caption text seems to refer to a different illutsration. Please check.	Accepted. Figure is revised.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
71225	78	1	78	6	Figure 2.31: it is unclear what "by income group" refers to here. Do the four dots refer to the average for each quartile of the income distribution? Please explain this in the Figure caption text.	Accepted. Figure is revised.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72557	78	1	78	1	It's hard to tell country names from Figure 2.31.	Accepted. Figure is revised.	Yun Hang	Emory University	United States of America
86169	78	1			This chart is almost impossile to descipher – so is the message .. ? (think I put in a comment to Tech Sum)	Accepted. Figure is revised.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
4097	78	2	78	6	Fig. 2.31 appears to contradict the explanations provided below the figure and in the corresponding text (p.77). According to the figure, carbon footprints of poorer countries look far greater than those of richer countries. And countries are aligned from top to bottom of the figure, not left to right as the caption explains.	Accepted. Figure is revised.	Tatsuki Ueda	National Agriculture and Food Research Organization	Japan
10531	78	2	78	6	The legend of figure 2.31 has problems: rather than countries being ranked from left to right, they are actually ranked from bottom to top. Also, the colour code does not match the figure.	Accepted. Figure is revised.	Philippe Waldteufel	CNRS	France
18067	78	2	78	2	Figure 2.31 is very difficult to read across the countries to data points. Consider not labelling all countries, but only those with outlying values (if this is key purpose of chart?) Or alternative chart design e.g. showing just size of range of per capita footprint	Accepted. Figure is 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)
20547	78	2	78	2	The legend refers to blue dots for developing countries and to purple dots for EU and US, whereas the figure actually shows blue dots for developed countries and yellow for developing countries.	Accepted. Figure is revised.	Government of France	Ministère de la Transition écologique et solidaire	France
72473	78	2	78	6	The legend does not correspond to the figure: left/right should be up/down and colors indicated in the legend do not correspond to those of the figure itself	Accepted. Figure is revised.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
72475	78	2	78	6	A detail of the 4 expanditure categories should be given and would render the figure more understandable. I would also suggest to use 4 different signs for these 4 expanditure categories to have a much more informative figure as for some countries the 4 dots (=cat. of expanditures) have veru different values, e.g. Ukraine	Accepted. Figure is revised.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
78323	78	2	78	6	I found it impossible to draw any messages from this figure.	Accepted. Figure is revised.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
2435	78	3	78	3	Notes: Blue dots are for the developing country group → Notes: Blue dots are for the developed country group	Accepted. Figure is revised.	Nyun-bae Park	Korea Institute of Energy Research	Republic of Korea
63473	78	9	78	11	It is odd to use this 2015 source, which compares data from different years, when 2018 per capita emissions data is available for these countries (National Inventory Reports submitted to UNFCCC). Additionally, it is misleading to compare Canada's 2007 data to China and UK's 2011 data given the downward trend of emissions in these years. Mainly, differences between per capita emissions would be smaller if 2011 information was used for Canada. The way the data is currently presented makes Canada's emissions per capita seem worse than it is. Canada's national inventory report available here: https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/inventory.html	Accepted. The sentence has been deleted.	Government of Canada	Environment and Climate Change Canada	Canada
603	78		11		two periods after (Maraseri et al. 2015)	Accepted. Text is edited.	Kim Hana	KAIST	Republic of Korea
8245	78		78		List of countries barely visable in the figure	Accepted. Figure is revised.	Frida Zahlander	DanChurchAid	Denmark
16203	78		11		two periods after (Maraseri et al. 2015)	Accepted. Text is edited.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
18069	79	1	79	2	This refers to 'housing' but should it also refer specifically to 'direct energy use for heating and cooling' (described on page 77 line 8-9 as key contributor, and specified on page 79 lines lines 7, 8, 12))	Rejected: it has been mentioned earlier and later and it should be clear that housing includes this.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
18071	79	1	79	2	There is only one reference to the use of atmospheric observations to verify the emissions estimated through the use of inventory models such as EDGAR. Both on global and regional scales atmospheric observations (ground-based and satellite) are used to verify emission estimates, there are many examples in the literature for CH4, N2O, HFCs, PFCs, SF6. Should this fact be raised and highlighted? Atmospheric observations used in so called 'top-down' studies do provide an independent cross-check of emissions estimated through the use of emission factors and activity data ('bottom-up').	Rejected: while relevant and important but it makes no difference to statement made here about the major consumption items and associated emissions.	Government of United Kingdom (of Great Britain and Northern Ireland)	Department for Business, Energy & Industrial Strategy	United Kingdom (of Great Britain and Northern Ireland)
48233	79	7	79	7	More locally within the US, Maine for example, private transport is much higher-- 41% of economy-wide emissions (https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/ERG_MCC_AssessingImpactsClimateChangeMaine_Summary_9.29.20.pdf, page 15)	Rejected: while they are interesting differences dependent on population density and other factors, there is not enough space in this section to eleborate. And the numbers refer to examples at the national level.	Susana Hancock	University of Oxford	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
9855	79	19		21	On Indonesian case, urban household may not only have much larger share of transport related emissions but also larger share of buildiing related emissions due to their building energy use as well as their take on property investments which increase building stock	Rejected. There is not enogh space for too much detail. But thanks for sharing these interesting details.	Government of Indonesia	Ministry of Environment and Forestry	Indonesia
20549	79	28	79	28	In this section, most of the criteria (age, sex, urban vs rural...) are directly related to income differences, whiwh remains the overarching driver of consumption. It should be clarified or use data which takes this into account (e.g. men consume more energy than women : to what extend is this due to men being globally wealthier, and to actual gender differences?)	Accepted. Income has been included as a separate factor. Also, the gender issue is aleady mentioned in the chapeau of section 2.6.2	Government of France	Ministère de la Transition écologique et solidaire	France
49697	79	28	83	42	The section takes a very comprehensive look at consumption-related emission drivers but I miss an overview of the major mitigation potential by changes in consumption. I couldn't find relevant content in Chapter 3 either. There's research by Ivanova et al. 2020 with a meta-analysis, indicating that consumption changes in transport have higher potential than other areas (food, housing etc.). Reference: https://iopscience.iop.org/article/10.1088/1748-9326/ab8589	Accepted. Reference to chapter 5 was added for in dpeth discussion on behavioral dirvers and examples of behevioral interventions and policies which can reduce emissions.	Nikola Medimorec	SLOCAT Partnership on Sustainable, Low Carbon Transport	Republic of Korea
71227	79	28	83	42	Section 2.6.2 would benefit from English language editing.	Accepted. Parts of the text in the sections is edited.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
86171	79	28			I'd guess a lot of this section could benefit from coordination with Ch.5?	Accepted. Cross reference to chapter 5 is included.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
20551	79	36	79	40	Supply side dimensions should be included in this list. See work by Elizabeth Shove	Noted. The reference to the supply side dimeneions is already included in the paragraph above this one.	Government of France	Ministère de la Transition écologique et solidaire	France
86763	79	43			Please remove the reference to meat connsumption as a example of higher food-related emissions.	Accepted. Text is edited.	Government of Argentina	Ministry of Environment and Sustainable development of Argentina	Argentina
48235	79	44	9	46	Can these percentages be expanded upon? Why are Norway and Sweden so different? This begs the question what factors are involved?	Rejected: interesting point but there is no space to investigate this further.	Susana Hancock	University of Oxford	United States of America
63475	79	44	79	44	the linkage between spending more money on vehicles and emissions is unclear here - the sentence imply that more expensive vehicles emit more GHGs, however, research suggests that fuel efficiency technologies can in crease vehicle fuel economy, at the expense of a higher vehicle price. https://www.researchgate.net/figure/Relationship-between-vehicle-price-and-fuel-economy-for-a-internal-combustion-engine_fig2_299404830	Rejected: no it does not imply that. It just states that men spend more. It does not say if the cars they buy are more expensive or more fuel efficient or if they tend to buy more cars (which would definitely be less efficient) than women having no or fewer cars.	Government of Canada	Environment and Climate Change Canada	Canada
601	79		14		period needs to be added after "extensively researched"	Accepted. Text is edited.	Kim Hana	KAIST	Republic of Korea
605	79		36	40	These sentences repeat the same contents the second sentence but just point out "not consciously". Please consider editing this paragraph	Rejected. The first sentence explains the general factors while the other sentence provides more details on the factors.	Kim Hana	KAIST	Republic of Korea
16201	79		14		period needs to be added after "extensively researched"	Accepted. Text is edited.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16205	79		36	40	These sentences repeat the same contents the second sentence but just point out "not consciously". Please consider editing this paragraph	Rejected. The first sentence explains the general factors while the other sentence provides more details on the factors.	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
25109	80	24	80	29	The first sentence says per capita emissions decrease with family size.This isn't consistent with the rest of the section. Yes living together is more efficient but family size is going down as you say in the rest of the para. Maybe the first sentence needs to be revised?	Rejected. The first sentence is refereing to the family size(number of family members) and not household size	Minal Pathak	WGIII TSU, Ahmedabad University	India
48237	80	37	80	37	Electricity? From what though? Comparing electricy with sources of electricity (solar, biomass, coal, geothermal, etc. isn't comparable.	Accepted. Text is revised.	Susana Hancock	University of Oxford	United States of America
607	80		1	48	The layout of this page (and following pages) is quite different from the former sections. Age needs to be 2.6.2.1. Please edit the layout.	Rejected. All factors are grouped under this section and due to the small size of the paragraphs, there is no need to create new sub-sections.	Kim Hana	KAIST	Republic of Korea
609	80		4		less -> more? Cannot understand this sentence. Driving is more energy-intensive compared to public transportation or riding a bike. If "negative" implies "minus", it should be better to express like "lead to reductions in emissions" (e.g.)	Accepted. Text is revised.	Kim Hana	KAIST	Republic of Korea
611	80		8		insert space before in-text citations. There are many in-text citation errors as well line 10, 16-17,… (I will not add the comments regarding the errors.)	Accepted. Text is edited.	Kim Hana	KAIST	Republic of Korea
613	80		8		suggest -> suggests	Accepted. Text is edited.	Kim Hana	KAIST	Republic of Korea
615	80		10	12	evidence ~~ provides evidence : needs to be modified.	Accepted. Text is edited.	Kim Hana	KAIST	Republic of Korea
617	80		14		insert and before have (this sentence has two verbs)	Rejected. The sentence is clear.	Kim Hana	KAIST	Republic of Korea
619	80		17	18	cannot understand this sentence. People over 65 in relation to the working-age population ?	The sentence referes to the dependent group.	Kim Hana	KAIST	Republic of Korea
621	80		29		remove comma before "at least"	Rejected. The sentence is correct.	Kim Hana	KAIST	Republic of Korea
623	80		48		Population density is not the direct factor. It is a proxy for urbanization. As the authors know, the compactness and adjacency in urban areas lead to less emissions. So, it would be hard for population density to influence on emissions.	Rejected. The reference is clear that higher population density is associated with lower emissions.	Kim Hana	KAIST	Republic of Korea
16207	80		1	48	The layout of this page (and following pages) is quite different from the former sections. Age needs to be 2.6.2.1. Please edit the layout.	Rejected. All factors are grouped under this section and due to the small size of the paragraphs, there is no need to create new sub-sections.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16209	80		4		less -> more? Cannot understand this sentence. Driving is more energy-intensive compared to public transportation or riding a bike. If "negative" implies "minus", it should be better to express like "lead to reductions in emissions" (e.g.)	Accepted. Text is revised.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16211	80		8		insert space before in-text citations. There are many in-text citation errors as well line 10, 16-17,… (I will not add the comments regarding the errors.)	Accepted. Text is edited.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16213	80		8		suggest -> suggests	Accepted. Text is edited.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16215	80		10	12	evidence ~~ provides evidence : needs to be modified.	Accepted. Text is edited.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16217	80		14		insert and before have (this sentence has two verbs)	Rejected. The sentence is clear.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16219	80		17	18	cannot understand this sentence. People over 65 in relation to the working-age population ?	The sentence referes to the dependent group.	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
16221	80		29		remove comma before "at least"	Rejected. The sentence is correct.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16223	80		48		Population density is not the direct factor. It is a proxy for urbanization. As the authors know, the compactness and adjacency in urban areas lead to less emissions. So, it would be hard for population density to influence on emissions.	Rejected. The reference is clear that higher population density is associated with lower emissions.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
71229	81	1	81	1	From a global perspective, higher population density is associated with lower emissions. Should this be "per capita emissions"?	Accepted. Text is revised.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
71231	81	14	81	17	The rebound effect is discussed in a very .extensive and detailed extensive manner with several references in 9.9.2, it is recomended adding a link to that section.	Accepted. A reference to chapter 9 has been added.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72301	81	14	81	17	The rebound effect is discussed in a very extensive and detailed extensive manner with several references in 9.9.2, it is recommended adding a link to that section.	Accepted. A reference to chapter 9 has been added.	bertoldi paolo	european commission	Italy
4877	81	16	81	16	Citation missing in References: Reference Saunders, Harry D., 2015. Recent evidence for large rebound: elucidating the drivers and their implications for climate change models. The Energy Journal 36(1), 23-48	Accepted. Reference included.	Harry Saunders	Carnegie Insitution for Science, Global Ecology Group, Stanford, USA	United States of America
20073	81	17	81	19	To underpin: -Marinakis, V., Doukas, H., Koasidis, K., & Albuflasa, H. (2020). From intelligent energy management to value economy through a digital energy currency: Bahrain city case study. Sensors, 20(5), 1456.	Noted. Due to space limitation, we may not be able to include additional text.	Haris Doukas	National Technical University of Athens, Greece	Greece
4931	81	26	81	29	At page 81 the relation between working hours and enviromental pressure is cited. It would be interesting to see how this retion is change during pandemic	Noted. COVID 19 issue is discussed elsewhere in the report.	Tiziana Susca	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Italy
20553	81	31	81	34	It is an essentially behaviourist view of social norms, which reduces them to processes of imitation. The notion of social norm in sociology is broader and allows us to account for collective processes that can be very structuring for individual behaviors, thus interesting for structural and long-lasting changes.	Noted. The first sentence has been deleted while addressing another comment.	Government of France	Ministère de la Transition écologique et solidaire	France
20555	81	38	81	39	The important scientific field iof sustainable consumption is not taken into account here.	Rejected. The point that this sentence is trying to make is not related to sustainable consumption	Government of France	Ministère de la Transition écologique et solidaire	France
625	81		12	14	This sentence is much better if it is placed in urban living part.	Rejected. It is a continuation of the previous sentence and is related to time use.	Kim Hana	KAIST	Republic of Korea
627	81		30	31	It doesn't seem right that this sentence is placed first. This section talks about the social norms. I think this first sentence is okay to be removed.	Accepted. Sentence is removed.	Kim Hana	KAIST	Republic of Korea
629	81		47		This sentence can be removed. Then the following sentence needs to be modified as follows: A positive relationship was found between general and carbon-specific knowledge and the attitude towards carbon-specific behaviours in US consumers (Polonsky et al. 2012).	Accepted. Text is revised.	Kim Hana	KAIST	Republic of Korea
16225	81		12	14	This sentence is much better if it is placed in urban living part.	Rejected. It is a continuation of the previous sentence and is related to time use.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16227	81		30	31	It doesn't seem right that this sentence is placed first. This section talks about the social norms. I think this first sentence is okay to be removed.	Accepted. Sentence is removed.	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
16229	81		47		This sentence can be removed. Then the following sentence needs to be modified as follows: A positive relationship was found between general and carbon-specific knowledge and the attitude towards carbon-specific behaviours in US consumers (Polonsky et al. 2012).	Accepted. Text is revised.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
10533	82	10	82	10	"research is shows that,"?	Accepted. Text is revised.	Philippe Waldteufel	CNRS	France
15151	82	34	82	35	Please add period of recession years	Rejected. The exact period is not important to make the point.	Noverita Takarina	Universitas Indonesia	Indonesia
20557	82	39	82	39	The important scientific field of sustainable consumption is not taken into account here	Rejected. The point that this sentence is trying to make is not related to sustainable consumption	Government of France	Ministère de la Transition écologique et solidaire	France
25119	82	40	83	42	Some of this overlaps with 2.4.3- please check	Noted. Section 2.4.3 refers to how providing energy access and decent living standards for the poorest will not impact emission budgets. This section refers to how extreme inequality at the top impacts emissions greatly. We are checking to avoid possible overlaps.	Minal Pathak	WGIII TSU, Ahmedabad University	India
631	82		9	17	The linear relationship between awareness/knowledge has been tapped into/criticized a lot. Please take a look at the following article. (Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?)	Rejected. The article is too old to cite (2002) for this report.	Kim Hana	KAIST	Republic of Korea
633	82		40	48	This inequality part should be reduced. First, the content of this part is repeatly talking about its negative impacts on emissions. In this part, how and why inequality has a negative effect on emissions rather than explaining the current situation (which was explained in former section, of course, based on other references)	Noted. We are checking to reduce potential overlaps. This section refers to how extreme inequality at the top impacts emissions greatly and what activities are associated with extreme inequality causing high emissions.	Kim Hana	KAIST	Republic of Korea
16231	82		9	17	The linear relationship between awareness/knowledge has been tapped into/criticized a lot. Please take a look at the following article. (Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?)	Rejected. The article is too old to cite (2002) for this report.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16233	82		40	48	This inequality part should be reduced. First, the content of this part is repeatly talking about its negative impacts on emissions. In this part, how and why inequality has a negative effect on emissions rather than explaining the current situation (which was explained in former section, of course, based on other references)	Noted. We are checking to reduce potential overlaps. This section refers to how extreme inequality at the top impacts emissions greatly and what activities are associated with extreme inequality causing high emissions.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
64963	83	2	83	4	I did not understand this sentence	Noted. Sentence has been edited for clarity.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
71233	83	2	83	4	The sentence "Matching the rebalancing…….during this period" is incomprehensible. Please amend.	Noted. Sentence has been ammended.	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
83895	83	5	83	9	Same comment for the previous text passage: On the shares of who emits what part of global emission in footprints, a recent paper (Semieniuk and Yakovenko 2020) provides new evidence on the evolution of global footprint inequality from 1970 thorugh 2013 that is more comprensive than the cited Chancel and Piketty, and estimates that footprint inequality had only a very slight trend to more equality. The full reference is: Semieniuk, G. and Yakovenko, V. M. (2020) 'Historical evolution of global inequality in carbon emissions and footprints versus redistributive scenarios', Journal of Cleaner Production, 264, p. 121420. doi: https://doi.org/10.1016/j.jclepro.2020.121420.	Noted. Reference is now included.	Gregor Semieniuk	University of Massachusetts Amherst	United States of America
83897	83	6	83	6	There is some innovative work by Goessling (2019) that looks at emissions of the very top emitters by tracking private jet travel using social media data of celebrities i.e. for persons within the top 0.1% or even more concentrated, that suggests the usual footprint estimates using more coarse-grained quantiles may even underestimate the inequality in footprints. More discussion and data is in Otto et al. (2019). The full references are: Gössling, S. (2019) 'Celebrities, air travel, and social norms', Annals of Tourism Research. Elsevier, 79(August), p. 102775. doi: 10.1016/j.annals.2019.102775. Otto, I. M. et al. (2019) 'Shift the focus from the super-poor to the super-rich', Nature Climate Change, 9(2), pp. 82–84. doi: 10.1038/s41558-019-0402-3.	Accepted. References and some text are now included. Thank you.	Gregor Semieniuk	University of Massachusetts Amherst	United States of America
83899	83	16	83	20	The point about an emerging global `middle class' could be reinforced by the discussion about consumption `at the extensive margin' such as first-time purchases of white goods and likely impacts on energy demand as discussed in Wolfram et al. (2013), and the increased use of air conditioning (Davis and Gertler 2015). Wolfram, C., Shelef, O. and Gertler, P. (2012) 'How Will Energy Demand Develop in the Developing World?', Journal of Economic Perspectives, 26(1), pp. 119–138. Available at: http://pubs.aeaweb.org/doi/10.1257/jep.26.1.119. Davis, L. W. and Gertler, P. J. (2015) 'Contribution of air conditioning adoption to future energy use under global warming', Proceedings of the National Academy of Sciences, 112(19), pp. 5962 LP – 5967. doi: 10.1073/pnas.1423558112.	Accepted. References are very good and helpful. Thank you they are now included in the text.	Gregor Semieniuk	University of Massachusetts Amherst	United States of America
78325	83	20	83	22	could be perceived as policy prescriptive.	Accepted. Has been edited to diminish that perception.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
83901	83	20	83	21	The scholars advocating for "trying a different option for sharing global carbon emissions" do not, however, explain how this option (of a cap or in the case of Hubacek et al. a floor) is to be implemented, which would require tremendous institutional change as argued by Semieniuk and Yakovenko (2020), which could be cited for caution about how difficult an option this is to implement. Full reference: Semieniuk, G. and Yakovenko, V. M. (2020) 'Historical evolution of global inequality in carbon emissions and footprints versus redistributive scenarios', Journal of Cleaner Production, 264, p. 121420. doi: https://doi.org/10.1016/j.jclepro.2020.121420.	Accepted. Reference is now included. Thank you.	Gregor Semieniuk	University of Massachusetts Amherst	United States of America
71235	83	30	83	30	There, conditions impacting hardest low-income urban residents should probably be "hardest hit low-income urban residents"?	Noted. Text is edited for clarity.	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
64899	83	35	83	36	advancing mitigation should not contribute to deepen existing inequalities, nor to increase of final energy use when we consider poverty elevation and providing basic needs in form of sanitation, electricity access, safe water or education. This is shown on the base of household level analysis in Zambia, Vietnam and Nepal. See Baltruszewicz et al 2021 https://iopscience.iop.org/article/10.1088/1748-9326/abd588/meta and https://www.sciencedirect.com/science/article/pii/S2214629621000530	Accepted. Thank you for the references now included.	Marta Baltruszewicz	University of Leeds	United Kingdom (of Great Britain and Northern Ireland)
3249	83	38	83	42	More discussion about equity issues are needed in this Chapter. IPCC could not avoid to show various ways to assess equity issues. It is important as the Paris Agreement is clear about equity principle, however does not contain any detail about that. Please, add a citation: Romanovskaya A.A., Federici S. How much greenhouse gases each planet inhabitant could emit while attaining the Paris Agreement temperature limit goal? The equity dilemma in sharing the global climate budget to 2100. 2019. Carbon Management. Volume 10, Issue 4. Pages 361-377. DOI: 10.1080/17583004.2019.1620037 Available online: http://dx.doi.org/10.1080/17583004.2019.1620037	This is a very interesting study and we thank you for the reference. The point is taken, however this section did not discuss equity principles for sharing the global climate budget and therefore the Reference though very relevant could not be directly added.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
78327	83	44	85	16	I find it odd that this box is on Chapter 2 not Chapter 5. Certainly worth a reference but 2 pages?	Noted. The box can be shorthened in final edit	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
635	83		44	47	The box cosists of one very long paragrph. So it would be good for authors to split this into several paragrphs.	Noted the box will be edited.	Kim Hana	KAIST	Republic of Korea
16235	83		44	47	The box cosists of one very long paragrph. So it would be good for authors to split this into several paragrphs.	Noted the box will be edited.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
20559	84	11	84	14	The sentence is not clear, with the particular case for DC - maybe it could be structured differently.	Noted. Box is edited to a shorter version.	Government of France	Ministère de la Transition écologique et solidaire	France
20561	84	16	84	17	The acronym should be placed after "bike-sharing scheme" for a better understanding. It would read "the bike-sharing scheme (BSS) in Shanghai..."	Noted. Edited	Government of France	Ministère de la Transition écologique et solidaire	France
48239	84	17	84	17	BBS needs to come before Shanghai otherwise it makes no sentence with mentions of London, Brisbane, etc. in the next setence (lines 19-20)	Noted edited.	Susana Hancock	University of Oxford	United States of America
71237	84	26	84	26	Unclear what "1.4 lower emissions per passenger" refers to. Lower by 1.4 times?	Noted edited.	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
4879	84	47	84	48	“Policy measures to avoid rebound would need to be considered and documented.” The word “avoid” here is problematic. As noted in IPCC SR1.5*, there is a tradeoff here. Rebound generally increases economic welfare even while it reduces energy saving. So policy measures aimed at suppressing rebound have negative economic welfare effects. Different countries will likely make this tradeoff differently, favoring economic welfare gains over energy use reduction and so disfavoring rebound suppression. This may hold especially true for developing countries, for whom economic benefits are especially needed to meet other Strategic Development Goals. Countries in the process of development show especially high material and energy intensities (Saunders et al. 2021), especially in the early stages. * findings of AR1.5: "...high rebound can help in providing faster access to affordable energy (SDG 7.1) where the goal is to reduce energy poverty and unmet energy demand (see Chapter 2, Section 2.4.3)" and goes on to say "...and to address policy-related trade-offs and welfare enhancing benefits (robust evidence, high agreement) (Chakravarty et al., 2013; Chakravarty and Roy, 2016; Gillingham et al., 2016), (Chakravarty et al., 2013)."	Accepted. Text is edited to retreat the use of word avoid.	Harry Saunders	Carnegie Insitution for Science, Global Ecology Group, Stanford, USA	United States of America
637	84		1	50	in-text citation, in former sections, there were not commas after author. Please be consistent.	Noted. Thank you.	Kim Hana	KAIST	Republic of Korea
16237	84		1	50	in-text citation, in former sections, there were not commas after author. Please be consistent.	Noted. Thank you.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
54721	85	1	85	1	Why is this section not including CH4 (and other non-CO2 gases)?	The literature on future CO2 emissions from current and planned infrastructure focusses largely on CO2 from fossil fuel combustion and industrial processes.	Government of United States of America	U.S. Department of State	United States of America
85177	85	33	85	35	This sentence should replace "urban districts" with cities or urban areas. Cities and their built environments and transport layouts represent some of the most substantive lock-ins.	Accepted. Changed.	Karen Seto	Yale University	United States of America
639	86		12		Figure 2.32 is not necessary.	Accepted. Figure was removed.	Kim Hana	KAIST	Republic of Korea
16239	86		12		Figure 2.32 is not necessary.	Accepted. Figure was removed.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
54723	87	1	93	17	This section on committed emissions has no references to agriculture, but some forms of animal agriculture, especially livestock, have very large global emissions and are related to major infrastructure investments such as confined animal feed operations (CAFOs), particularly from the point of view of the farmers or owners. In some countries, these constituencies also have considerable influence over government resources and policies so they should be included in this assessment of committed emissions. If the absence of such emissions reflects limitations of models, then the text should explain both why the commitments matter and how the model limitations influence what is and is not included in the text.	Rejected. The scenario literature on long-term emission reduction pathways highlights the importance of fossil-fuel infrastructures and related carbon lock-ins as pointed out in the chapter. This is not the case for the agricultural sector, because it does not play the same role in decarbonizing the world economy (in fact, it is much more important when it comes to natural sink management). We are also not aware of such a literature. We added a sentence on this and point out the lack of LULUCF emissions later on in the discussion of estimates.	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
86173	87	1			Terminology ... ? (obviously, running through this section ...) .... also see remarks on the final section	We no longer refer to "commited emissions", but rather speak descriptively of "future CO2 emissions from existing (and planned) fossil fuel infrastrucutre.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
86175	88	1			Any way to tweak this table into one page?	Done. Thanks.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
71239	88	12	88	12	Please clarify in caption whether estimates refer to global committed emissions.	Accepted. Improved the caption. Thanks.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
74793	90	20	90	23	The text in line 20-23 describes figure 2.33a and indicates that future CO2 emissions from fossil fuel infrastructure have failed to peak and continued to rise despite countries' efforts to organize mitigation action around the globe. - the statement is not consistent with figure 2.33a which shows a peak in CO2 emissions (from around the year 2014) in Asia and developing pacific. - the text could be revised to also explain the peak exhibited in Asia and developing Pacific	Rejected. We had to cut the section to keep the chapter within limits. We removed Figure 2.33 and focussed the discussion entirely on global trends.	Government of Kenya	Kenya Meteorological Service	Kenya
641	90		4		in-text citation error (Tong et al. 2019a)->(2019a)	We carefully checked citations throughout the section.	Kim Hana	KAIST	Republic of Korea
643	90		11		no verb. Related-> is related to	We carefully checked citations throughout the section.	Kim Hana	KAIST	Republic of Korea
653	90		16		What are total remaining commitments? The y axis should be the total commitments?	Noted. We decided to drop the term "committed emissions". However, we improved the y-axis label for clarity.	Kim Hana	KAIST	Republic of Korea
16241	90		4		in-text citation error (Tong et al. 2019a)->(2019a)	We carefully checked citations throughout the section.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16243	90		11		no verb. Related-> is related to	We changed the entire sentence to safe space.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16253	90		16		What are total remaining commitments? The y axis should be the total commitments?	Noted. We decided to drop the term "committed emissions". However, we improved the y-axis label for clarity.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
5085	91	19	91	29	You mention "current fossil fuel infrastructures". Were any assumptions on lifecycles applied or did you simply assume that the overall volume of 715 Gt on average were maintained?	We changed the entire sentence to safe space.	Lina Hollender	n/a	Germany
78329	91	19	91	29	These uncertainties do not reflect the full range as commented earlier	We change to Working Group III net cumulative CO2 emissions until net-zero emissions for 1.5°C and 2°C emission reduction pathways and report the range as provided by chaoter 3.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
83037	91	19	91	29	The enormous uncertainties in the WG1 carbon budget calculations and the many substantial changes in the WG1 methodology (between SR1.5 and AR6) might warrant to avoid the countdown language used here	Rejected. This is no countdown language. It is an instructive comparison of future CO2 emissions from long-lived infrastructure with the remaining carbon budgets.	Geden Oliver	German Institute for International and Security Affairs	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
83475	91	19	91	29	Ensure to update with latest remaining carbon budget assessment from WG1 Ch5.	Noted. There was a decision to move to net cumulative CO2 emissions from 1.5°C and 2°c scenario pathways as presented by chapter 3 in Working Group III for internal consistency.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
30647	91	30	92	9	It is afraid that this paragraph will be misleading, because the required retirements of fossil fuel power plants due to carbon budget depend on the emissions from other sectors as well as their capacity factor and the opportunities of CCS. Suggest to delete this paragraph or add the detailed conditions for estimating these numbers.	Rejected. There is a relevant literature on this topic. Estimates come from cross-sectoral models that take these issues into account. We decided to keep this information, but strealined and further improved it.	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan
645	91		20		in-text citation error the order of the references.	Could not find a problem in that line. But thanks. We checked citation style throughout.	Kim Hana	KAIST	Republic of Korea
16245	91		20		in-text citation error the order of the references.	Could not find a problem in that line. But thanks. We checked citation style throughout.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
70127	92	3	92	4	this implies retiring 30 (19-34) and 24 (22-27) year earlier when following 1.5°C pathways...	Corrected. Thanks	Rayner Andersen	Department of Fisheries and Oceans	Canada
78099	92	3	92	6	Please revise calculations of earlier retirement years for the 1.5°C pathways.	Corrected. Thanks	Charlotte Plinke	Climate Analytics	Germany
64965	92	10	92	10	In Fig. 2.34, clearer vertical scale would be nice	We have gone through all figures to improve readability. We added a clearer y-axis and y-axis scale. We also improved ist labelling to avoid the term "committed emissions", which we no longer use.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
647	92		7		PPCA members?	Accepted. We wrote our the acronym: power past coal alliance	Kim Hana	KAIST	Republic of Korea
649	92		17	18	in-text citation error the order of the references.	We carefully checked citations throughout the section.	Kim Hana	KAIST	Republic of Korea
651	92		22		It would be nicer to briefly explain the various infrastructure solutions. It is because the authors stated conventional opitions were not included.	This section already needs to be cut down from the Second Order Draft version. We do not really have space to expamd here.	Kim Hana	KAIST	Republic of Korea
655	92		10		resolution issue (figure 2.35 as well). The y axis - emission -> emissions	Corrected. Thanks	Kim Hana	KAIST	Republic of Korea
16247	92		7		PPCA members?	Accepted. We wrote our the acronym: power past coal alliance	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16249	92		17	18	in-text citation error the order of the references.	We carefully checked citations throughout the section.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16251	92		22		It would be nicer to briefly explain the various infrastructure solutions. It is because the authors stated conventional opitions were not included.	This section already needs to be cut down from the Second Order Draft version. We do not really have space to expamd here.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16255	92		10		resolution issue (figure 2.35 as well). The y axis - emission -> emissions	Corrected. Thanks	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
30649	93	0	93	0	The lifetime of historical evidence for gas power is 36 years according to the main text. However, in the figure the line of the lifetime is about 39 years as same as that for coal power. Please check it..	We removed the figure, but corrected this in the text. Thanks!	Government of Japan	Climate Change Division - Ministry of Foreign Affairs	Japan

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
71241	93	18	96		Elements of this section deserve to be more prominent in the SPM. The issue of residual emissions is increasingly relevant to policymakers and the private sector given the popularity of net zero targets. It is in every country and company's private interest to consider that their own emissions are part of this residual, yet stringent targets such as 1.5°C make this an impossible wish. Therefore a more objective understanding of what the 'residual' consists is very important.	Thank you. We will be discussing with the SPM drafting team how the issue of residual emissions could be elevated to the SPM.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
83039	93	18	96	8	Since you make the case that residual emissions create demand for CDR (and since this is connection is highlighted in chapters 3 and 12 and in SPM and TS) it would be very instructive to expand this discussion to non-CO2 emissions (at least by adding a paragraph and some indicative numbers), since in many scenarios 'hard-to-abate' emissions at the time of net-zero are to a large extent non-CO2 emissions (often from agriculture), in national scenarios often ~50%. Since there aren't any articles on residual emissions in net-zero GHG trajectories yet, this part of ch2 could become a future focal point for the policy-relevant debate on residual emissions in the context of net-zero targets	Thanks. The literature is not really discussing this, but even AR5 has pointed out the fact that non-CO2 emissions play a prominent role in net-zero pathways. However, there is a complication around atmospheric lifetimes: more short-lived forcers like methane may actually not need to be reduced to zero. In any case: we do not have space for this as we had to trim down the section substantially to keep the chapter within its given word limits.	Geden Oliver	German Institute for International and Security Affairs	Germany
86177	93	18			Two comments on the issues / debates though I havent been deep in the literature First important to frame as an economic decision. - Economic risk inevitably in build decisions - Over what lifetime is the intiial capital actually recovered - The retirement decision is likely in fact to be one of reduced utilisation + rising maintenance costs, or a point of major refurbishment	This goes beyond what the literature is covering and what the purpose of this section is. We are foucssed on synthesizing two strands of literatures providing a perspective on future CO2 emissions from infrastructures - in line with the remit of the chapter.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
86179	93	18			Second, useful to flag that it is not just top-down climate policy that may drive out. It could also be the intrinsic dynamics of new entrants, particularly now renewables in the power sector, and how that will impact coal. [these are both reasons whey I dislike the term „committeed“]	We no longer use the term "committed emissions". We refer to "future CO2 emissions from infrastructures". It is helpful to expand to intrinsic dynamics as the reference to stringent climate policy is a design issue to derive the estimates used here.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
63477	93	22	93	27	suggest changing "cannot" (line 27) to "are not" to be consistent with the language (i.e., use of "are not") on line 22, as these two words have different meanings. "Cannot" implies that it is impossible; while "are not" does not imply that it is impossible (in the context of line 22-23). If the correct term is "cannot" in this sentence on line 27, it would be useful to include the reasoning (e.g., CCUS technologies not expected to be advanced enough or deployed at the necessary scale). The reasoning provided above, on lines 22-23, only applies to the term "are not".	Thanks for pointing out this inconsistency. It is not really possible to determine exactly what emission component "cannot" be removed from the system. We have adjusted the language throughout the section.	Government of Canada	Environment and Climate Change Canada	Canada
657	93		1		resolution issue; the levels of radiative forcings need additional explanations. Individual levels are parallel to which represenative scenarios or GTP (global temperature increase potential)	Accepted. We will replace the forcing levels by temperature references.	Kim Hana	KAIST	Republic of Korea
661	93		26	28	It would be nicer to clarify the timeframe for the estimates (I believe this number is cumulative estimates by the end of this century.)	Accepted and done. We explain these forcing levels in the caption now.	Kim Hana	KAIST	Republic of Korea
16257	93		1		resolution issue; the levels of radiative forcings need additional explanations. Individual levels are parallel to which represenative scenarios or GTP (global temperature increase potential)	Noted, thanks.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16261	93		26	28	It would be nicer to clarify the timeframe for the estimates (I believe this number is cumulative estimates by the end of this century.)	Accepted and done. Thanks.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
659	94		8		in-text citation error the order of the references. Line 17 and 18; line 22; line 26-17 as well.	We carefully checked citations throughout the section.	Kim Hana	KAIST	Republic of Korea

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
16259	94		8		in-text citation error the order of the references. Line 17 and 18; line 22; line 26-17 as well.	We carefully checked citations throughout the section.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
7975	97	1	97	1	The framing of separating climate effects as observed from "climate policy" (equal carbon pricing only) and "non-climate policies" (such as air pollution policy, etc) is very strange and frames the climate problem as a purely economic problem. Surely, we have moved further than this in the academic climate policy research discourse! Climate policy is NOT only carbon pricing, but also R&D, market introduction support, subsidies, standards, and similar policies aimed at improving the performance of zero-carbon technology and get it to market at scale (feed-in tariffs, not carbon pricing, has done the most to explain the climate policy progress we have seen to date!). Further, climate policies are now expanding beyond the energy production/transformation stage and include infrastructure policies (subsidies, planning, etc) and institutional reform (e.g. electriicty market reform, demand-side regulations like standards for end-use products). All of these very important policies are excluded by the inexplicable focus on cabron pricing = climate policy, meaning that you perpetuate an outdated paradigm! Carbon pricing can probably help solve several climate policy problems, but it cannot solve all - if nothing else because not all barriers standing in the way of decarbonisation are price-based barriers! - and it is critical to acknowledge this in reports such as this one.	Accepted. Difference beween policy, policy domains and instruments, distinction between climate and non-climate policies explained, limited scope of this section relative to Chapter 13 justified.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
8309	97	1	105	34	I am not sure if the discussion of policies fits well into the chapter, I would have expected an assessment of the effects of policies in Ch13. I'd find it more intuitive to only mention that of course policies played a role for emissions and refer to CH13 (perhaps include a box in Ch2).	Taken into account. Plenary outline mandates Ch2 to assess effectiveness of at least selected policies and instruments. Cross-references to Ch13 made.	Michael Jakob	MCC Berlin	Germany
11147	97	1	105	34	This section on policy would give a much more balanced view, and one that is more consistent with the other chapters in the report, if it were to align with the multiple analytic frameworks presented in chapter 1. Currently, the section is nearly exclusively embedded in the economic efficiency analytic framework. From the standpoint, it is clear that carbon pricing is the optimal policy instrument, both theoretically and empirically (since the indicators for effectiveness are also different across the frameworks; e.g. in the transitions dynamics framework, many policies can be viewed as effective if they create the conditions needed for other, later policies to achieve deep emissions reductrions). The result is the section more or less ignores the use of and effects of other policy instruments, such as renewable energy support, and regulatory standards.	Taken into account. Aside from carbon pricing, another section for other regulatory policies is constructed with more literature.	Anthony Patt	ETH Zürich	Switzerland
15153	97	1	97	2	the section title should be the impact on emission based on climate and non-climate policies and measures	Rejected. The current title follows the IPCC decision on the outline of chapters and the meaning is the same as the one proposed by the comment.	Noverita Takarina	Universitas Indonesia	Indonesia

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
20563	97	1	97	2	The distinction made in this section between climate and non-climate policies is a strange one that does not correspond to the way that most governments and other actors perceive or organise their actions. The distinction does not seem to be made in chapter 13. The fact is that many policies such as support for renewable energy, transformation of transport systems, improvement in waste management, etc. are undertaken because they lead to a reduction in CO2 or other GHG emissions - they are climate policies, just as policies that directly target emissions such as carbon pricing. It might be preferable to use a different terminology distinguishing perhaps instruments that directly price or regulate CO2 and other GHG emissions, and other climate policies.	Taken into account. Aside from carbon pricing, another section for other regulatory policies is constructed with more literature.	Government of France	Ministère de la Transition écologique et solidaire	France
63479	97	4	97	4	suggest changing word "is" to "include". Other factors include social acceptability: equitable, effective, and efficient does not always result in support/acceptance.	Rejected. The current title follows the IPCC decision on the outline of chapters and the meaning is the same as the one proposed by the comment.	Government of Canada	Environment and Climate Change Canada	Canada
27587	97	20	98	4	Delete Figure 2.37 and "National climate policy is complex and difficult. This is clearly demonstrated by Figure 2.37, which shows a cluster analysis combining climate policy success indicators (climate law adoption, fossil subsidy levels, per capita emissions levels) with political economy indicators, such as the strength of certain interest groups (e.g. oil & gas rents), state institutions and capabilities (e.g. control of corruption) and social factors (e.g. social trust and climate awareness) (Lamb and Minx 2020). Countries around the world thus face widely varying contexts and levels of hinderance in adopting climate policies and ensuring their effectiveness. The figure provides a useful backdrop to assessing the impacts of policies and measures discussed in the rest of this section.", as analysis is rather biased. For instance, "weathly OECD" countries' governmental revenues originate from taxation of fossil fuels consumption, and some EU countries are presented as "fractured democracies".	Taken into account. Plenary outline mandates Ch2 to assess effectiveness of at least selected climate and non-climate policies and instruments. Ch13 has more flexibility (not mandated to address non-climate policies). Difference between policies and instruments explained. Cross-references to Ch13 made.	Eleni Kaditi	Organization of the Petroleum Exporting Countries, OPEC	Austria
48241	98	0	98	0	Really great visual, very illustrative and helpful.	Noted but figure deleted in response to other comments.	Susana Hancock	University of Oxford	United States of America
48243	98	0	98	0	What are the 12 variables? I see 9 across country groupings.	Figure deleted in response to other comments.	Susana Hancock	University of Oxford	United States of America
3251	98	1	98	1	Not clear what is the X axis mean	Figure deleted in response to other comments.	Anna Romanovskaya	Institute of Global Climate and Ecology	Russian Federation
15217	98	1	98	1	The background colors of the maps of Taiwan Province and Chinese mainland are inconsistent. The East Section of China-India Border is wrongly drawn and the Dotted Line of South China Sea, Nanhai Zhudao, Diaoyu Dao and its affiliated islands of China are missing. It is suggested to use a color block map, delete the national boundary lines, adjust the base color of Taiwan province to be consistent with Chinese mainland, and mark the island points.	Figure deleted in response to other comments.	Government of China	China Meteorological Administration	China
47321	98	1	98	4	figure 2.37 I'm agreed with all factor which hinders climate policy adoption and effectiveness including the corruption factor, but I didn't agree with the factor of Democracy and its effect on hindering climate policy adoption and effectiveness. I am afraid that this factor will have political rather than scientific dimensions related to measures to adopt and activate climate policies, which is the goal of this sixth scientific report.	Figure deleted in response to other comments.	Khaled Mohamed Madkour	Ain Shams University, Cairo, Egypt	Egypt

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
72477	98	1	98	5	A definition of the terminologies used in this figure must be given, in particular for "2. Fragile states" and "4. Fractured democracies" in other words on what characteristics (economical, political, etc.) are based these distinctions on the 5 terminologies used here. As it is shown, I have troubles to see e.g. Portugal as a "Fractured democracy" and why can't a e.g. Fractured democracy not be an oil and gas state at the same time. The mixing between political, economical and energy-based considerations is very confusing here.	Figure deleted in response to other comments.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany
7959	98	6	98	6	Why is "carbon pricing" equated with "climate policy" here? I would expect that the IPCC now has come further than this: section 2.8.2 is about carbon pricing, and not about "climate polcies" - carbon pricing is merely one of very many different climate policies!	Accepted. Difference beween policy, policy domains and instruments, distinction between climate and non-climate policies explained, limited scope of this section, e.g. assessing carbon pricing as one of the instruments in climate policy is explained.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
11149	98	10	98	12	It is true that carbon pricing is both popular, and in some respects very effective. But it would be useful for the reader to also identify other types of policies that are popular, and (perhaps in different ways -- which is why Chaopter 13 presents multiple criteria for assessing effectivness) effective.	Accepted, partly. Other types of policies mentioned in 8.1. Popular changed to widely used.	Anthony Patt	ETH Zürich	Switzerland
7957	98	12	98	16	Agree, and the paper of Best et al (cited) agrees with Green (https://doi.org/10.1088/1748-9326/abdae9) that the emission reductions from carbon pricing schemes have been modest, and sometimes zero.	Noted.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
45781	98	14	98	16	The symbol “%p” is not clear. Is this simply percent (then delete p) or something else like “parts per ?”	%p is for 'percentage point', and is different from 'percentage'. It is now written out.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
74795	98	14	98	16	it is not clear what the units of "growth rate" given in line -14 and line -16 as "%p" mean. Could it be made clear what units are used?	Noted. The unit of growth rate is % and it indicates the increase of emissions year by year as the text explains.	Government of Kenya	Kenya Meteorological Service	Kenya
61525	98	17	98	18	Does a lower carbon pricing gap mean higher carbon price?	Noted. Yes, a lower carbon pricing gap mean higher carbon price, as explained in the footnote.	Takashi Homma	Research Institute of Innovative Technology for the Earth (RITE)	Japan
11153	98	19	99	2	This is not quite right. Lilliestam et al didn't find "no empirical evidence" for the effectiveness of such policies on promoting technological change. Rather, they found limited evidence that such policies had no effect on promoting technoloigical change. That is an important distinction.	Taken into account. The sentence is deleted.	Anthony Patt	ETH Zürich	Switzerland
45783	98	19	98	19	The reference “OECD 2018” is incomplete. Correct is: OECD (2018), Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading, OECD Publishing, Paris, https://doi.org/10.1787/9789264305304-en.	Accepted, reference corrected.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
7955	98	98	8	12	I disagree: empirical evidence rather suggests that carbon pricing is NOT a strong driver of decarbonisaiton, and shows clearly that actually existing carbon pricing schemes do little, or nothing, to trigger the technological change required for full decarbonisation of energy. There is empirical evidence that actual carbon pricing schemes trigger some behavioural change and thus reduce emissions somewhat (https://doi.org/10.1088/1748-9326/abdae9). There is also evidence that carbon pricing in reality, outside of models, has not triggered investments in the necessary zero-carbon energy technologies (https://doi.org/10.1002/wcc.681).	Rejected. This is a classic prices vs quatities debate. The text cites evidence of pricing impacts from the assessed publication. True that current low carbon prices do not lead to major behavioural changes.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
663	98		16		remove period before (Best et al. 2020)	Accepted, The period removed.	Kim Hana	KAIST	Republic of Korea
16263	98		16		remove period before (Best et al. 2020)	Accepted, The period removed.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
11155	99	2	99	5	This finding is not in contrast with the Lilliestam finding. Lilliestam found evidence of no relationship between a particular policy (carbon pricing) and a particular outcome (investment in low carbon technologies). Hashmi and Alam find evidence of a relatiohship between a policy (environmental tax revenue) and a different outcome (carbon emissions), as well as between one outcome (patent counts) and another outcome (emissions). That is not inconsistent with Lilliestam. Since countries with carbon pricing typically also have other policies driving innovation, there may well be a correlation between innovation and emissions.	Partially accepted. The text referring Lilliestam has been deleted considering the page limit and the relative importance of the finding.	Anthony Patt	ETH Zürich	Switzerland
7961	99	20	99	23	The cited paper (Le Quere et al) indeed says exactly this, but that article does NOT - as implied by the placement of this statement in the carbon pricing/climate policy subsection - say that this is because of carbon pricing. Because we know that carbon pricing has triggered no or very little invesment in renewables, we also know that if the decrease in emissions in 18 investigated countries is because of an increase of renewables, then that share of the emissoin reduction has NOT been triggered by carbon pricing. Rather, we can be certain that this share of observed emission reductions can be attributed to technology support and market introduction policies, which are responsible for essentially all deployment of renewable power to today.	Accepted. We moved this statement to the subsection for other regulatory policies.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
86181	99	20			Could be more specific eg "Claims that compliance simply reflected the ease of the targets are not supported either by the evidence of earlier economic studies (which projected precisely the opposite: Grubb, 2016), the impact on domestic legislation (Chapter 13), or ex-post evaluation which shows clear impact of the Protocol on emissions (Maamoun, N., 2019: The Kyoto protocol: Empirical evidence of a hidden success. J. Environ. Econ. Manage., https://doi.org/10.1016/j.jeem.2019.04.001.)	Partially accepted. Added the statement with the reference Maamoun (2019).	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
86183	99	20			I have pointed this out to Chapter 14 which tbh has an extremely inaccurate account of Kyoto Protocol in almost all respects (including their statement on impact). FYI in case of interest: “There are probably a dozen papers assessing the impact of the Kyoto Protocol on emissions. The paper by Almer and Winkler 2017 is the only one to report no discernible impact. It is a paper which demonstrates technical sophistication, but also - as can happen - seems to stumble into an obvious error, if I am not mistaken. Whereas other papers try to assess using panel data and comparisons with other countries, the paper evaluates KP outcomes against 50 US States. Unfortunately, unless I misunderstand something, this appears technically sophisticated but is actually almost irrelevant since most US states are correlated by many things, most obviously the Shale Gas revolution. Isnt the technical conclusion that participation in the Kyoto Protocol had statistically as much impact as the US Shale revolution (plus US State policies also quite widespread)- which was very big. That is totally different from saying it had no impact, and would explain why this paper is such an outlier. It was anyway superceded, in the same journal by the much more extensive and generalised methodology and study of Maamoun, N., 2019: “	Noted. No action.	Michael Grubb	UCL - Institute of Sustainable Resources	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
11151	99	25	99	26	I don't think this statement is correct. Technology support instruments -- FITs, subsidies, RPSs, and quotas -- appear to be more popular as a class of clomate policy compared to the various forms of carbon pricing policies. According to IRENA 2018 (Renewable energy policies in a time of transition, ISBN 978-92-9260-061-7) there are 126 countries with low carbon technology sdupport policies in the power sector, 68 countries with support policies for low carbon fuels in the transport sector, and 21 countries with low carbon technology support policies associated with heating and cooling. That would appear to outnumber, by more than a factor of three, the 61 carbon pricing initiative that you cite.	Accepted. 'the most' is replaced by 'among' and technology support instruments added together with the IRENA reference.	Anthony Patt	ETH Zürich	Switzerland
78331	99	25	99	26	Not sure Chapter 13 puts it quite that way. It actually notes that carbon taxes are rather unpopular!	Accepted. 'the most' is replaced by 'among' and popular replaced by 'widely used'	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
83041	99	32	99	39	Why are these numbers only on EU-25 (a rather unusual group, probably without UK, Romania and Bulgaria)? And why is the latest article from 2015? Numbers seem to be quite outdated	Taken into account. The sentence is deleted.	Geden Oliver	German Institute for International and Security Affairs	Germany
7963	99	37	100	1	There are quite a few assessments of the effects of the EU ETS, and most of them conclude that the effects have been smaller (or nothing) than the cited Bel & Joseph. For example Schäfer 2019 (https://doi.org/10.1016/j.enpol.2019.06.066) or Klemetsen et al 2020 (/https://doi.org/10.1142/S2010007820500062); it is also one of the central findings of Green's review (https://doi.org/10.1088/1748-9326/abdae9), which naturally reviews a large set of papers investigating the EU ETS.	Noted. The text on Bel and Joseph has been deleted.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
665	99		38		It would be hard for the authors to use "achieved" how about using "showed"?	Noted. The sentence is deleted.	Kim Hana	KAIST	Republic of Korea
16265	99		38		It would be hard for the authors to use "achieved" how about using "showed"?	Noted. The sentence is deleted.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
11159	100	1	100	2	The use of the word "other" is a little confusing here, as it creates the impression that policies aimed at renewable energy are viewed as "non-climate" policies. Continuing from the AR5, this report defines climate policies broadly to include those that do not focus purely (or even primarily) on emission reduction, but nevertheless are intended to have an effect relevant for mitigation and/or adaptation.	Partly accepted. Deleted 'non'(climate) but the use of the terms climate and non-climate policies is explained in the Introduction.	Anthony Patt	ETH Zürich	Switzerland
48181	100	8	100	10	China's pilot carbon market can indeed play a role in reducing carbon intensity in pilot areas by promoting industrial restructuring. However, the assessment mentioned that this role of carbon market does not play a role in promoting energy structure optimization and energy intensity reduction. This statement is inaccurate. Studies have shown that the carbon market can promote emission reduction by reducing energy intensity, promoting industrial structure optimization and energy structure optimization.Supporting documents: Xian Y et al. Opportunity and marginal abatement cost savings from China's pilot carbon emissions permit trading system: simulating evidence from the industrial sectors. Journal of Environmental Management 2020, 271, 110975. https://doi.org/10.1016/j.jenvman.2020.110975.	Rejected. The referred paper is not a kind of ex-post evaluation on the emission impacts from ETS.	Yang Wang	Beijing Climate Center	China
48245	100	8	100	8	What is meant by 'significant', that's an empty word here that is critical to quantify for this discussion.	Accepted. 'significant' deleted.	Susana Hancock	University of Oxford	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
48247	100	26	100	28	What is a level of taxation that is useful? How can we use taxation to affect emissions? What is sufficient? How is this quantified?	Noted. The empirical analyses show that the rates in the past were not sufficient to faciliate greater reduction of emissions.	Susana Hancock	University of Oxford	United States of America
7965	100	29	100	32	This finding is contradicted by Green 2021 (https://doi.org/10.1088/1748-9326/abdae9) that carbon taxes perform BETTER (in terms of environmental effectiveness) than ETSs.	Accepted. The sentence is deleted.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
7969	100	33	100	33	As above, this section is not about sectoral climate policies, but about sectoral carbon pricing.	Noted. The direction of emission change is the key issue here.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
7967	100	37	100	46	It is worth mentioning why and how these carbon tax systems have reduced emissions: the main effects stated in these papers (and also others, like Andersson 2019 (https://doi.org/10.1257/pol.20170144) show that the by far most important driver is a shift from gasoline to diesel cars - diesel is more carbon-efficient than gasoline, but this can hardly be seen as progress towards any type of climate target.	Noted. The provided reference is a kind of ex-ante anticipation and not about ex-post evaluation, which is the main focus of this section.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
11157	100	37	100	46	Given that the primary policy approach for mobility is regulatory such as emissions standards (e.g. the EU 95 gCO2 / km, or the US CAFE standards), and there is increasing use of support instruments for EVs, as well as quotas and announced bans on ICE sales, it seems surprising that this section ofcuses on carbon taxes on vehicle fuel. See for example https://doi.org/10.1016/j.enpol.2016.05.043 on the link between the EU 95 gCO2 / km standard and electric vehicle adoption.	Noted. It refers to the region targeted by the initiative. And "at the aggregate level " has been deleted for avoiding confusion.	Anthony Patt	ETH Zürich	Switzerland
667	100		12		Here, the aggregate level refers to the the nation wide result or the result of participating states?	Accepted. Removed.	Kim Hana	KAIST	Republic of Korea
669	100		24		remove space before period.	Noted. It refers to the region targeted by the initiative. And "at the aggregate level " has been deleted for avoiding confusion.	Kim Hana	KAIST	Republic of Korea
16267	100		12		Here, the aggregate level refers to the the nation wide result or the result of participating states?	Accepted. Removed.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16269	100		24		remove space before period.	Accepted. The sentence is revised with the reflection of the reference recommended.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
15219	101	1	101	3	In the sentence "failed to show any statistically significant impacts on reducing emissions of China’s power plants", the references cited for this conclusion are outdated and with few samples. So it is a conclusion inconsistent with the actual situation in China. After the implementation of the ultra-low emission standard, the emission reduction of Chinese power plants is significant. It is suggested that the authors refer to the latest literature and change this sentence to“Market-based regulation and government subsidies in China contributed to improving operational efficiency and reducing emissions. In addition, the implementation of ultra-low emission standards also has resulted in a significant reduction in emissions from China's power plants.” The supporting literature is as follows: Ling Tang et al. Substantial emission reductions from Chinese power plants after the introduction of ultra-low emissions standards. Nature Energy. 2019, volume 4, pages 929–938.	Noted. The recommended article is better suited for Ch. 13 on policy evaluations.	Government of China	China Meteorological Administration	China

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
7971	101	13	101	26	This box is correct and supported by new and peer-reviewed studies as well Gugler et al 2021 (https://doi.org/10.1016/j.jeem.2020.102405). What they explicitly find (and the OECD study only implicitly) is that carbon pricing can have the effect of pushing coal out of the merit order - but ONLY if the alternative generation capacities are already in place. If they are not in place, such as in every other country than the two investigated countries Germany and UK, then carbon pricing does not have the effect of pushing coal out (there are marginal effects, but not the wholesale shifts observed in the UK and, seemingly ongoing, in Germany). This is a very important qualification of the statement: unless other policies have not already triggered investments in other generation, carbon pricing shoudl not be expected to push out coal. F	Noted. Ch 13 has a lot more on this. Cross-ref inserted.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
7973	101	13	101	26	As above, it is worth mentioning what type of effect has led to the observed emissions reduction: it is a shift from a carbon-intensive generation technology (coal) to a less carbon-intensive one (gas). Hence, it's not really "decarbonisation" and the observed shifts will not be helpful to get to zero emissions, because it is not a shift to zero-carbon energy.	Noted. Chapter 13 presents more detailed assessments for which we lack the space here.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
25121	101	13	101	26	There is consensus that this was successful - but this is just one country case study and a single reference. There are some new studies supporting this evidence and its interaction with other policy instruments. I suppose the authors plan to develop this box before FGD?	Accepted. Thank you for the great idea. The GHG emissions implications of the Montreal Protocol are included. Space limits preclude inserting figures.	Minal Pathak	WGIII TSU, Ahmedabad University	India
54725	101	27	105	34	If not mentioned elsewhere, Section 2.8.3 could be a place for a discussion of the Montreal Protocol and emission changes that have arisen as a result of it, although it would be better if figures showing total GHG magnitudes and changes included the ozone-depleting Montreal Protocol Gases, where feasible.	Accepted. Thank you for the great idea. The GHG emissions implications of the Montreal Protocol are included. Space limits preclude inserting figures.	Government of United States of America	U.S. Department of State	United States of America
86185	101	27			Occurs to me there i an interesting asymmetry. Presumably, air quality measures can either increase (FGD reduces efficiency) or reduce GHG emissions (if reduce or close coal plants. But reducing GHG emissions necessarily reduces pollution associated with coal combustion?	Agreed. This is why we distinguish between end-of-pipe control policies for air pollution management in contrast to structural change (including fuel substitution and coal phase out) policies and policies that effect activity levels. We discuss this in the third paragraph of this sub-section	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
30471	101	41	101	41	Looks like categories are not harmonized between CEDS and EDGAR. I suspect AWB on fields is include din EDGAR, it should probably be removed - then categories would be comparable.	Not sure what is referred to here. The sentence has been modified.	Steven Smith	PNNL/JGCRI	United States of America
30473	101	46	101	47	While this statement is true, it is misleading. It is true for individual measures, but in aggregate, air pollution control will always increase climate forcing (because the net effect of air pollutants is warming, see WAG I).	Agreed. We have now added the word "individual" to the sentence to make this clearer.	Steven Smith	PNNL/JGCRI	United States of America
671	101		37	38	in-text citation error the order of the references.	Accepted. The order of the references has been fixed	Kim Hana	KAIST	Republic of Korea
16271	101		37	38	in-text citation error the order of the references.	Accepted. The order of the references has been fixed	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
71243	102	20	102	30	A recent study estimated the energy savings due to energy efficiency policies in the EU in the period 1990 to 2013: Paolo Bertoldi, Rocco Mosconi, Do energy efficiency policies save energy? A new approach based on energy policy indicators (in the EU Member States), Energy Policy, Volume 139, 2020, https://doi.org/10.1016/j.enpol.2020.111320. (https://www.sciencedirect.com/science/article/pii/S030142152030077X) While a more recent article assess the energy savings in the EU residential sector: Tsemekidi Tzeiranaki, Sofia; Bertoldi, Paolo; Diluiso, Francesca; Castellazzi, Luca; Economidou, Marina; Labanca, Nicola; Ribeiro Serrenho, Tiago; Zangheri, Paolo. 2019. "Analysis of the EU Residential Energy Consumption: Trends and Determinants" Energies 12, no. 6: 1065. https://doi.org/10.3390/en12061065	Accepted. The additional references have been inserted.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
72303	102	20	102	30	A recent study estimated the energy savings due to energy efficiency policies in the EU in the period 1990 to 2013: Paolo Bertoldi, Rocco Mosconi, Do energy efficiency policies save energy? A new approach based on energy policy indicators (in the EU Member States), Energy Policy, Volume 139, 2020, 111320 https://doi.org/10.1016/j.enpol.2020.111320. (https://www.sciencedirect.com/science/article/pii/S030142152030077X) While a more recent article assess the energy savings in the EU residential sector: Tsemekidi Tzeiranaki, Sofia; Bertoldi, Paolo; Diluiso, Francesca; Castellazzi, Luca; Economidou, Marina; Labanca, Nicola; Ribeiro Serrenho, Tiago; Zangheri, Paolo. 2019. "Analysis of the EU Residential Energy Consumption: Trends and Determinants" Energies 12, no. 6: 1065. https://doi.org/10.3390/en12061065	Accepted. The additional references have been inserted.	bertoldi paolo	european commission	Italy
61617	102	24	102	26	"Efforts to support a transition to renewable energy sources are also seen to have important air quality and climate co-benefits (Apergis et al. 2018)." Another paper (Apergis et al., 2010, https://doi.org/10.1016/j.ecolecon.2010.06.014) concludes that similar benefits can be had by supporting nuclear energy as well. There is no reason to leave nuclear energy out, so please revise “renewable energy” into “renewable and nuclear energy” and include the 2010 citation as well to be more consistent. IPCC should not be biased against or in favour of any single technology, but promote all effective mitigation efforts equally.	Accepted. The sentence has been edited and newer references have been cited.	Rauli Partanen	Think Atom	Finland
65655	102	24	102	26	"Efforts to support a transition to renewable energy sources are also seen to have important air quality and climate co-benefits (Apergis et al. 2018)." How about efforts to support nuclear energy? Are there any such efforts? Do such efforts have climate benefits? I am asking for the cited reference (Apergis et al. 2018) does not discuss nuclear energyl but earlier work from the same author (Apergis et al., 2010, https://doi.org/10.1016/j.ecolecon.2010.06.014) does and concludes in favor of nuclear. The point is that, in bringing forward a need for policies to support renewable energy, the IPCC should simultaneously call for policies that support nuclear energy. Please fix this inconsistency.	Accepted. The sentence has been edited and newer references have been cited.	Eero Hirvijoki	Aalto University	Finland
15155	102	31	102	31	Please add two or three sentences about the emission trend since and during pandemic before the sentence "Finally, ...'	Rejected. Section 2.2 already presents the recent trends in emissions. This section is focused on policies and their impacts	Noverita Takarina	Universitas Indonesia	Indonesia

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
47323	102	31	102	35	we should add examples of these opportunities for mitigating climate change as a result of the COVID-19 pandemic and adopt them e.g. switching to working from home and switching to remote teaching etc.	Accepted. Additional citations have been inserted and the text has been edited to reflect thse trends.	Khaled Mohamed Madkour	Ain Shams University, Cairo, Egypt	Egypt
37015	102	45	102	47	Electric vehicles require electricity for charging the batteries.	Accepted. Edit to "Electric vehicles powered by clean electricity can…"	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37017	102	45	102	47	This ultimately puts load on the electricity generation,	Accepted. Edit to "Electric vehicles powered by clean electricity can…"	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
37019	102	45	102	47	unless the energy mix involves substantial low carbon emissions, use of electric vehicle will ultimately increase CO2 emissions indirectly	Accepted. Edit to "Electric vehicles powered by clean electricity can…"	Arun kumar Nayak	Bhabha Atomic Research Centre Trombay Mumbai	India
11161	102	47	103	4	It is true that EV LCA emissions, and hence their advantages relative to ICE vehicles, depend on the power supply mix. But to place that into context, it is also important to note that it is only in exceptional cases that EVs fail to have substantially lower emissions, and that the gap is projected to increase over time as the power sector becomes decarbonized. See https://doi.org/10.1038/s41893-020-0488-7 . This contextual information would also make this paragraph consistent with Chapter 11.	Accepted. Citation added and text added "although even with current grids electric vehicles reduce emissions in almost all cases "	Anthony Patt	ETH Zürich	Switzerland
673	102		1	2	It would be nicer to input how the effect is within paranthesis. e.g., local point sources (+) as apposed to non-point sources (-). Also, it needs to be clearer regarding the effectiveness. The effectiveness of reducing air pollutants?	Partially accepted. Clear conclusions on the positive or negative implications of local point and non-point sources can not be drawn. However, we have added a sentence to provide more detail on how effective various policies have been	Kim Hana	KAIST	Republic of Korea
675	102		36		Actually, I do not think this layout is the best. Sectoral climate policies were discussed in 2.8.2.3. But I do not know why the transportation sector and AFOLU sectors were separately discussed. For the consistency, I think the transportation section should be included in 2.8.2.3. The AFOLU needs to be discussed as part of climate policies. carbon sink(AFOLU) is part of mitigation.	Partially accepted. The section 2.8 is reorganized taking into account the comments.	Kim Hana	KAIST	Republic of Korea
16273	102		1	2	It would be nicer to input how the effect is within paranthesis. e.g., local point sources (+) as apposed to non-point sources (-). Also, it needs to be clearer regarding the effectiveness. The effectiveness of reducing air pollutants?	Partially accepted. Clear conclusions on the positive or negative implications of local point and non-point sources can not be drawn. However, we have added a sentence to provide more detail on how effective various policies have been	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
16275	102		36		Actually, I do not think this layout is the best. Sectoral climate policies were discussed in 2.8.2.3. But I do not know why the transportation sector and AFOLU sectors were separately discussed. For the consistency, I think the transportation section should be included in 2.8.2.3. The AFOLU needs to be discussed as part of climate policies. carbon sink(AFOLU) is part of mitigation.	Partially accepted. Transport moved to sectoral policies, but AFOLU kept in 'other' policies because their objectives include biodiversity, land, water, etc. protection, not only climate.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
30431	103	1	103	5	This "EDGAR, GAINS, CEDS and FAOSTAT emissions are consistent in magnitude and trend" is no longer true for CEDS N2O due to our use of FAO defaults (so higher trend, as noted).	Comment related to page 2-20, line 19	Steven Smith	PNNL/JGCRI	United States of America
20567	103	4	103	5	They also include environmental degradation linked to the extraction of the necessary rare metals.	Accept: add "materials, supply chains, and recycling capacity."	Government of France	Ministère de la Transition écologique et solidaire	France
30433	103	18	103	28	There is a confusing shift here from discussing the impact of air pollution on climate (which is large) to talking about the impact of air pollutant control measures on GHG emissions (which is small). Separate these into different paragraphs.	Incorrect page/line. There is nothing in this paragraph about air pollution.	Steven Smith	PNNL/JGCRI	United States of America
20565	103	28	103	28	travelled by car? or is it the overall transportation demand which decreases?	Accept. Change to "0.16% reduction in private vehicle kilometres travelled per capita"	Government of France	Ministère de la Transition écologique et solidaire	France
71245	103	29	103	38	The content of this paragraph is a repetition of the content in Box 2.2.	I suggest we keep this paragraph. There is some overlap but I would not say repitiion and some of these points are better made in the context of other policies, rather than in the box on sharing economy.	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
8085	103	39	103	44	Please use the full title "agriculture, forestry and other land-use", because "land-use" includes agriculture and forestry.	Accepted and changed as suggested.	Joachim Rock	Thuenen-Institute of Forest Ecosystems	Germany
71247	103	39	105	10	The sub-section 2.8.3.3 summarizes needs and climate impacts of the agricultural, forestry and land use policies. I find this section unbalaned as it almost only dicusses the issue in the deforestation context, while policies addressing the agricultural sector are almost not mentioned despite its importance in terms of GHG emissions. At the same time, many of the conclusions from the deforestation example are valid also for the agricultural sector and could easily be used to broaden the scope of this section to also include agriculture. E.g., the conclusion (p104,rows 33-34) "Governments may have an important contribution to make here, particularly in safeguarding the interests of small producers." and (p.104, rows 1-2) "Stimulus and support for adaptation and mitigation can come form the UN system and from international development institutions." are valid also for small/organic farmers vis-a-vis large-scale agro-industry. To take the example of Europe; small/medium and environmentally concerned farmers are often asking for more -not less- policies and regulations, and see it as neccessary both from a climate perspective and to maintain competitiveness relative large agro-industrial complexes, see e.g., https://www.ceja.eu/press-releases/857. I therefore think the need for governmental support for small producers in regulations and policies should be broadened to encompass all AFOLU sectors.	Sentence added indicating the AFOLU related policies.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
24901	103	42	103	43	AFOLU is responsible for about 1/4 (not 1/3) of global GHGs	Value changed	Giacomo Grassi	Joint Research Centre, European Commission	Italy
83043	103	42	103	42	"share" intead of "part"	Editorial changed	Geden Oliver	German Institute for International and Security Affairs	Germany
71249	103	43	103	43	Here it states that the AFOLU sector is responsible for about one thir of total GHG emissions, while in Section 2.2.4 you state that AFOLU contributes 23%. I suppose this depends on different definitions of sector boundaries, but for a layman the different statements may be confusing.	Kept in Section 2.2.4 for coherence. Accepted and changed in the text.	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
83045	103	43	103	43	24% are a closer to a quarter than to a third	See above, we keep the exact nr for AFOLU in order not to create confusion.	Geden Oliver	German Institute for International and Security Affairs	Germany
64967	104	3	105	10	More scientific references could be cited, especially after p104 l24	Literature added.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
4101	104	4	105	10	It is helpful for readers to define "zero-deforestation" more carefully, because I couldn't find such wording in Chapter 7. Does it aim to eradicate the entire forest uses by humans of the world? Or to balance the rates of decrease (forest uses) and increase (reforestation) so that a net loss in forest area does not occur?	Definition of zero-deforestation added for clarity.	Tatsuki Ueda	National Agriculture and Food Research Organization	Japan
51773	104	4	104	6	Given the lack of transparency in many of the zero-deforestation initiatives, it might be more appropriate to say these are "announced" instead of "undertaken", which can't really be verified.The lack of transparency in this area is of major concern, as transparency is often a prerequisite for improvements in sustainability.	Suggestion taken and changed in the text.	Florin Vladu	UNFCCC Secretariat	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
20569	104	5	104	6	Such efforts have conducted to the developemnt of the HCS approach, a scientific methodology that makes it possible to distinguish forest plots known as HCS forests to preserve degraded areas that are therefore suitable for agricultural development. The approach combines carbon stock values with the protection of HCV areas (including peatlands and riparian zones) and areas important for the livelihoods of local communities, as well as the Free, Informed and Prior Informed Consent of populations(Rosoman, G., Sheun, S.S., Opal, C., Anderson, P., et Trapshah, R., editors. (2017) The HCS Approach Toolkit. Singapore : HCS Approach Steering Group)	Method and reference included in the text.	Government of France	Ministère de la Transition écologique et solidaire	France
11163	104	15	104	15	Delete the word "related." As the term "climate policy" is used in this report, renewable portfolio standards are "climate policies" to the same extent as those that focus on emissions.	Wrong page number, refers to p 105, l 14. Text deleted anyway.	Anthony Patt	ETH Zürich	Switzerland
20571	104	15	104	16	It also requires an agreement on the definition of the word "forest". (cf glassary of the SROCC)	Definition of forest added.	Government of France	Ministère de la Transition écologique et solidaire	France
20573	104	18	104	18	"stakeholders…producers": This is also proposed in the HCS approach	Terminology widened	Government of France	Ministère de la Transition écologique et solidaire	France
11145	104	19	104	20	Since renewable energy support policies appear to outnumber carbon pricing policies by a factor of 3 (see my comment for page 99 lines 25 - 26), it could be interpreted as somewhat misleading to say that carbon pricing policies are among the most popular without mentioning that technology support policies are substantially more popular.	Wrong page number, refers to p 105, l 14. Text deleted.	Anthony Patt	ETH Zürich	Switzerland
20575	104	19	104	20	"progress..measures" : progress towards the definition of the word "Forest" (Lund, H.G. (2000). Coming to Terms with Politicians and Definitions. In: “Forest Terminology: Living Expert Knowledge. How to Get Society to Understand Forest Terminology”, Proceedings of the 6.03.02/SilvaVoc Group Session at the IUFRO World Congress 2000, and Selected Contributions on Forest terminology, M. Kaennel Dobbertin & R. Prüller (Eds). IUFRO Occasional Paper 14, pp.23-37.)	Reference included in the text.	Government of France	Ministère de la Transition écologique et solidaire	France
11121	104	21	104	22	I don't know of a particular citation, but I think that many people would seea stronger link with regulatory policies such as emissions standards than with carbon taxes, in the transportation sector. That is certainly how chapter 11 frames things.	Wrong page number, refers to p 105, l 14. Text deleted.	Anthony Patt	ETH Zürich	Switzerland
20577	104	23	104	24	More thought should be given to the definition of the word "forest", to which the word "deforestation" is closely related, and to the relationships that should be established between national, legal and ecological definitions of this word. (cf glossary SCROCC)	Definitions included in the text.	Government of France	Ministère de la Transition écologique et solidaire	France
20579	104	33	104	34	In 2017 for example, France has drawn up its climate plan, which aims to accelerate the implementation of the Paris Agreement and fulfil its New York and Amsterdam commitments. The climate plan aims to stop in 2030 the importation of products contributing to deforestation (soya, palm oil, beef and its by-products, cocoa, rubber) as well as wood and its by-products. To this end, it intends to develop a strategy to support agricultural certification by adopting HCS criteria (MTES, 2018. Stratégie nationale de lutte contre la déforestation importée 2018-2030. https://www.ecologique-solidaire.gouv.fr/sites/default/files/2018.11.14_SNDI_0.pdf)	Comment noted and the HCS included, but not the whole text.	Government of France	Ministère de la Transition écologique et solidaire	France
20581	104	35	104	35	Other than in Brazil and in Indonesia (where most of the HCS initiatives have been engaged by oil palm producers)	Added in the text	Government of France	Ministère de la Transition écologique et solidaire	France
677	104		3	47	I think it is rather a box material.	Considered but it was decided to keep it as a part of the Chapter, not a box.	Kim Hana	KAIST	Republic of Korea

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
16277	104		3	47	I think it is rather a box material.	Considered but it was decided to keep it as a part of the Chapter, not a box.	Government of Republic of Korea	Korea Meteorological Administration (KMA)	Republic of Korea
51775	105	1	105	2	Can the statement be substantiated based on actual references?	References added in the text.	Florin Vladu	UNFCCC Secretariat	Germany
54727	105	11			Change "Main Conclusion" title as it is only the conclusion of Section 2.8. Since this is the last section in Chapter 2 readers might construe it as the conclusion of Chapter 2.	Main conclusions are summarized in the ES, deleted as subsection.	Government of United States of America	U.S. Department of State	United States of America
60733	105	11	105	34	Main conclusions section discusses the main finding that emissions reduction has taken place even if policy instruments widely vary. However, the subsequent discussions on policies, and successes of the instruments do not indicate confidence levels These would enable policymakers to weigh their decisions based on how welleach ofthe instrumennts perform well.	Main conclusions are summarized in the ES, deleted as subsection.	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
7977	105	12	105	18	There is also evidence that carbon pricing has not triggered zero-carbon invesments, and hence not triggered technological change (https://doi.org/10.1002/wcc.681). Hence the observed emission reductions are good news, but they are irrelevant for the transition to a fully decarbonised future. Investments in zero-carbon energy (and means of transport, and industrial production) is essential: zero-carbon technology is a necessary condition for decarbonisaiton, and if the scale is sufficient, it is also a sufficient condition. Reducing emissions now is neither necessary nor is it sufficient, if the source of emissison reductions is not investment in zero-carbon technology.	Main conclusions are summarized in the ES, deleted as subsection.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
5221	105	16	105	16	Since 2012, renewables have played a significant role in the U.K., but not in EU27. There has been a very slight decrease in UE27 in GHG emissions, in spite of huge investments made in solar and wind equipments. In Germany, the leader european country for wind and solar development, the solar and wind produced electricity is nessary to compensate the shutdomn of nuclear power plants, with a net result result insignificant in terms of GHG emissions. Since 1990, GHG emissions n EU has clearly dereased, due to progresses made in former USSR countries and esat Germany.	Main conclusions are summarized in the ES, deleted as subsection.	Michel SIMON	Retraité/ Pdt d'association	France
7979	105	19	105	19	This statement that carbon pricing is among the most popular instruments is irrelevant (who cares what is popular?) and it is not true. There are some 60-70 carbon pricing schemes in teh world. Practically every country in the world has renewable electricity support schemes,generally a feed-in tariff or auctions. Just to mention one set of climate policies that is "more popular". It is also not true that it has proven effective. See the various sources provided above. In particular, if such a statment remains in the final text, it would be important to note WHY carbon pricing has triggered emission reductions: it has triggered minor shifts from carbon-intensive technologies to less carbon-intensive but still carbon-emitting technologies (e.g. gasoline to diesel, coal to gas power). hence, it has NOT triggered the processes needed for full decarbonisation, raising doubts of whether this instrument can do so at all: so far, carbon pricing has NOT triggered the necessary zero-carbon technology investments	Main conclusions are summarized in the ES, deleted as subsection.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
48249	105	19	105	19	This also needs to be justified because previously write (eg above comment, p100 ln26-28) that taxation is typically insufficient. So tax must be high enough.	Main conclusions are summarized in the ES, deleted as subsection.	Susana Hancock	University of Oxford	United States of America

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
78333	105	19	105	19	I don't think Chapters 9 (buildings) and Chapter 13 (policy) state it so baldly. Housing regulations, capital grants for people w/o access to capital markets may have been more effective.	Main conclusions are summarized in the ES, deleted as subsection.	Jim Skea	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
86187	105	19	105	21	Woudl be nice if this were true. I think reality is more complex. But that would be to figure out with Chapter 13? But I reallu like having an effort to iclude policies in this chapter	Main conclusions are summarized in the ES, deleted as subsection.	Michael Grubb	UCL - Institute of Sustainable Resources	United Kingdom (of Great Britain and Northern Ireland)
7981	105	23	105	26	Yes, the context is important. But also the nature of the barrier involved: if there is a non-price barrier holding a zero-carbon development back, such as infrastructure problems, then a carbon price does not address that barrier and does not help solve the problem.	Main conclusions are summarized in the ES, deleted as subsection.	Johan Lilliestam	Institute for Advanced Sustainability Studies & University of Potsdam	Germany
47723	105	23	105	28	Strengthening the strategic environmental	Main conclusions are summarized in the ES, deleted as subsection.	Yulizar Yulizar	Universitas Pertamina	Indonesia
47725	105	23	105	28	assessment could be used to link between	Main conclusions are summarized in the ES, deleted as subsection.	Yulizar Yulizar	Universitas Pertamina	Indonesia
47727	105	23	105	28	climate policies and economics, social	Main conclusions are summarized in the ES, deleted as subsection.	Yulizar Yulizar	Universitas Pertamina	Indonesia
10535	105	27	105	34	Climate policies likely to induce considerable co-benefits would be (a) to encourage education of young women and access to birth control, particularly in developing countries and (b) to refrain from supporting families with many children. That this possibility to act upon the powerful demographic factor in global warming is not considered among mitigation issues is a mystery for me; however there is hope, since this issue is openly introduced in §3.7.7.1 below. A reference might be Wynes and Nicholas, 2017	Noted. No space to go into such details. Ch 13 is to proper place to discuss these co-benefits.	Philippe Waldteufel	CNRS	France
54729	105	36	107	2	Is this supposed to be a research planning document? Statements suggesting that "more research is needed" should perhaps be phrased instead as "more research in area x would reduce uncertainties related to y and improve predictability in z."	Accepted: We have rephrased and revised this section substatially. Su to text limitation this sections sticka to knoledge gasps at a broader level.	Government of United States of America	U.S. Department of State	United States of America
60735	105	36	107	2	The discussion on knowledge gaps in this chapter on emissions trends indicate a thoughtful insight	Accepted: Thank you	Lourdes Tibig	Climate Change Commission, Philippines	Philippines
1215	105	46	106	2	In 1970s US and European countris were the major resource to produce CO2 emission. The polluted air was blown to China and recouped there. Then the clean air was blown to Japan and polluetd again there. After that the air was blown into Pacific Ocean and cleaned again. The clean air was polluted again in the US. Nowadays China is also one of the most polluting countries.	Noted	Junichi Horie	Advantage Partnership Lawyers	Japan
1661	105		107		Also in the sub-item Gaps ... the statements are rather vague and unfortunately no very specific statements are made about what exactly one should investigate in the future in order to get which specific answers to current questions. It is a shame that the authors don't dig deeper into the wound and say exactly what's missing now.	Noted: In such a short section aiming to half IPCC page, getting into nitty-gritty is not possible. We have to stick toa broader level knowldge gaps. However, the text has been changed substantially in this version to be specific as much as posisble, even at a broader level.	David Novak	DIPLOMA Fachhochschule Nordhessen, https://www.diploma.de/, owner of the chair of sustainability	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
54731	106	3	106	15	Suggest a careful rewrite of this paragraph to avoid the suggestion that ALL of these actions are "crucial" for emissions mitigation. Certainly each one of these actions (demand management, alternative economic models, population control, and rapid technology transition) would help accelerate emission reductions, but different countries will likely avail themselves of the options discussed in these sentences to very different degrees (and consider some of them to be non-starters).	Noted: This point itself is accepted. But this section only talks about knowledge gaps, but not about actions. We have removed "needed" type languge in entire section. In addition, we have also added "to different extent and in different setting"	Government of United States of America	U.S. Department of State	United States of America
1217	106	10	106	10	Carbon taxation must be fair and equally for every country.	Noted	Junichi Horie	Advantage Partnership Lawyers	Japan
1219	106	16	106	19	Inequality: we have to look back at the history of pollution. Many under developing countries argue that developed countries have been poulluting since the industrial revolution. Therefore , the under developing countries have requested more relaxation on them.	Noted	Junichi Horie	Advantage Partnership Lawyers	Japan
20583	106	16	106	21	Much research has been done on inequalities in energy consumption. These works could inform this issue of the links between inequalities and emission (see works by Middlemiss or Sovacool). However the causal perspective seems here very narrow, as causal mechanisms are rather rare in society, while many non-causal mechanisms are at play.	Noted	Government of France	Ministère de la Transition écologique et solidaire	France
71251	106	41	106	41	I believe the word "Synthetic" should be replaced with "Synthesizing"?	Accepted: edited	Philippe Tulkens	European Union (EU) - DG Research & Innovation	Belgium
29827	107	4	107	41	The FAQs could benefit from beeing written in a more explanatory language than in the current draft. Currently the FAQs to a large extent are only copied in from some relevant paragraphs of the chapter's exexcutive summary. We think that the selection of FAQs are good, but hope that the language can be made less technical and thereby easier to understand for the readers. You could also consider including some graphics to the FAQs, and e.g. Figure 2.11 could fit nicely with the message you want to convey with FAQ2.2.	Accepted. FAQ rephrased.	Government of Norway	Norwegian Environment Agency	Norway
9275	107	5	107	14	Apart from the fact that lay readers might not know what "GtCO2eq" stands for, they might also expect something else than comparisons of past emission rates from this FAQ. How do these numbers or rates tell us if we are "on track to reduce emissions" (of what, btw)? I would have appreciated a reference to future greenhouse gas or CO2 emissions, for example as expressed in the Nationally Determined Contributions and/or an estimate how likely these will be fulfilled. I would suggest to rephrase either the answer or the question. One suggestion for a rephrased question could be: "Have greenhouse gas emissions been reduced in the recent history?" - but I wonder how useful this focus is for a wieder audience. Most people might be more interested in future projections.	Accepted. Question rephrased as suggested.	Maike Nicolai	Helmholtz Centre Geesthacht	Germany
46497	107	5	107	14	FAQ 2.1: this FAQ simply lists a lot of numbers. Please put these numbers in context for a typical reader of FAQs and answer the question posed as title of the FAQ, mainly by defining what "on track" is supposed to mean and by then relating the numbers to that.	Accepted. Question rephrased.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
54733	107	5	107	14	What does "on track to reduced emissions" mean? To what end specifically? Clarification warranted.	Accepted. The question has been rephrased in order to answer better the actual question.	Government of United States of America	U.S. Department of State	United States of America
60737	107	5	107	14	It is suggested that Frequently Asked Question 2.1 be reviewed and improved. The answer given does not sufficiently answer the question "Is humanity on track to reduce emissions?".	Accepted. The text has been amended.	Lourdes Tibig	Climate Change Commission, Philippines	Philippines

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
63481	107	5	107	5	Suggest re-phrasing to "Are emissions being reduced?" or "What is the current rate of emissions reduction?". Using the term "on track" would require the paragraph to mention an objective, for example, emissions need to be reduced by x%/yr to achieve 1.5C... current rates are... therefore, humanity is not on track". Given that this info is in FAQ 2.3, it would be easier to just retitle 2.1.	Accepted. Question rephrased.	Government of Canada	Environment and Climate Change Canada	Canada
64969	107	5	107	14	The answer sounds technical, with too many numbers in my view. In the FAQ context, I think that the text should remind that net emissions should be halted to stop the temperature increase in order to emphasize the overall challenge.	Accepted. Question rephrased to better fit with the answer.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
17773	107	12	107	14	(FAQ 2.1) don't think you need the line explaining GWP in an FAQ	Accepted. GWP explanation has been deleted	Jonathan Lynn	IPCC	Switzerland
54735	107	12			""Emissions and removals of GHGs are weighted by Global Warming Potentials with a 100-year time horizon (GWP100), using values from the Sixth Assessment Report (Section 2.2.1)."" Statement is out of context.	Accepted. Statement deleted	Government of United States of America	U.S. Department of State	United States of America
9277	107	15	107	27	This is a really interesting FAQ! It would be most useful to lay readers if you could explain very clearly what the term "(absolute) decoupling" means - not just in brackets after the second mention of the term. Are the 36 countries or the examples provided part of the 43? Are you able to mention very briefly how the decoupling has been achieved or what it entails exaclty?	Accepted. Decoupling clearly explained in the text.	Maike Nicolai	Helmholtz Centre Geesthacht	Germany
15365	107	15	107	15	I suggest to rephrase the question to: "FAQ 2.2 Are there countries that have reduced emissions and grown economically grow at the same time?" Reason: the word 'managed' might suggest it is a deliberate process, whereas in reality it is more a side-product of different circumstances, rather than a managed process.	Accepted. Question rephrased	Thomas Wiedmann	UNSW Sydney	Australia
17775	107	15	107	27	(FAQ 2.2) can we list the countries referred to? E.g. 3 footnotes (there is a figure showing the ones with falling emissions in 2.2.3	Rejected. The list would be too long for the FAQ	Jonathan Lynn	IPCC	Switzerland
46499	107	17	107	27	FAQ 2.2: the text simply repeats what is said in SPM B.2.4. Please avoid such duplications, e.g. by rephrasing the question and answering it in a more general way: "Is it possible to decouple GDP and emissions?".	Accepted. Text rephrased.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
64971	107	17	107	27	I think that the meaning of absolute decoupling should be explained earlier than at lines 25-26 as the term appears at lines 21-22. In my view, the text lacks an evaluation of the magnitude of the emission reductions achieved compared to what is needed, and what kind of "GDP sacrifice" may be needed to achieve carbon neutrality.	Accepted. Decoupling clearly explained in the text.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
9279	107	28	107	28	Please add "…to keep global warming below 1.5°C". If this FAQ (question) is presented outside the context of the IPCC report, it might otherwise become unclear on what we are supposed to act.	Accepted. Context added to the question.	Maike Nicolai	Helmholtz Centre Geesthacht	Germany
9281	107	28	107	41	This FAQ might leave readers with a very gloomy conclusion because it places the focus on an almost imminent failure. This does not inspire the kind of action that would be needed to fulfil the Paris goals. I would think that this FAQ is quite close to what many people ask, but I would still prefer a more neutral question.	Accepted. Question rephrased.	Maike Nicolai	Helmholtz Centre Geesthacht	Germany
17777	107	28	107	41	(FAQ 2.3) this answers the question how much time do we have to act to keep warming below 1.5ºC. So either headline should be changed, or text should be changed to show we can still act even if we miss the deadline for 1.5º	Accepted. Question rephrased.	Jonathan Lynn	IPCC	Switzerland

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
46501	107	28	107	41	FAQ 2.3: The years by when the remaining emission budgets are depleted, provide little information on the question “how much time do we have to act”. Information about the emission pathways should be included in this question. Simply listing numbers might also infer a misleading sense of accuracy. We suggest to give the typical FAQ-reader some context to those numbers. That could include an explanation of the budget approach/different budget approaches. Considering the large uncertainties connected to carbon budgets, it does not seem helpful to focus on specific dates (years), the budget approach should rather be contextualized with the importance and role of emission pathways (including net zero timelines, emission peaking and reduction rates) and what this means for timely climate action to stay below 1,5°C.	Accepted. Question rephrased.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
54737	107	28	107	41	To the question "How much time do we have to act" one would need to know "to achieve what goal"? The jargon of "the remaining carbon budget for keeping warming below 1.5°C will be exhausted before 2030" is impenetrable for an average reader. State the response in plain English.	Accepted. Question rephrased.	Government of United States of America	U.S. Department of State	United States of America
83047	107	28	107	41	The enormous uncertainties in the WG1 carbon budget calculations and the many substantial changes in the WG1 methodology (between SR1.5 and AR6) might warrant to avoid the countdown language used here	Accepted. Text rephrased based on the new numbers of Chapter 5.	Geden Oliver	German Institute for International and Security Affairs	Germany
83473	107	28	107	41	Ensure to update with latest remaining carbon budget assessment from WG1 Ch5.	Accepted. Question rephrased.	Joeri Rogelj	Imperial College London	United Kingdom (of Great Britain and Northern Ireland)
54739	107	29			Throughout the paragraph, information in brackets is not explained.	Accepted. Information explained	Government of United States of America	U.S. Department of State	United States of America
64973	107	29	107	41	I woud introduce the concept of locked-in emissions from long-lived infrastructures which shortens the time margin for societal changes	Rejected. Only short answer possible.	Patricia Martinerie	Centre National de la Recherche Scientifique, France	France
1663	107		107		In the FAQ, the right questions are asked, but the answers are so complicated and numerically confusing that the answers may be coherent, but the reader cannot use them for a possible implementation.	Accepted. The wording has been adapted in order to be more comprehensive.	David Novak	DIPLOMA Fachhochschule Nordhessen, https://www.diploma.de/, owner of the chair of sustainability	Germany
85621	108	28	155	15	First author name is missing. There are many other references missing the first author.	Accepted. References checked and corrected.	San Win	Environmental Conservation Department, Ministry of Natural Resources and Environmental Conservation	Myanmar
303	114	36	114	37	The names in this reference are not correct.	Accepted. We corrected this reference.	Sandro Fuzzi	ISAC CNR	Italy
72447	143	30	143	38	The reference given L30-31 is wrong and is actually the same as the one given L37-38, which is correct	Accepted. We corrected this reference.	Sylvain Pichat	University of Lyon, Ecole normale supérieure de Lyon, Laboratoire de Géologie (LGL-TPE)	Germany

Comment Id	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
45785	158	14	158	21	The emissions of SF6 and NF3 are probably significantly underestimated. An uncertainty factor of +20% is too low. There is a discrepancy between reported and measured values (see: Publications Office of the European Union, 2018, Atmospheric monitoring and inverse modelling for verification of greenhouse gas inventories, https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/atmospheric-monitoring-and-inverse-modelling-verification-greenhouse-gas-inventories). The substances are needed in aluminium and magnesium production, solar cell production and in semiconductor production. Those production facilities are increasingly located in Asia. Most of Asian countries don´t report SF6 and NF3 emissions under UNFCCC. So, the emissions should be higher.	Accepted. The new uncertainty estimate is 30%. Note that uncertainties in global emissions from atmospheric measurements are probably lower.	Government of Germany	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety International Climate Policy	Germany
37497	165	17	165	18	While the point about "westernization" of diets in several economies is true, it would be useful to also include a couple of sentences about the nutirtional or health consequences of such changes in diets. Have these changes been beneficial, neutral or detrimental overall.	No p. 165 in this chapter.	Government of India	Ministry of Environment, Forests and Climate Change	India
7701					Noting to this fact that most of CO2 issue are because of developed countries industrial factories, appropriate procedures for controlling these industries and attention to these countries for faster control of carbon issue rate, must paid.	Rejected. IPCC does not provide policy prescriptions	Leila Rashidian	Meteorological	Iran
54741					The method by which quoted emission magnitudes are derived needs to be mentioned -- be it by UNFCCC reporting, other inventory analysis, or atmospheric-based budget analysis.	Accepted. We added comprehensive supplementary material, which provides information on the dataset, method and underlying uncertainties.	Government of United States of America	U.S. Department of State	United States of America
54743					It would be useful to have the term "F-gas" is defined in this chapter and list the chemicals included in this term. If this term is being used here consistently with previous UNFCCC and IPCC definitions, it does not include two important classes of long-lived and very potent GHGs -- the CFCs and HCFCs -- but their emissions are substantial even now (2016 CFC global emissions = 0.8 GtCO2-e/yr, HCFC global emissions = 0.8 Gt CO2-e/yr; in 2009 emsisions from these Montreal Protocol gases were about 6-8 Gt CO2-eq; 2018 Ozone Assessment from top-down methods). The only place in the chapter where "Montreal Protocol Gases" are mentioned is in Figure 2.3, but no discussion of their emissions and emission changes anywhere else, which would be important to include in any discussion of overall GHG emissions and trends (e.g., Section 2.2.2, Figure 2.4). Ignoring those gases here, because of the alignment of the Paris Agreement vs. the Montreal Protocol, or for any other reason, seems inappropriate given that they significantly affect the total GHG emission and it's change since 1990, in Figure 2.4 for example. Furthermore, it would be appropriate to reconsider the term "Montreal Protocol Gases" in this report because hydrofluorocarbons or HFCs are now controlled by the Montreal Protocol's Kigali Amendment. Are contributions from HFCs included as "Montreal Protocol Gases" in Figure 2.3, or are they instead part of the F-gas category? Some discussion of the Montreal Protocol and it's Kigali Amendment seems important -- particularly since this Amendment to the Montreal Protocol will be fundamentally important for understanding future changes in F-gas emissions. A potential solution for nomenclature might be to define these terms: ozone-depleting Montreal Protocol gases (CFCs, HCFCs, CCl4, etc) and non-ozone-depleting Montreal Protocol gases (HFCs), the latter being included in the F-gas basket.	Accepted. We have addressed this now in the chapter and mention all the major groups of F-gases included. We also provide information on CFCs and HCFCs. Thanks	Government of United States of America	U.S. Department of State	United States of America
54745					What is the role of military activities in contributing to GHG emissions? Is it a driver?	This is beyond the scope of this chapter - and not easily observable from available emissions inventories.	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
54747					There is mixed terminology throughout Chapter 2, regarding use of the terms low-, middle-, and high-income countries and developed and developing countries. The first use is correct and the use of developing/developed outdated. Use depends a bit on the cited publications and derived figures of course.	Noted. Terminology is fixed now according to WGIII rules.	Government of United States of America	U.S. Department of State	United States of America
54749					It would be helpful to state which of the emissions discussed in Chapter 2 are used in WGI. CEDS is discussed in this chapter, so having this at the beginning of the chapter would make it more transparent.	Noted. We describe the main datasets used here - right at the beginning of section 2.2. More details on other datasets are mostly provided in the online supplement to the chapter.	Government of United States of America	U.S. Department of State	United States of America
54751					Use of GWP100 throughout the chapter is not immediately linked with the new radative forcing of WGI, nor is it linked with the use of GWP* in WGI.	Rejected. We devote an entire corss-Working Group box to this matter. In the main body of the chapter we refer to this box. We also have a figure on historical warming prepared in collaboration with WG1.	Government of United States of America	U.S. Department of State	United States of America
54753					Why is AR5 used as a 'reference' period. Is this typical?	We are encouraged to highlight developments since the last assessment report particularly. Last reported year in most WG3 AR5 emission figures is 2010 - so we focussed on 2010-2019 in particular, but in the context of the broader period 1990-2019.	Government of United States of America	U.S. Department of State	United States of America
54755					It is odd that the RCP literature is not linked to the committed emissions. For example, in Section 2.72, can the range of FFI emissions for RCPs be presented in the context of committed FFI emissions?	We link committed emissions to the most recent AR6 scenarios. This ensures the most up-to-date information and consistency across the report.	Government of United States of America	U.S. Department of State	United States of America
54757					The chapter discusses the remaining carbon budget in some detail, but misses some literature, like Jones et al., https://gmd.copernicus.org/articles/12/4375/2019/, and Matthews, https://www.nature.com/articles/s43247-020-00064-9	Rejected. We focus on ommitted emissions from fossil fuel infrastructures here.	Government of United States of America	U.S. Department of State	United States of America
83049					In the context of net zero targets and the policy-relevant differentiation between CO2 and non CO2, or long-lived and short lived it would be instructive if the chapter could provide shares of gases in the major sectors (those highlighted in 2.4). Probably no need to show trends. Better to do this here than in sectoral chapters, because ch2 can provide a uniform reporting format (which then could be picked up by sectoral chapters if they want to)	Noted. We agree that this is interesting, but there is so much data to present in this chapter and tight space constraints. We therefore opted against detailed plots.	Geden Oliver	German Institute for International and Security Affairs	Germany