

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
1551	0	0	0	0	In specific cases, the Netherlands for example, a key mitigation strategy involves the fuel switch from natural gas to electricity (at least near and medium term): there is political agreement to abandon the use of natural gas, one of its primary energy sources. This has great consequences for the future energy infrastructure, which requires technological challenges and the development of energy policies that can deal with the impacts this has on energy users and producers. See for a review this article: "The great Dutch gas transition", Oxford institute for energy studies, July 2019. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2019/07/The-great-Dutch-gas-transition-54.pdf	Thanks for the comment. The suggested paper was studied. The technological part of the chapter considers this energy transition, that is happening not only in the Netherlands, but also in other countries.	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
10009	0	0	0	0	Energy sufficiency definition is attributed to Thomas et al. (2019); I believe it was introduced in: - Darby, S., & Fawcett, T. (2018). Energy sufficiency: an introduction Concept paper. Energy Sufficiency project, ECEEE. There are here and there some references to (Darby and Fawcett, 2018) and (Fawcett and Darby 2019) throughout the text, although none of these are cited in the references list, so I cannot be sure which studies the authors refer to.	The energy sufficiency concept was not clearly defined in Box 1 of the chapter.	Haris Doukas	School of Electrical and Computer Engineering, National Technical University of Athens	Greece
12933	0	0	0	0	The chapter has many crowded and uncommunicative figures and tables. Many of them are not properly displayed.	Most figures were redrawn, hoping to be more communicative.	Prashant Goswami	Institute of Frontier Science and Application	India
12935	0	0	0	0	Too many preAR5/Ar5 references should be avoided. The chapter now has about fifty such references, going as far back as 2009.	The references that are pre-AR5 are in those parts of the chapter that were not included or considered in AR5. Therefore they are pertinent.	Prashant Goswami	Institute of Frontier Science and Application	India

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
24485	0				<p>The chapter does not account for the potential of using buildings as CCS strategy. The use of wood as construction material appears briefly in the energy section, in the use of Biomass, but it is not presented as strategy for, in fact, having buildings with negative emissions. Scientifically, this claim is supported by recent publication in Nature Sustainability (Churkina et al. 2020). In the article, the authors recognize de conditions for this possibility and calculate scenarios on how much a technological shift can in fact create a form of stabilizing the carbon capture made by vegetal growth and the use of engineered timber as building material.</p> <p>“Abstract: The anticipated growth and urbanization of the global population over the next several decades will create a vast demand for the construction of new housing, commercial buildings and accompanying infrastructure. The production of cement, steel and other building materials associated with this wave of construction will become a major source of greenhouse gas emissions. Might it be possible to transform this potential threat to the global climate system into a powerful means to mitigate climate change? To answer this provocative question, we explore the potential of mid-rise urban buildings designed with engineered timber to provide long-term storage of carbon and to avoid the carbon-intensive production of mineral-based construction materials.”</p> <p>Churkina, G., Organschi, A., Reyer, C.P.O. et al. Buildings as a global carbon sink. Nat Sustain (2020). https://doi.org/10.1038/s41893-019-0462-4</p>	The section on materials has been completely rewritten and this comments has been taken into account	Thiago Garcia	Potsdam Institute for Climate Impact Research — PIK	Germany
33171	0				This is an excellent report but I would like to suggest to include who local government/other organisations can play role effectively in promoting climate resilient building. It should also include junior school level curriculum for teaching climate resilient building and its usages for next generation	Thank you for your positive comment, and for your suggestion. Governance is included	Edris Alam	Rabdan Acadmey	United Arab Emirates
37487	0				The whole summary needs to be rearranged and made more coherent. 1) Describe current status and trends of building energy use and building GHG emissions, keeping the two separate; 2) Potential for mitigation actions is high - break into two parts a) technical solutions and b) behavioral and sufficiency solutions; 3) Challenges to enhancing mitigation in the buildings sector; 4) links to SDGs and other co-benefits. These correspond closely to the numbered points listed at the end of Sec. 9.1	The whole summary has been rewritten, this comments has been taken into account	Michiel Schaeffer	Climate Analytics	Netherlands
35645	1	3	101	42	As the report has clearly been written by mutiple authors, there is a need for extensive proof-reading to give the chapter more coherence, readability and consistency. Unecessary repetitions, poor sentences structures and spelling errors must be treated and corrected.	The whole chapter has been proof-read before submission of the SOD. This comment was taken into account	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
35647	1	3	101	42	The chapter discusses several concepts related to buildings including some new concepts such as energy sufficiency. It is therefore important that there is a conscious decision to structure the sequencing of the Chapter to ensure that all aspects of each presented concept are logically and clearly grouped in a manner that is engaging for the reader.	Each section of the chapter has been organised following the concept sufficiency-efficiency-renewables. The concepts have been defined in the introduction	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
46111	1	1	131	1	district heating and cooling is called by many different names throughout the chapter? Power to heat not mentioned?	District heating and cooling was now uniformized in the chapter. On the fact about power to heat, the chapter did not include the power to x vocabulary up to now.	Neven Duic	University of Zagreb	Croatia
14741	1	1	131	4	LEED, or Leadership in Energy and Environmental Design has been a voluntary certification system can contribute significantly on emission reduction from buildings, which are mostly complied by big industries for their own reputation and social responsibility point of view. However, for a mass scale improvement in the field, every country should have some initiative to update their building codes to address climate change mitigation issue. As building sector is a major contributor to global emission, UN Climate may prepare some specific guideline for Building codes and force the member countries to implement it. There could be more discussion and case studies in this regard in the section.	The policy sector reviews all building certificates and labels used in the buildings sector	Md. Sirajul Islam	Department of Civil and Environmental Engineering, North South University, Bashundhara, Dhaka	Bangladesh
8547	1	1	131	5	This document uses the both British and American English. Recommend those be written in same expression (marked blue)	The whole chapter has been proof-read before submission of the SOD. This comment was taken into account	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8549	1	1	131	5	Concerning quotation, there are various expressions including "et al., 20XX", "et al. 20XX" and "et al, 20XX". Recommend those be written in same expression (marked purple).	The whole chapter has been proof-read before submission of the SOD. This comment was taken into account	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
9273	1	1	131	48	My opinion is the chapter should be differentiate between Composition, Production and Construction and Operating phases because each phase has specific characters, suppliers and consumers, then the mitigation efforts maybe more effective, and economically justified.	LCA is a core pillar and we have considered this. This has been included when possible. But the literature does not provide the mitigation options and potentials in all phases.	Ayman Batisha	International Sustainability Institute (ISI)	Egypt
9275	1	1	131	48	Similarly, the chapter should be differentiate between existing, new and planned buildings because each category has specific characters and consumers, then the mitigation efforts maybe more effective, and economically justified.	The chapter considers both existing and new buildings. When needed this difference is explicitly shown. If the difference is not shown is because that specific section applies for both.	Ayman Batisha	International Sustainability Institute (ISI)	Egypt
9277	1	1	131	48	Correspondingly, the chapter should offer some sort of recommendations about the best fit Buildings (Reinforced concrete (RC), Steel, and wood/timber ... etc.), from mitigation point of view, if more than one option is available.	The section on materials has been completely rewritten and this comments has been taken into account	Ayman Batisha	International Sustainability Institute (ISI)	Egypt
9279	1	1	131	48	Analogously, the chapter should offer some sort of classifications concerning most important consumers for building services (Residential buildings, factories, Hotels and Touristic buildings). It will be very useful in addressing the mitigation options.	Agree it is very important but now it is not possible to do with the literature available. Now only residential/non-residential possible.	Ayman Batisha	International Sustainability Institute (ISI)	Egypt

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
9281	1	1	131	48	In the same way, the chapter should offer some sort of classifications concerning most important factors such as the distribution of Buildings GHG in geographic locations in the World. It will be very useful in addressing the mitigation options.	This has been addressed in SOD, data was not available before	Ayman Batisha	International Sustainability Institute (ISI)	Egypt
13533	1		131		One of the weakest parts of the FOD concerns the treatment of fuel switching and electrification as a strategy to decarbonise buildings. As rightly noted in the chapter, more than 50% of buildings emissions come from indirect emissions. One crucial strategy to decarbonise the sector is therefore to switch to fuels/electricity that have or will have (assuming a widespread decarbonisation of the energy supply sector) a low carbon content. Currently in the chapter, there is almost no discussion of this strategy. This aspect is mainly addressed via the on-site generation of energy/prosumers, which might not always be the cheapest option from a system perspective. There is for instance no discussion of electrification of heat as a way to decrease the dependence of fossil fuels, or of district heating and cooling. I understand that chapter 8 on urban systems deals a bit with district heating, but the absence of electrification, district heating and cooling systems from the Buildings chapter is very problematic. How far can we decarbonise buildings energy demand through fuel switching and electrification? These are all very relevant questions for the decarbonisation of buildings which will probably not be addressed as such in the urban systems chapter and would find their proper place in the Buildings chapter. A quick literature research about "electrification of buildings energy demand" will provide many references. For district heating and cooling, I could recommend the work from the Heat Roadmap projects, which I recommend even more easily that I have not been part of these projects: Paardekooper et al (2018), Heat Roadmap Europe 4 Quantifying the Impact of Low-Carbon Heating and Cooling Roadmaps: Connolly et al. (2014) Heat Roadmap Europe: Combining district heating with heat savings to decarbonise the EU energy system; Möller (2019) Heat Roadmap Europe: Towards EU-Wide, local heat supply strategies, Persson (2019) Heat Roadmap Europe: Heat distribution costs, etc	This aspects were included in SOD.	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
1881	2	13	2	13	Add sub-head 9.3.4 'Building construction cycle chain and emission'	LCA is a core pillar and we have considered this. This has been included when possible. But the literature does not provide the mitigation options and potentials in all phases.	Alka Bharat	Department of Architecture & Planning, M.A.National Institute of Technology (An Institute of National Importance),Bhopal (M.P.)	India

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45163	2	14	2	14	I read : « zero carbon buildings » Unless writing instead « zero fossil carbon buildings », this may sound rather strange since we do hope that new buildings will store even more non fossil carbon than present buildings. (It may also happen that many more 8 stores buildings will be constructed with wood, as it the case now in France, Switzerland & Austria.) Since wood include [non fossil] carbon... it would be less confusing not to forget, (as usual, unfortunately), the word fossil. (See also my comments on « decarbonisation » in Annex A.)	Building should go beyond "zero fossil carbon", buildings should aim at "zero carbon", and this is the spirit of the chapter	Raymond Zaharia	Le Club des Argonautes http://www.clubdesargonautes.org	France
1883	2	21	2	21	De-construction	Small typos were corrected in SOD when still relevant.	Alka Bharat	Department of Architecture & Planning, M.A.National Institute of Technology (An Institute of National Importance),Bhopal (M.P.)	India
1885	2	28	2	29	Delete 'reasons and willingness'	Not relevant any more	Alka Bharat	Department of Architecture & Planning, M.A.National Institute of Technology (An Institute of National Importance),Bhopal (M.P.)	India
39861	2	1	3	19	The Transport Chapter is divided into several section according to the main categories of transport : land transport, aviation, shipping... I think the Buildings Chapter would need to make such categories appear clearly somewhere, maybe in "Buildings services", these main categories being : - heating : space heating and domestic water heating, - cooling - lighting - cooking - appliances and how much energy consumption is associated with each in various representative cases of climate (maybe 5-10 countries/regions ?) with a map like in AR5 Figure 9.3 and Figure 9.4 declined by region. AR5 had only 2 categories : thermal uses and appliances, that would work.	Text has been revised	Bianka SHOAI-TEHRANI	RTE, CentraleSupelec	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
1887	3	2	3	2	Modify Sub-head 9.8.2 - Delete 'The nexus of'	Accepted - text revised	Alka Bharat	Department of Architecture & Planning, M.A.National Institute of Technology (An Institute of National Importance),Bhopal (M.P.)	India
1889	3	4	3	5	Swap 9.8.4 and 9.8.5	Rejected - some issues like energy poverty or air pollution are associated with health impacts, environmental quality and social well-being. We think that it is better to discuss all these dimensions in subsequent sections.	Alka Bharat	Department of Architecture & Planning, M.A.National Institute of Technology (An Institute of National Importance),Bhopal (M.P.)	India
36831	3	11	3	12	Camel notation has been used. This is not consistent with the other headings. Consistency is required.	Small typos were corrected in SOD when still relevant.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
1891	3	12	3	12	Add sub-head 9.9.7 - Market-mechanism tools to mitigate	This section was completely resturctured	Alka Bharat	Department of Architecture & Planning, M.A.National Institute of Technology (An Institute of National Importance),Bhopal (M.P.)	India
36833	3	15	3	15	Camel notation has been used. This is not consistent with the other headings. Consistency is required.	Small typos were corrected in SOD when still relevant.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
7853	4	1	4	1	[Recommended] one thrid → one-third	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39361	4	1	4	37	This section should be supported with data and facts. The concept of sufficiency must be defined in the ES as it was done in the introduction section.	The concept of sufficiency was defined in Box 1. New data was added in SOD	Emmanuel RAUZIER	NGO Association negaWatt	France

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31903	4	5	4	7	It doesn't seem right to highlight developing countries and Africa in the executive summary, particularly in % terms, because their growths must be on a very small base. In spite of this rise, it is quite likely that they are much lower than the developed countries, particularly on a per-capita basis.	The executive summary was completely rewritten	Ashok Sreenivas	Prayas (Energy Group)	India
37489	4	6	4	7	percentage increase, not absolute	Not relevant any more	Michiel Schaeffer	Climate Analytics	Netherlands
7855	4	7	4	7	[Recommended] of → in	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
1987	4	9	4	9	The use of the term "building sector" is misleading. From a macroeconomic perspective, "buildings" are not a "sector". It is suggested to use a different term, e.g. "area of activity".	Thank you. This was suggested language from the IPCC scoping meeting, and so it is retained	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
7857	4	9	4	9	[Recommended] delete "a"	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
12999	4	9	4	9	Suggest to align wording with international practices - buildings is a final consumption sector. Typically end use refers to the actual use of the energy service driving energy consumption (e.g. space heating).	We did use the wording found in the literature. Thanks for the comment	Mafalda Leite de Faria Coe	International Energy Agency	France
39337	4	9	4	12	I suggest that this be reinforced in order to support the 3 statements in questions	Not relevant any more	Emmanuel RAUZIER	NGO Association negaWatt	France
35651	4	11	4	13	This sentence should be revised and expanded. It is not in all parts of the globe that owners and occupants can become "prosumers". This also goes for the contribution that highly energy efficient and connected buildings can make to the energy system. Properly and intelligently designed and interconnected buildings have a significant role to play in the future, but they will only become widespread within a coherent, properly enforced, enabling policy context.	Not relevant any more	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
13529	4	13	4	14	The meaning of the sentence is not clear.	Not relevant any more	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
3239	4	13	4	16	The sentences "Furthermore, sufficiency measures may deliver energy savings even before they are implemented through efficiency and behaviour as sufficiency avoids energy demand without costs. As an action, energy sufficiency aims at reducing the input of technically supplied energy towards sustainable levels, with a qualitative or quantitative change in the service or utility from energy." are somehow confusing and lack clarity. The glossary explains sufficiency as: The adequate availability of resources required for a decent standard of living. The term as used in the context of energy sufficiency is not in line with that definition which is: The adequate availability of energy required for a decent standard of living. However, the main text does not explain what the decent standard of living is and does not provide information where buildings have been built/are used that do not provide decent standard of living but something above such level.	The concept of sufficiency was defined in Box 1. New data was added in SOD	Klaus Radunsky	retired from Umweltbundesamt	Austria

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39339	4	13	4	16	This requires further clarification. The concept of sufficiency, efficiency, energy savings and behavior are different. They should NOT be mixed as in this paragraph. I encourage that each of these concept be introduced through a proper definition.	The concept of sufficiency was defined in Box 1. New data was added in SOD	Emmanuel RAUZIER	NGO Association negaWatt	France
35653	4	13	4	23	This paragraph contains a narrative that seeks to set out and explain several important and interlinked concepts related to the contribution that buildings can make to climate change mitigation. As such, its current format and structure could lead to confusion in the mind of the reader as to the difference between energy efficiency, energy sufficiency, energy savings and enegy-related behaviour. All of these have a contribution to make, but we must be sure that the concepts are well defined and clearly sequenced in our narrative.	Not relevant any more	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
37491	4	13	4	24	Sufficiency needs to be defined more broadly as a concept, even briefly, before this paragraph's information can make sense	The concept of sufficiency was defined in Box 1. New data was added in SOD	Michiel Schaeffer	Climate Analytics	Netherlands
7859	4	14	4	14	behaviour	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7861	4	16	4	16	[Recommended] therefore → , therefore,	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7863	4	18	4	18	behavioural	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39341	4	20	4	20	What is the meaning of lower limits of sufficiency. What are those limits?	Small typos were corrected in SOD when still relevant.	Emmanuel RAUZIER	NGO Association negaWatt	France
3241	4	20	4	23	The sentences "Given the lower limit of energy sufficiency and the fact that many people around the world still lack appropriate access to energy services, energy sufficiency is not only about demand reduction but also about matters of distribution and equity. The aim is to ensure well-being and Decent Living Standard (DLS)." also are confusing albeit the same sentences can be also be found in the main text. It seems that the authors wanted to express that there are further needs for energy resources and material resources in order to meet the needs of many poor people in the world that lack adequate shelter, etc. and that those needs have to be addressed despite the need to meet the temperature goals as specified in the Paris Agreement.	The concept of sufficiency was defined in Box 1. New data was added in SOD	Klaus Radunsky	retired from Umweltbundesamt	Austria
7865	4	22	4	22	[Recommended] well-being → the well-being	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
3237	4	22	4	23	It is somehow strange to note that the term "Decent Standard of Living" is used in the executive summary but could not be found in the main text. Either something has been lost in the main text or this term should not be used in the executive summary. The basis of the use of the term in this context would be that there has been identified some literature that has been included in the references and has been referenced in the main body of the chapter.	The executive summary was completely rewritten	Klaus Radunsky	retired from Umweltbundesamt	Austria

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7867	4	24	4	24	[Recommended] Energy → the energy	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7869	4	24	4	24	[Recommended] building → the building	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
37493	4	24	4	25	First two sentences can be eliminated as they don't really say anything, and nothing that connects to the more important second part of the paragraph	The executive summary was completely rewritten	Michiel Schaeffer	Climate Analytics	Netherlands
48173	4	24	4	28	Badly written - grammatical errors	The executive summary was completely rewritten	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
7871	4	25	4	25	[Recommended] building type → building, the type	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
35655	4	25	4	28	The points made here relating to multiple benefits of energy efficiency and on the contribution that attention to the quality and energy performance of buildings can make to the achievement of SDG's could be better emphasised as building owners and policy-makers are often more motivated to take action by the prospect of gaining benefit from these additional effects.	The executive summary was completely rewritten	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
7873	4	27	4	27	[Recommended] delete "of"	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
42637	4	28	4	28	poverty, health, and sustainable cities	Thanks for the comment. This was considered in the chapter.	Vivian Grudde	Climate Change & Transformation Advisory (Freelancing)	Germany
3243	4	29	4	40	These statements are correct. However one key aspect is missing: do we already have the technology that allows to build and live in a building that meets all those needs and allows for carbon neutrality. And if so: are the costs reasonable and not significant larger compared to a conventional building. And if so: for what climate circumstances has such achievement already been demonstrated. It would be really great to include such literature. It need not be from peer reviewed journals but it should be based upon an industry survey or from the result of successful bidding processes.	The executive summary was completely rewritten	Klaus Radunsky	retired from Umweltbundesamt	Austria
35659	4	29	4	40	This paragraph mixes up technologies that are used in buildings and services that owners/occupiers expect to receive from those technologies in a way that is confusing and potentially misleading. Full revision of this paragraph is needed.	Not relevant any more	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
7875	4	30	4	30	[Recommended] energy → the energy	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7877	4	31	4	31	[Recommended] In → From	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

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35657	4	31	4	31	Why is "nutrition" included. It is not typically considered a service provided by buildings.	The literature shows that yes, nutrition should be considered as building service	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39343	4	32	4	36	There is a confusion between services and equipment to deliver the services. A rephrasing is needed	This part was rewritten and the comment was taken into account.	Emmanuel RAUZIER	NGO Association negaWatt	France
19787	4	33	4	33	I think that "heating, ventilation, air conditioning (HVAC)" should be replaced by "heating, ventilation, and air conditioning (HVAC)"	Small typos were corrected in SOD when still relevant.	Adrián Mota-Babiloni	University Jaume I of Castellon	Spain
7879	4	36	4	36	[Recommended] and → ,and	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7881	4	40	4	40	[Recommended] delete "the"	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13395	4	41	4	41	Reference to SDG7 instead of or in addition to Sustainable Energy for All would make more sense	Not relevant any more	Thibaud Voita	IFRI	Germany
45479	4	41	4	42	Is 3% biomass too high or too low? The sentence is unclear	Not relevant any more	Louis-Gaëtan Giraudet	CIREC, Ecole des Ponts ParisTech	France
13535	4	41	4	43	In WEO 2019: traditional biomass decreased by 3% between 2010 and 2018	Not relevant any more	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
3245	4	41	4	44	Those figures for the bulk of the buildings can not provide information what the best available technology is with respect to buildings. It will take many decades to renew the stock of buildings so that its performance reflects the current best available technology. Given the life time of buildings it will take several decades until there will be a significant change in emissions from buildings in a country as with growing welfare also the square meters per person will increase.	This comment was considered when rewriting the chapter, thanks	Klaus Radunsky	retired from Umweltbundesamt	Austria
25137	4	41	4	44	In the context of buildings, refer to associated matters in regard to biomass (e.g. indoor pollution)	Done in the Box about biomass	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
35649	4	1	7	37	The Executive Summary will require special consideration once the rest of the Chapter is re-worked. At present its structure is poor with several unnecessary repetitions. As multiple readers of the report will only read the Executive Summary of each Chapter, they must be masterful, concise and engaging parts of each Chapter.	The executive summary was completely rewritten	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
35669	4	1	7	37	The topic of energy renovation of existing buildings, a topic of crucial important for developed regions such as the EU, is barely mentioned in the Executive Summary. Without a specific section on this topic, the Chapter on buildings risks being viewed by such regions as irrelevant. This should be rectified by including a substantial narrative on the challenge of energy renovation and the huge climate change mitigation potential it represents. In reality, the huge energy use of buildings must be addressed if there is to be even the smallest chance of meeting the goals of the Paris Agreement.	The executive summary was completely rewritten	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium

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39359	4	1	7	37	The Executive Summary makes reference to building renovation but failed to draw lessons from the progress made so far in renovation of buildings. In the EU and other developed countries, the main challenge is to renovate the building stock. Overall, the ES lacks data to support statements made. Contribution of digitalisation of the construction sector to mitigation should also appear in the ES.	The executive summary was completely rewritten	Emmanuel RAUZIER	NGO Association negaWatt	France
47267	4	1	7	39	Slight formatting consistency needed for executive summary with shorter easier to read bullet points with bold headlines like in chapters 4,5, 11 and others would help readability of executive summary.	The executive summary was completely rewritten	Beat Brunner	Lightning MultiCom SA	Switzerland
3177	4	2	7	37	Please indicate the Section(s) referenced for each of the paragraphs.	Included	Sai Ming LEE	Hong Kong Observatory	China
3233	4	2	7	37	It is strongly recommended to include the precise reference to the main body of the text in order to trace the findings included in the Executive Summary.	Done	Klaus Radunsky	retired from Umweltbundesamt	Austria
3235	4	2	7	37	It is noted that there might be significant overlap between chapters 8 and 9. It is strongly recommended to explain in chapter 8 as well as in chapter 9 what the focus of each chapter is. Furthermore it seems important to avoid any duplication of information/assessment.	Both chapter were completely revisited, and duplications were deleted.	Klaus Radunsky	retired from Umweltbundesamt	Austria
11125	4		7		Promotion of electrification & avoidance of carbon lock-ins is the key to achieve the Paris goals, and thus, promotion of electrification in building sector should be clearly written in the Executive Summary, with an exaple of targeted electrification ratio based on IPCC SR15 scenarios or IEA scenario.	The executive summary was completely rewritten	Midori Sasaki	industrial organization	Japan
13531	4		7		The weight and the positioning of sufficiency in the executive summary seems at odds with its weight in the chapter itself, and the huge knowledge gaps that remains. To quote the "research gaps" part: "There is limited evidence on sufficiency measures". The research gaps equally not that "There is limited evidence on sufficiency measures". While there is no doubt that sufficiency can contribute to the decarbonisation of buildings, it is more weight it is given in the executive summary that is questionable. Because this weight does not seem to reflect the contents of the buildings chapter, it gives the impression that authors want to highlight a specific research agenda more than to reflect and assess the current state of the literature. In that regard, the conclusion strikes a much better balance between the importance of sufficiency and technological solutions in mitigation policies.	The executive summary was completely rewritten	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
25135	4		7		Executive Summary to have the same layout/format as in other chapters (e.g. include key statements)	The executive summary was completely rewritten	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
36835	4	14	14	4	this does not read well.Should it not be "behaviour change"?	Not relevant any more	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
33911	4		87		The chapter mentions energy savings in several tables and throughout the text. For the chapter to be credible, it is vital to say that the savings are actual or modelled. Modelled savings should be given with a health warning as they may never materialise.	Included	Rajat Gupta	Oxford Brookes 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
39429	4	1	100	33	Reference to the concept of sufficiency is very much welcome in the whole chapter 9. However, the way the sections are currently organized does not appear optimal to facilitate the reading and understanding of such new concept. Repetitions should be avoided and attention should be paid to consistency between different sections.	The concept of sufficiency was defined in Box 1. New data was added in SOD	Emmanuel RAUZIER	NGO Association negaWatt	France
10609	4	4	#REF!	#REF!	60% of CO2 or of energy?	Not relevant any more	David Schoeman	University of the Sunshine Coast	Australia
13527	4	5			It is not clear whether the emission increase comes from the construction itself (cement, concrete, ...) or from the activities pursued in new buildings	Rewritten	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
45215	4	7			Need to specify that this referring to the rate of increase, not the absolute increase, China has much higher absolute increase in CO2 emissions from buildings over period 2010-2018	Not relevant any more	Timothy Goodson	International Energy Agency	France
48171	4	11			consumers become prosumers	Small typos were corrected in SOD when still relevant.	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
43667	4	13			Very well written chapter with many substantial points. Here, consider to motivate the paragraph with wellbeing and DLS, and then explain how sufficiency can support this goal (rather than the other way around).	The concept of sufficiency was defined in Box 1. New data was added in SOD	Felix Creutzig	MCC Berlin	Germany
31905	5	1	5	3	It would be surprising if energy required for cooking also did not go down around the world in this period, driven by people switching to modern fuels from traditional fuels. Given the efficiency difference between traditional and modern cooking fuels, this reduction is likely to be greater than the reduction due to efficient lighting.	This was included in section 9.6	Ashok Sreenivas	Prayas (Energy Group)	India
1553	5	2	5	2	Most likely, it is not energy demand (in terms of volume) that has decreased, but energy use (in terms of consumption). Which is due to efficiency e.g. from the transition to compact fluorescent lamps and led lamps. So energy efficiency has more than compensated the growing need for lighting.	Not relevant any more	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
7883	5	2	5	2	[Recommended] which has → that has	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7885	5	6	5	6	[Recommended] Energy → the Energy	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7887	5	6	5	6	[Recommended] building → the building	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7889	5	6	5	6	[Recommended] with → by	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
1557	5	6	5	9	These lines are superfluous, they're already mentioned on page 4 lines 24-28	Not relevant any more	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
13001	5	6	5	9	Copied ipsis verbis as from page 1 lines 24-27.	Not relevant any more	Mafalda Leite de Faria Coe	International Energy Agency	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
33031	5	6	5	9	The paragraph is repeated in Page 4, Line 24-27.	Not relevant any more	Melinda Yasarani Matara	Qatar Green Leaders	Qatar
48175	5	6	5	9	Repeat of previous content	Not relevant any more	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
37495	5	6	5	10	strike these lines	Not relevant any more	Michiel Schaeffer	Climate Analytics	Netherlands
7891	5	8	5	8	[Recommended] residential → the residential	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39347	5	9	5	29	This section is unclear and should be re-written as different concepts are presented with no data no evidence as a back-up.	Yes, this section was completely rewritten	Emmanuel RAUZIER	NGO Association negaWatt	France
13537	5	10	5	11	In the decarbonisation strategies, fuel switching in favor of carbon-free energy carriers is not mentioned as such, even though this is a crucial strategy from a system perspective (electrification and district heating/cooling, in addition to on-site renewable energy which is already mentioned)	Energy carriers were considered in Section 9.2, not in the technology section itself	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
3247	5	10	5	18	It is the impression that modern buildings that reflect best available technology need external resources. As correctly pointed out in the second paragraph of this executive summary, users of modern buildings become to prosumers. This means: these users will sell energy to the market because their building produces more electricity than they need for operating the building. The structure of the grid will change - there will be small, local grids and much less demand for transport of energy to buildings used as shelter etc. These lines thus contradict somehow what is the result of the assessment as reflected later on, e.g. page 6, lines 3 to 10 and page 6, lines 11 and 12.	Thanks, considered in the new version of the chapter.	Klaus Radunsky	retired from Umweltbundesamt	Austria
35661	5	10	5	18	One of the repetitions from earlier in the Executive Summary. Consider if it is necessary for emphasis.	The executive summary was completely rewritten	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39345	5	10	5	18	There is a repetition with what is already written in page 4, line 13 to 23	Not relevant any more	Emmanuel RAUZIER	NGO Association negaWatt	France
35663	5	10	5	29	As for comment 8 above, this section mixes up technologies in a confusing manner leading to a lack of clarity. The authors should agree on the message that this listing of technologies/services is intended to deliver and then re-write.	This section was completely resturctured	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
13539	5	11	5	18	Repetition from page 4	Not relevant any more	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
45481	5	11	5	18	The whole paragraph is repeated	Not relevant any more	Louis-Gaëtan Giraudet	CIREC, Ecole des Ponts ParisTech	France
46799	5	11	5	18	Repetition of lines 14-22 on page 4. The respective paragraphs could be merged. Content fit better into the flow of the text on page 5.	Not relevant any more	Jessica Grove-Smith	Passive House Institute	Germany
7893	5	13	5	13	[Recommended] for instance → for instance,	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
7895	5	15	5	15	behavioural	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
42635	5	16	5	18	Here the exact same sentence as on page 4 l.20 is repeated	Not relevant any more	Vivian Grudde	Climate Change & Transformation Advisory (Freelancing)	Germany
48177	5	16	5	18	Repeat of previous content	Not relevant any more	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
11129	5	18	5	19	To avoid carbon lock-ins, more stringent building code that promote electrification and prohibit fossil fuel usage is needed as well. Thus, add "and introduction of more stringent building code that prohibit fossil fuel usage" before "in developed country" so as to read;"acceleration of building retrofit rates retrofit and introduction of more stringent building code that prohibit fossil fuel usage in developed country."	Building codes are considered in depth in section 9.9. This comment was considered in rewriting the section.	Midori Sasaki	Industrial organization	Japan
13543	5	19	5	20	"but their contribution to climate change is not always quantified". This sentence, and its juxtaposition with the sufficiency paragraph just after (as well as the one before) gives the impression that while sufficiency measures are a reliable way for decarbonisation, technological options remain uncertain. I do not know whether that is the intention of the authors, but this is how I interpret the text, which I believe does not reflect the state of the literature. In AR5 for instance, technological options showed a reliable way to reduce energy demand.	Not relevant any more	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
13541	5	19	5	29	Again, fuel switching is not mentioned as part of the technological solutions	Answered above	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
33033	5	19	5	29	Recommend the paragraph to be reorganized to have a logical flow. The preferable flow of the paragraph: Startw sith 'Passive technologies', 'active technologies', 'technological advancements' and finally 'digitalisation'. The following sentence in the paragraph 'These technologies can change the building to become a small power plant, producing energy' can then be used to end the paragraph.	Not relevant any more	Melinda Yasaranji Matara	Qatar Green Leaders	Qatar
13003	5	20	5	24	Copied ipsiis verbis as from page 1 lines 36-40.	Not relevant any more	Mafalda Leite de Faria Coe	International Energy Agency	France
46801	5	20	5	24	Repetition of lines 36-40 on page 4. The respective paragraphs could be merged. The content seems to fit better into the flow of the text on page 5.	Not relevant any more	Jessica Grove-Smith	Passive House Institute	Germany
36837	5	21	5	21	The use of the indefinite article "the" makes line 21 odd. The first indefiniote article "the" is OK. The issue is with the last three	Not relevant any more	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
48179	5	21	5	28	Repeat of previous content	Not relevant any more	Ian Hamilton	University 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
7897	5	24	5	24	[Recommended] delete "the"	Not relevant any more	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7899	5	25	5	25	[Recommended] and → , and	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7901	5	28	5	28	Digitalisation	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7903	5	30	5	30	behavioural	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13005	5	30	5	30	Above, behavioural aspects have been mentioned as independent from sufficiency, and here they are considered as a sufficiency measure. I think the latter is correct, but requires alignment.	Sure, done, thanks a lot.	Mafalda Leite de Faria Coe	International Energy Agency	France
1555	5	30	5	31	Behavioural actions have a significant saving potential, but at the same time this is difficult to achieve since it requires voluntary actions by consumers. Who need to be motivated by policies, that can influence people's 'mental accounting'. The voluntary aspect limits the saving potential significantly, so the realistic or economic/social (compared to the technical) potential is much lower. This drawback is something to press more firmly in the text.	Considered in section 9.5	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
33035	5	30	5	32	The sentence emphasizes the 'great' effect of non-technocological and behavioral mitigation actions in buildings as sufficiency measures in energy use and GHG emissions. Recommended to support the use of the word 'great' with a level of evidence and agreement.	Not relevant any more	Melinda Yasarani Matara	Qatar Green Leaders	Qatar
39431	5	35	5	40	efficiency behaviour mentioned as "one-time" decision. Please consider human behaviour change is a multi-stage process and not sudden and one-time decision. Basically, there are many internal and external drivers (e.g. norms, financial facilities) and barriers (e.g. ownership status) involve in a decision-making process which can lead them or make delay to their energy behaviour (e.g. insulation). Please see Niamir, et al. 2020 (https://doi.org/10.1016/j.erss.2019.101356); Rai & Rabinson 2015 (https://doi.org/10.1016/j.envsoft.2015.04.014); ...	Literature reviewed and included when pertinent. Comment considered in the text.	Leila Niamir	MCC	Germany
7905	5	36	5	36	behaviours	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7907	5	37	5	37	behaviours	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7909	5	38	5	38	behaviours	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7911	5	39	5	39	organisational	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
7913	5	40	5	40	[Recommended] a context → the context	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7915	5	40	5	40	behavioural	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7917	5	40	5	40	[Recommended] key → the key	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
33037	5	42	5	43	It is unclear whether 'size' referred to in the sentence is family size or building size. The paragraph is focused on non-technological and behavioral mitigation actions and hence may be referring to 'family size'. Building size, on the other hand, is out of the control of the building occupants and thus cannot be considered as a non-technological and behavioral mitigation actions.	Thanks, rewritten.	Melinda Yasarani Matara	Qatar Green Leaders	Qatar
7919	5	43	5	43	[Recommended] conform → conforming	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7921	5	45	5	45	[Recommended] delete ","	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7923	5	46	5	46	[Recommended] high → a high	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7925	5	47	5	47	[Recommended] delete ","	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7927	5	47	5	47	[Recommended] delete "to"	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
35665	5	30	6	2	These lines address the issue of energy sufficiency and behaviour, both significant new areas of exploration for better understanding the climate change mitigation potential of buildings. This could become the part of the Executive Summary that bring together all elements related to energy sufficiency in a coherent and complete manner. Having such a section on energy sufficiency, clearly defined, will help the Chapter	The concept of sufficiency was defined in Box 1. New data was added in SOD	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39349	5	30	6	2	While the first sentence introduces the concept of non-technological solutions, however the rest of the (long) section focuses on behavior change. Non-technological solutions including behavior are part of sufficiency measures to be considered. I therefore suggest that sufficiency received a full and separate treatment, as this is a fairly but important new concept.	Not relevant any more	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
43669	5	28			Digital solutions are important if rebound effects are managed well. Yet: there is a tradeoff in more ubiquitous surveillance. That can be technologically solved to (trusted data governance, secure computation, etc.) but only with deliberate policy choices. https://www.theguardian.com/technology/2020/mar/08/how-to-stop-your-smart-home-spying-on-you-lightbulbs-doorbell-ring-google-assistant-alexa-privacy Also consider Shoshana Zuboff's book Zuboff, Shoshana. The age of surveillance capitalism: The fight for a human future at the new frontier of power. Profile Books, 2019.	The part on digital solutions is included not in the box "Digitalization"	Felix Creutzig	MCC Berlin	Germany
36839	6	2	6	2	The word "training" is odd and not suitable. A better word should be used.	Small typos were corrected in SOD when still relevant.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
1989	6	3	6	10	When specifying reduction potentials, it should always be stated whether these concern direct, indirect or embodied emissions. General formulations such as "very low GHG emissions" are imprecise and can lead to misunderstandings.	Considered when possible	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
7929	6	9	6	9	[Recommended] Additional → The additional	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7931	6	13	6	13	[Recommended] stricter → the stricter	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
48181	6	16	6	17	Repeat of previous content	Small typos were corrected in SOD when still relevant.	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
22343	6	18	6	19	Supplement: "The realization of this mitigation potential requires an acceleration ... high agreement) by elimination the barriers to it."	Not relevant any more	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
45219	6	18	6	19	Reinforce that increasing retrofit rates in advanced economies is not sufficient, unless accompanied by standards that see retrofitted buildings achieve NZEB status or similar.	Yes, this was considered in section 9.4	Timothy Goodson	International Energy Agency	France
4509	6	19	6	20	immediate introduction of very ambitious building and equipment standards in developing countries may not be affordable for building owners and tenants and may be unrealistic due to a number of reasons (affordability, enforcement of building codes, lack of qualified work force, lack of materials with sufficient quality etc.). What is here meant by "very ambitious"? Is this Nearly-Zero Energy Buildings (NZEB)?	Not relevant any more	Leonardo Barreto	Austrian Energy Agency	Austria
39351	6	22	6	26	A link could be made with the section on potentials from line 3 to 10 on page 6	Not relevant any more	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
36841	6	23	6	23	on "the" number of assumptions.... Should it not be "a"?	Small typos were corrected in SOD when still relevant.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
39353	6	30	6	31	Could international definitions be used for designing climate? For instance, what "warm winter" refers to?	All definitions were considered together with the "glossary" task force	Emmanuel RAUZIER	NGO Association negaWatt	France
35299	6	6	7	37	i.e usage of , from (robust evidence, high agreement) to (robust evidence; high agreement)?	done	Reyneir Tasico	UpScale PH/ Psychological Association of the Philippines (Member)	Philippines
45217	6	13			It is not sufficiently clear that what is needed is implementation of new and strict policies, and increasening of the stringency of existing policies.	Not relevant any more	Timothy Goodson	International Energy Agency	France
45221	6	25			Disagree, new technology solutions and economies of scale have the potential to reduce required investments, think it is wise to indicate that there is uncertainty in both directions.	Considered in the new version of SOD	Timothy Goodson	International Energy Agency	France
31907	7	2	7	6	There is very little evidence that improved cookstoves improve indoor air quality sufficiently to have a significant impact on health outcomes. Improved cookstoves whose emission levels are comparable to modern fuels (e.g. LPG) are either not available or prohibitively expensive. What is available results in emissions with significant health impacts, and often they are not used as "improved stoves" over the years. So it would be good to reword this.	Accepted - text revised	Ashok Sreenivas	Prayas (Energy Group)	India
7933	7	3	7	4	[Recommended] as well as energy efficiency interventions in buildings that live energy-poor households in both developed and developing economies → , as well as energy efficiency interventions in buildings that live energy-poor households in both developed and developing economies,	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36843	7	4	7	4	is "live" correct? is it not supposed to be "leave"?	Taken into account - text revised to be more clear.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
22345	7	6	7	6	"reduced financial stress regarding energy costs". Explanation: The financing stress regarding gross living costs / gross rent tends to increase while the financial stress regarding energy costs decreases, see line 12.	Accepted - text revised	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
7935	7	9	7	9	[Recommended] in home → in-home	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7937	7	12	7	12	[Recommended] energy efficient → energy-efficient	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
7939	7	15	7	15	[Recommended] economy → the economy	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
35667	7	17	7	25	Another confusing paragraph with some incomplete sentences. As the first time that policies are mentioned, we should understand which type of policies are being referred to. Are they energy consumption regulations, building performance standards or other policy types? Re-writing required.	Accepted - text revised	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39355	7	17	7	25	This section refers to innovative policies. However, it does not propose any new policy. Innovative policies mentioned in the introduction section should be included in the ES.	The executive summary was completely rewritten	Emmanuel RAUZIER	NGO Association negaWatt	France
7941	7	18	7	18	[Recommended] addition → addition,	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
4511	7	19	7	20	In addition to energy efficiency, building codes must incorporate minimum requirements for renewable energy use in buildings	Accepted - text revised	Leonardo Barreto	Austrian Energy Agency	Austria
33039	7	19	7	20	It should be noted that 'green building certification systems' have also proven effective in addition to building codes.	Accepted - text revised	Melinda Yasararaji Matara	Qatar Green Leaders	Qatar
4513	7	20	7	22	Can net zero building codes already be applied in developing countries? Do the countries have the capabilities for enforcement and the qualified work force to construct buildings meeting these standards? Are they affordable?	Accepted - text revised	Leonardo Barreto	Austrian Energy Agency	Austria
7943	7	21	7	21	[Recommended] net zero → net-zero	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
1991	7	22	7	23	Please give examples of "most advanced building codes with requirements to make buildings positive energy and carbon neutral over the lifecycle of the building". Ideally, the terms "positive energy building" and "carbon neutral building" should be defined.	Done in Section 9.9	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
7945	7	23	7	23	[Recommended] carbon neutral → carbon-neutral	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
4515	7	24	7	25	Policy instruments should combine energy efficiency and renewable energy where possible and a coordinated implementation of energy efficiency and renewable energy measures in buildings should be encouraged	Accepted - text revised	Leonardo Barreto	Austrian Energy Agency	Austria
37497	7	26	7	31	This paragraph should be moved toward the beginning of the summary as part of a more general reorganization to bring coherence to the whole Summary	The executive summary was completely rewritten	Michiel Schaeffer	Climate Analytics	Netherlands
39357	7	26	7	31	What are the new policies which may change behavior and lifestyles?	Done in Section 9.9	Emmanuel RAUZIER	NGO Association negaWatt	France
7947	7	27	7	27	behaviours	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
1993	7	32	7	32	Please replace "embedded" with "embodied"	Small typos were corrected in SOD when still relevant.	Thomas Lützkendorf	Karlsruhe Institute of TEchnology (KIT) - Research University of Helmholtz Association	Germany
7949	7	32	7	32	[Recommended] delete "to"	Small typos were corrected in SOD when still relevant.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36845	7	32	7	32	The sentence "At the same time polices shall also address to embedded carbon in new building construction" is not clear	Accepted - text revised	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
1995	7	34	7	34	There is no definition for "sustainable building products". Construction products per se are not subject to a sustainability assessment. So far, their environmental properties have been described and communicated without an assessment - e.g. in an EPD. Please use the term "construction products".	Accepted - text revised	Thomas Lützkendorf	Karlsruhe Institute of TEchnology (KIT) - Research University of Helmholtz Association	Germany
1997	7	35	7	35	Please replace the term "building sector" with "real estate sector".	Rejected. Vocabulary from the literature and in compliance with IPCC instructions was followed.	Thomas Lützkendorf	Karlsruhe Institute of TEchnology (KIT) - Research University of Helmholtz Association	Germany
1559	7	35	7	37	A suggestion to add here, is the need for financial guarantees and for energy policies that offer them (which are in fact addressed in the text, for example page 9-94). Guarantees can provide incentives to lend money for energy saving investments, which makes it easier for consumers to repay loans (increase creditworthiness) or highers their expected returns (periodic costs, or cost savings). An example are guarantees provided as part of a government revolving fund, as mentioned on page 9-94 lines 6-9. An example are energy saving loans in the Netherlands (energiebespaarlening from the Nationaal energiebespaarfonds).	The executive summary was completely rewritten	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
48183	7	20			The simple presence of building codes in themselves are not sufficient. Codes need to be adopted but more importantly adhered to, which is no easy process.	Accepted - text revised	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
48185	7	37			I would comment on skills and capacity also needs to be included here. Financing is only one part of enabling this transition. Having those who are trained with the right skills, and have the knowledge for how to build these buildings is critically important.	Accepted - text revised	Ian Hamilton	University 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
1999	8	2	8	3	The share of 32.2% is not the only number available. Other sources indicate about 39% of this. See the source for this: https://webstore.iea.org/download/direct/2454 (IEA, 2019, p. 54); https://globalabc.org/uploads/media/default/0001/01/f64f6de67d55037cd9984cc29308f3609829797a.pdf (IEA, 2018, p. 11 / figure 1).	accepted.	Thomas Lützkendorf	Karlsruhe Institute of TEchnology (KIT) - Research University of Helmholtz Association	Germany
22347	8	2	8	3	The amount of 32.2 % of global emissions should be divided in its parts for direct, indirect and embodied emissions. There should be a link to chapter 2, page 28 ff. with 6 % of direct emissions from buildings The emissions should be divided in heating, hot water and electricity (not for heating) on the other side. See figure 9-7, where these parts are explained	accepted. Text are vised and linkages are established.	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
13009	8	3	8	3	29% of TFC is true if non-energy use is considered in the total - otherwise the share of buildings is even larger. Are non-energy uses being considered on purpose? If so, I would suggest to add a remark explaining why.	Reject. This scentense is discussing on energy use. GHG emission of non-energy use is not discussed in this place.	Mafalda Leite de Faria Coe	International Energy Agency	France
13011	8	4	8	4	29.3% of the global electricity demand seems too low. Please double check.	Double checked and corrected. Building electricity consumption is 11755 TWh, and total final energy demand is 23031 TWh, the share of building sector electricity demand is 51%	Mafalda Leite de Faria Coe	International Energy Agency	France
13013	8	13	8	13	Thank you to acknowledge IEA databases. However, the reference IEA 2019b points to a generic IEA database. Please complete reference as IEA has many databases. Possibly the CO2 Emissions from fuel combustion database (https://www.iea.org/reports/co2-emissions-from-fuel-combustion-2019)?	accepted. Literature added.	Mafalda Leite de Faria Coe	International Energy Agency	France
36847	8	25	8	25	buildings chapter. Should it not be "building" chapter? Without an s!	accepted. Text revised.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
13547	8	25	8	26	While in Chapter 8, they do talk about district heating, fuel switching (heat pumps, district heating, biomass, etc) remains an important option for buildings decarbonisation and should be mentioned as such in the buildings chapter	accepted. Text revised.	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
13007	8	3	9	3	Please complete reference IEA 2019 - as it has not title and only points to te generic website - please also consider revising as needed, as this points out to preliminary data.	accepted. Data source revised.	Mafalda Leite de Faria Coe	International Energy Agency	France
33899	8		12		The chapter introduction needs to be more clear about the challenges with mitigation carbon emissions from energy used in new buildings and existing buildings.	accepted. Text revised.	Rajat Gupta	Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
13545	8	5			Not clear what the 10% increase refers to	accepted. Text revised to "The final energy demand of building sector increased 10% from 2010 to 2018."	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
39863	9	16	6	29	Regarding the French 2020 building code, it is in the process of being and there are many debates about the parameters it should include and the values they should have. Unfortunately there is no peer-review documentation on this, only newspaper articles, but I thought it could be interesting to shed some light on the issue for AR6 authors since I directly work on the subject. One of the main debates is about the carbon content of electric heating. If the CO2 content of classic fossil fuelled heating is clear, the CO2 content of electric heating is more difficult to assess since the CO2 content of 1 kWh of electricity depends on the generation mix. The French average CO2 content for electricity is 60 gCO2/kWh, as specified in the Carbon Database managed by French Environmental Organisation ADEME. For each electricity, the Database tries to use calculate a carbon content that reflects the power plants solicited for this particular use. The most "accurate" method would be to assess average CO2 content of each use based on the hour - by - hour CO2 content of the power mix and hour - by - hour consumption. The Carbon Database has until now used a simplified method called the seasonalized method, where it attributes more CO2 from fossil fuelled electricity to heating, ending up with a 180gCO2/kWh content. The method is now debated whether it should be updated, by calculating the CO2 factor of electricity for heating using the amount of electricity consumption used for heating each month and the emission factor of the generation mix for this month, which could end up attributing a 80gCO2/kWh content to electric heating according to the latest news. The specifics will be determinant for how CO2 emissions from buildings will be assessed with the emission factors of the carbon database.	Agreed, but the related parts are deleted by Author. These detailed information is not suitable to be introduced in the 9.1 introduction section. Therefore, the two sentences are deleted.	Blanka SHOAI-TEHRANI	RTE, CentraleSupélec	France
22349	9	3	9	6	Note: Indirect emissions can only be influenced to a very limited extent by the building owners.	Noticed. The share of electricity is about 50% of total final energy consumption in building sector now, and it may increase in the future. The difference of direct and indirect emission is an interesting topic in building sector.	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
2001	9	7	9	12	In the listing of life cycle stages to be considered, maintenance, repair, replacement, refurbishment and transport are missing, among others. It is recommended to also mention the recycling potential (module D).	accepted. Text are revised.	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
22351	9	7	9	12	Note: The material manufacturing process plays a crucial role in embodied emissions - the emissions are therefore determined by the sector industry.	accepted. Text are revised.	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
37059	9	7	9	12	Page 9-9, Line 7, (c), The third category of emissions from buildings refers to the emission from the building life cycle assessment (LCA) perspective. This definition suggests operational emissions is part of embodied emissions as operational emission is part of life cycle of a building. This is not accurate and thus not the definition of embodied emissions. An accurate definition is required.	accepted. Text are revised.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
2003	9	13	9	13	The source "Röck et al" cited in the text is also given in the bibliography as "Röck and Coauthors". For scientific publications, it is common to name all co-authors in the bibliography.	Noted. Thank you. We are following the IPCC template for referencing	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
2005	9	13	9	13	It is suggested that the source "Röck et al." is discussed in more detail in section 9.4.5.	agreed.	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
11127	9	13	9	20	Add examples of policies that enhance electrification and avoid carbon lock-ins in building sector. Eg, restriction of connecting gas pipelines into new buildings (ORDINANCE NO. 7,672–N.S., Berkeley, CA)	Agreed and related sentences are deleted.	Midori Sasaki	industrial organization	Japan
2007	9	15	9	20	Why is the example of France highlighted while developments in Finland, Sweden, Denmark, Switzerland etc. are not shown? It is suggested that several examples are given.	Agreed and related sentences are deleted.	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
36849	9	17	9	17	"... described above". .."above" where? Please be specific! Do proper cross-referencing	Agreed and related sentences are deleted.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
4519	9	23	9	23	Does the concept of sufficiency already finds ist way into policy design?	Yes	Leonardo Barreto	Austrian Energy Agency	Austria
7951	9	25	9	25	behaviours	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7953	9	30	9	30	[Recommended] wellbeing → well-being	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36851	9	30	9	30	consistency required. "wellbeing" or "well-being"?	accepted. Text revised.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
7955	9	32	9	32	behaviour	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7957	9	34	9	34	organisation	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
4517	9	35	9	37	Financing mechanisms combining renewable energy and energy efficiency will be required	accepted. Text revised.	Leonardo Barreto	Austrian Energy Agency	Austria
7959	9	44	9	44	optimization, behavioral	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
18841	9			48	Low carbon economy is achievable in agriculture, power generation, housing and urban planning as well as all sectors of humanity	agreed. This line number is not found.	Michael Ugom	University of Nigeria, Nsukka	Nigeria
33149	9				This is an excellent report but I would like to suggest to include who local government/other organisations can play role effectively in promoting climate resilient building. It should also include junior school level curriculum for teaching climate resilient building and its usages for next generation	Agreed. This topic will be discussed in policy section	Edris Alam	Rabdan Acadmey	United Arab Emirates
7961	10	3	10	3	decarbonized	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7963	10	7	10	7	organisation, behaviour	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36853	10	8	10	8	(Saheb & al, 2020) should be corrected. It is (Saheb et al., 2020)	accepted. Text revised.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
7965	10	10	10	10	realise	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7967	10	15	10	15	behaviour	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36855	10	18	10	18	".. Leads to reduce.." does not read well. consider: "leads to a reduction in...."	accepted. Text revised.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
7969	10	20	10	20	organisation	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
13397	10	31	10	45	The link to SDG should be more developed, for instance including tradeoffs. It should also be mentioned that there is no consensus on these links - see for instance the results fo International Council for Science (ICSU) (2017) A Guide to SDG Interactions from Science to Implementation [D.J. Griggs, M. Nilsson, A. Stevance, D. MacCollum (eds)], Paris: International Council for Science. on the links between SDGs 7 and 1 that ignore the positive effects on energy efficiency in the fight against poverty (p. 137)	Noted - the links on SDGs are discussed in detail in Section 9.8. There, apart from the co-benefits of the mtigation actions, some trade-offs are also presented (see for example the Table included in Section 9.8). However, almost all studies agree that the co--benefits are considerably higher compared to trade-offs, and this is the reason that the issue of trade - offs is not mentioned in introduction.	Thibaud Voita	IFRI	Germany
7971	10	35	10	35	decarbonisation	accepted. Text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
9209	10	41	10	42	A reference is needed here to link the achievement of SDG3 on health and well-being. See: Nunes, A.R. (2019). General and specified vulnerability to extreme temperatures among older adults. International Journal of Environmental Health Research, DOI: 10.1080/09603123.2019.1609655; Nunes, A.R. (2018). The contribution of assets to adaptation to extreme temperatures among older adults. PLoS ONE, 13 (11): e0208121; Nunes, A.R., Lee, K. and O’Riordan, T. (2016). Rethinking the Sustainable Development Goals under a health and well-being framework. BMJ Global Health, 1 (3): e000068.	Noted - This issue is discussed in section 9.8.2.2, including some of the proposed references.	Ana Raquel Nunes	University of Warwick, UK	United Kingdom (of Great Britain and Northern Ireland)
36859	11	21	9	23	While the intention behind Figure 9.1 is great, i.e. to show the connection with other chapters, readers do not immediately see this. I do not see how Figure 9.1 shows the connection between Chapter 9 and other chapters of AR6. I suggest the diagram to be revised with an additional layer between the heptagon containing “Chapter 9 Building” and the other quadrilaterals containing the different chapters. The layer should explicitly state the connections.	Agreed and figure reivsed. Due to the frequent change of other chapters, this Figure will be updated again after SOD.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
45223	11	1	11	10	Would stress that buildings are not only becoming power plants, but that buildings are becoming an integral part of an increasingly integrated and multi-directional energy system. This means that not only can buildings be producing energy, and injecting electricity into networks, but buildigns can also be a source of flexibility, providing vital and increasingly valuable services to electricity systems. Demand sid-response, on site storage, and solar PV all contribute to allowing buildings to respond to signals coming from the network, i.e. changes in output from utility scale generation, contrasting with the traditional paradigm of utility scale genertion responding to changes in demand. How to unlock this capacity at a large scale and ensure that consumers see a large share of the benefits is a key question requiring policy solutions.	Agreed, and text revised.	Timothy Goodson	International Energy Agency	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
4521	11	2	11	10	An integrated district approach allows synergies between the supply and demand side and reaping benefits from energy efficient buildings and local consumption of renewable energy to achieve decarbonisation	Agreed, and text revised.	Leonardo Barreto	Austrian Energy Agency	Austria
7973	11	7	11	7	decarbonisation	Agreed, and text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
45089	11	11	11	12	Referral to the role of buildings in sectoral coupling and integration in the energy system based on renewable energy as a novelty since AR5 is very relevant and could be provided or supported with additional review in the chapter.	Agreed, and text revised.	Siir Kilkis	The Scientific and Technological Research Council of Turkey	Turkey
36857	11	13	11	13	the building sector are related to all other chapters in this report. It will be great to be specific. Say AR6 report	Agreed, and text revised.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
7975	11	24	11	24	[Typo] Bibliometric → Bibliometrics	Agreed, and text revised.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
42039	11	1			The integration of buildings in the energy systems has to be understood in the context of a plurality of prosumers interacting with the power network. This can be done only in the context of smart grids. I have made a similar remark for chapter 6 as well. In fact smart grids are instrumental in any link of the energy chain, including EV and HEV. For "the public", smart grids are mainly known as ICT supporting the integration, operation and integration of smart grids into power networks. But smart grids are much more than this and, in fact, and cover also the interaction with the prosumers which can be energy consumers and also producers (with a high relevance of billing and other interactions between providers of power or energy services), and many of them having (at least in the future) a vehicle connected to network for charging from or supporting the power network, parked in the dwelling of the prosumer. The integration of buildings in the energy system cannot be approached without a reference to smart grids	Agreed, and text revised.	Francisco Javier Hurtado A	European Patent Office	Germany
2009	12	2	12	3	The figure is not readable	accepted and revised	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
36861	12	2	12	3	Germany appears on Figure 9.2. Could this be an anomaly? Can it be deleted?	accepted and revised	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
2355	12	3	12	3	Figure better in vertical format, otherwise characters are too small.	accepted and revised	Dieter Boer	Universitat Rovira i Virgili	Spain

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
36863	12	3	12	3	Can VOSviewer not be deleted?	Noted, later version addressed this.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36865	12	4	12	4	"chapter Buildings" does not read well. I think it should be Building chapter	accepted. Text revised.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36867	13	2	13	3	This is really confusing! You cannot say that the section mainly details of the building sector....rather than evaluate ... done in the following sections. You are saying that you will not evaluate mitigation potentials, then you switch to say, it is done in the following section. This sentence needs to be sorted.	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
37061	13	7	13	8	Not clear! Especially with "influence" occurring twice in one sentence	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
33041	13	7	13	9	It is not clear why 'ventilation' is singled out in the statement. Heating, cooling, lighting, plug loads, etc all influence energy cost.	Changed in the text	Melinda Yasaranji Matara	Qatar Green Leaders	Qatar
48187	13	10	13	10	Why are slums separate than these other types? I would expect that slums can also be categorized into any of the following types. Slum is a socio-economic condition that influences the building quality, by itself it is not a building type.	Noted, later version addressed this.	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
22353	13	10	13	11	Supplement: "Residential buildings can be classified as slums, single-family house and multi-family house or apartment/flats building as well as per ownership: owner-occupiers, landlords and owners' association/condominiums." Explanation: Ownership has (combined with incomes and legal regulation) a crucial effect on ability for investment in a building.	Added in the text	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
2011	13	15	13	15	Please replace the "building types" with "types of construction works". Some examples - sports field - are not buildings. Possibly, it also makes sense to differentiate between buildings and infrastructures.	While the authors appreciate this comment, we don't agree with it. This classification is compiled from books and also it refers to the buildings in those "places".	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
2647	13	15	14	1	Table 9.1: for completeness there are some buildings the single purpose of which is parking automobiles. Also, in the Sports section, I assume it includes indoor swimming pools and tennis courts, which are both rather greedy in terms of energy;	The authors believe that these suggested buildings are included in the table already	Philippe Waldteufel	CNRS/IPSL/LATMO S	France
4523	13	15	14	1	Is this table required in full length? Could it be simplified?	Noted, later version addressed this.	Leonardo Barreto	Austrian Energy Agency	Austria

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
36869	13	15	14	1	In Table 9.1, inconsistency in the use of Camel notation. This should be corrected. What is the added-value of Table 9.1? I suggest only the building types in the first column should be considered and written in 1 or 2 sentences. The other columns do not add any value, especially given the stringent word or page limits of this report.	The intention of the table is to show the high diversity of existing buildings.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
35671	13	1	17	32	This section of the chapter reads and looks more like a textbook describing some of the characteristics of the buildings sector. As it is informational and not a narrative addressing the climate change mitigation potential of buildings, it could be changed to an annexe of the Chapter or report.	Thanks for the comment, but the IPCC does not allow annexes. Moreover, this section stated the boundaries of the rest of the chapter where the mitigation potential is assessed, as the beginning of it states.	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39363	13	1	17	32	Shouldn't this section be moved to an annex as it is not about evaluating mitigation options?	Thanks for the comment, but the IPCC does not allow annexes. Moreover, this section stated the boundaries of the rest of the chapter where the mitigation potential is assessed, as the beginning of it states.	Emmanuel RAUZIER	NGO Association negaWatt	France
48189	13	15			I think the division of these building types if more related to their activity, rather than their form. So, while residential tends to be classed by their form (detached, semi-detached, multi-unit), non-residential is classed by their use-type.	The intention of the table is to show the high diversity of existing buildings.	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
37499	14	2	14	6	these lines do not tell us much of anything as a small random sampling of statistics in two regions	This figure/this section were just a draft in the FOD. It will be completed in SOD.	Michiel Schaeffer	Climate Analytics	Netherlands
39433	14	2	15	2	1) figure 9.3(a): there is a significant decrease from 2000-7 to 2008-12. what was the reason of this drop? It would be nice to discuss it. 2) figure 9.3(b) presented number of building in which year? Cumulative? 3) it would nice to visualize (a) and (b) in a way to facilitate comparison, maybe x axis in both present number of buildings?	This figure/this section were just a draft in the FOD. It will be completed in SOD.	Leila Niamir	MCC	Germany
33893	14	14			Table 9.1: It may be good to call out cold storage under warehouses. Also, where do roads and bridges feature? They are structures with large footprints, without being buildings.	The intention of the table is to show the high diversity of existing buildings.	Debra Roberts	EThekwini Municipality	South Africa
22355	15	1	15	2	Figure 9.3 (b): For residential EU-28 multi-family: it's the number of dwellings, not buildings	This figure/this section were just a draft in the FOD. It will be completed in SOD.	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
29117	15	2	15	2	Title mentions trends in buildings stock. Panel b on EU28 could reflect trends. Or suggest to modify the title	This figure/this section were just a draft in the FOD. It will be completed in SOD.	Minal Pathak	Ahmedabad University	India

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
36873	15	7	15	7	This definition of foundation is not good enough. A rough definition and better one, is an extension of a building above the ground. A foundation can be under the ground surface, that does not mean that what is above the foundation is a superstructure. Please, check this site: https://www.designingbuildings.co.uk/wiki/Superstructure	Thank you for the suggestion, but the authors think that the definition used is correct	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
48191	15	11	15	11	manly = mainly	Changed in the text	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
13111	15	11	15	13	What authors mean by local materials? This has to be clarified. is it earth-based building materials? I suggest to add some example for more clarity.	Definition added in the text	Jean Noël Yankwa Djobo	Ministry of Scientific Research and Innovation/Local Materials Promotion Authority (MIPROMALO)	Cameroon
33043	15	12	15	13	Preferably to cite a literature for this statement. Developing countries tend to use cheap and readily available construction materials or techniques which are more often not identified as vernacular architecture.	This section has been rewritten and this comment was taken into consideration	Melinda Yasaranji Matara	Qatar Green Leaders	Qatar
37501	15		16		I do not understand the point of a table telling us that buildings have walls and ceilings and doors and plumbing	All this section is about setting the boundaries of the chapter	Michiel Schaeffer	Climate Analytics	Netherlands
12865	15	3		15	An analysis of the CO2 intensity and footprint of the embedded energy in the building components is missing.	Materials are considered in section 9.4	Arnulf JÄGER-WALDAU	European Commission, JRC	Italy
36871	15				Figure 9.3(b), thousand), does it mean we have to multiply the figure by 1000 again? I just want to make sure this is accurate. So we have 160 430 000 single family houses in EU-28. Also note the UK is no longer part of EU-28. So please consider this. I now suggest, a footnote should be included to take into account the fact that the UK is no longer part of the EU-28. This should just be an acknowledgement especially given this report is yet to be published.	This figure/this section were just a draft in the FOD. It will be completed in SOD.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36875	16	1	16	3	Visually, what makes this smart? I do not see the smartness in Figure 9.5. How can one infer from Figure 9.5 that the building on the right is smart and the one to the left is vernacular? It is not obvious! Authors should clarify this.	Figure 9.5 was removed	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
13113	16	1	16	4	I guess the difference in the two types of architecture relies on the types of building materials used as well as the technology. So, a legend showing a description of the name of materials used in both types of buildings will be more illustrative. For example indicate that the roof in the Vernacular architecture is made of straw and that the walls are made of earth blocks.	Figure 9.5 was removed	Jean Noël Yankwa Djobo	Ministry of Scientific Research and Innovation/Local Materials Promotion Authority (MIPROMALO)	Cameroon

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
2013	16	2	16	3	Figure 9.5 is not adequate in terms of quality and provided information for an IPCC report and should therefore be omitted. The topic "smart building" should not be presented in this form.	Figure 9.5 was removed	Thomas Lützkendorf	Karlsruhe Institute of TEchnology (KIT) - Research University of Helmholtz Association	Germany
36877	16	2	16	3	What is S.XX on this Figure?	Figure 9.5 was removed	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
33045	16	10	16	10	Fire safety; detection and protection;' can be coined as 'Fire and Life Safety' which is the industry recognized term for these systems.	Changed in the text	Melinda Yasararaji Matara	Qatar Green Leaders	Qatar
46803	16	12	16	14	It not not clear what is meant by "much greater" at the end of the sentence. "...while if the building and the services were considered holistically, the overall energy performance would be better"?	Changed in the text	Jessica Grove-Smith	Passive House Institute	Germany
15113	16	1	17	31	Why do IPCC only include one (heat pumps) of several competing technologies for smart buildings? Sorry, but this whole chapter seems kidnapped by the heat pump maffia. Similar integration is disuccsed for alternative means of heating such as district energy systems. These pictures provide the reader with a view that smart houses can only use heat pumps.	The figure has been improved. Other comments claim that heat pumps are not highlighted enough. Authors of this chapter have made a great effort to include all technologies without highlighting one over the others.	Levihn Fabian	KTH - Royal Institute of Technology	Sweden
37503	16		17		This section reads as a hastily assembled collection of several relevant but random aspects of building energy consumption.	This section has been rewritten since it was just a draft in FOD. But this section is not about buiding energy consumption, it is about building services.	Michiel Schaeffer	Climate Analytics	Netherlands
33803	16	4			How does non-Western housing fit in here? If the house on the right is 'smart', are more old fashioned buildings not smart? What is actually the definition of a 'smart' home? Must it have some digital component? A rammed earth house with a thatch roof is arguably even smarter in terms of low carbon footprint and insulation. How can discussion on building structures be applicable to all regions?	Figure 9.5 was removed	Debra Roberts	EThekwin Municipality	South Africa
48193	16	4			Figure 9.5 The building to the left could easily be a highly efficient building depending on where it is located. I would suggest that this figure does not convey what might be superficial differences in designs. A smart building also implies digital - but in fact, a building designed and constructed with little digital technologies can easily be highly efficient. Suggest removing this image.	Figure 9.5 was removed	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
17097	17	1	17	2	I would not call batteries, storage tanke, etc. energy services. Energy services rather are light, comfort, etc.	The figure was redone.	Kornelis Blok	Delft University of Technology	Netherlands
19263	17	1	17	2	Figure 9.6 misses some devices (soalr water heater, fuel cell combined heat power, smart thermostat (controller)?). These should be incorporated.	The figure was redone.	Masahiro Sugiyama	University of Tokyo	Japan

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
35673	17	1	17	2	Figure 9.6 does not show all building energy services. It focusses on building energy services from a renewable energy perspective. It does not show, for example, ventilation services, heating services (such as radiators or underfloor heating) or cooling services. We only see in the figure a selection of renewable energy related equipment.	The figure was redone.	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39435	17	1	17	2	What about small-scale hydro power? In many villages still counts as a source of energy. Please see Rotilio, et al. 2017 (https://doi.org/10.3390/su9122211)	The figure was redone.	Leila Niamir	MCC	Germany
7993	17	7	17	7	(Rabe et al., 2018)	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
1561	17	9	17	9	Rephrase sentence? Natural ventilation "increases" energy consumption, or "offsets" (decreases) energy savings.	Changed in the text	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
7995	17	9	17	9	[Recommended] offsets → reduces	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
46807	17	9	17	11	Suggest to start the paragraph with the second and third sentence. Then continue into details and different options.	Changed in the text	Jessica Grove-Smith	Passive House Institute	Germany
46809	17	9	17	11	Considering the importance of the "provision of adequate ventilation" and the impact on the choice of ventilation method can have on the energy performance of the building, a lot more relevant information could be added here. For example the benefits of heat or energy recovery in the case of mechanical ventilation as an effective efficiency measure. Efficient ventilation solutions depend on the building typology and climate. A general statement that "natural ventilation offsets energy consumption" appears misleading in the light that in more extreme climates solutions with mechanical ventilation with heat recovery can lead to lower overall energy consumption that natural ventilation providing a similar air quality.	This topic is considered in depth in section 9.4	Jessica Grove-Smith	Passive House Institute	Germany
36879	17	12	17	12	"..experienced rised" does not make sense	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
821	17	12	17	19	Include how change in climatic trends regarding night time and day time humidity in combination with elevated temperatures could use more emphasis regarding increased energy consumption in buildings.	This topic is considered in depth in section 9.4	Ann Kosmal	U.S. General Services Administration	United States of America

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
32501	17	12	17	19	Policies to improve efficiency of AC and other cooling equipment can avoid significant emissions as demand for cooling grows. For instance, doubling the efficiency of new stationary air conditioners using best available technologies avoids 6 GtCO ₂ by 2030 and 29 GtCO ₂ by 2050. Up to 260 GtCO ₂ -e can be avoided with policies that encourage both maximum energy efficiency and use of low-GWP refrigerants. Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory (“For best-available-technology (or “maximum” efficiency), total savings to 2050 are 373.0 and 257.6 GtCO ₂ e for baseline (or static) electricity emission factors and decreasing emission factors, respectively (Fig. 1). Table S1 in the SI shows the GHG emissions for the reference case (no efficiency improvement and baseline HFC refrigerants) vs. the policy case of best-available technology (BAT) energy efficiency and low GWP refrigerants for 2030, 2040, and 2050 with static emission factors for both cases Reference case cumulative GHG emissions are 587.1 Gt CO ₂ e while the policy case is 214.1 Gt for an overall cumulative savings of 373.0 Gt CO ₂ e.”); Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING.	Section 9.9 was completely rewritten. This comment was taken into consideration	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32807	17	12	17	19	Policies to improve efficiency can lead to a large amount of avoided emissions as demand for cooling grows. For instance, doubling the efficiency of new stationary air conditioners avoids 6 GtCO ₂ by 2030 and 29 GtCO ₂ by 2050. Up to 260 GtCO ₂ -e can be avoided with policies that encourage both maximum energy efficiency and use of low-GWP refrigerants. Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory (“For best-available-technology (or “maximum” efficiency), total savings to 2050 are 373.0 and 257.6 GtCO ₂ e for baseline (or static) electricity emission factors and decreasing emission factors, respectively (Fig. 1). Table S1 in the SI shows the GHG emissions for the reference case (no efficiency improvement and baseline HFC refrigerants) vs. the policy case of best-available technology (BAT) energy efficiency and low GWP refrigerants for 2030, 2040, and 2050 with static emission factors for both cases Reference case cumulative GHG emissions are 587.1 Gt CO ₂ e while the policy case is 214.1 Gt for an overall cumulative savings of 373.0 Gt CO ₂ e.”); Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING.	Section 9.9 was completely rewritten. This comment was taken into consideration	Kristin Campbell	Institute for Governance & Sustainable Development	United States of America
46811	17	12	17	22	Suggest to add that an increase in cooling is not only expected due to rise in temperature but also due to e.g. population growth, augmented comfort standards and changing lifestyles. Especially in developing countries in hot climates as shown by expected trends shown in e.g. - Üрге-Vorsatz D, Cabeza LF, Serrano S, Barreneche C, Petrichenko K: Heating and cooling energy trends and drivers in buildings. Renew Sustain Energy Rev 2015, 41:85-98 - Allouhi A, El Fouih Y, Kousksou T, Jamil A, Zeraouli Y, Mourad Y: Energy consumption and efficiency in buildings: current status and future trends. J Clean Prod 2015, 109:118–130.	Cooling was addressed now in a Box. This comment was considered.	Jessica Grove-Smith	Passive House Institute	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
33047	17	15	17	19	It should be noted that the use of thermal storage technologies is primarily related to energy cost reduction as opposed to minimizing energy consumption which is implied in the sentence.	This is not true; there is a lot of literature that show that energy storage (especially thermal energy storage) can increase energy efficiency of buildings	Melinda Yasarani Matara	Qatar Green Leaders	Qatar
36881	17	23	17	23	not too sure about the citation style! The whole manuscript should be checked for consistency	It will be done in the SOD and in the last draft of the manuscript.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
46813	17	23	17	31	Wording of paragraph is not very clear	This section has been rewritten since it was just a draft in FOD.	Jessica Grove-Smith	Passive House Institute	Germany
48195	17	23	17	31	I don't understand what this paragraph is saying	This section has been rewritten since it was just a draft in FOD.	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
42043	17	3			In this paragraph, a reference to aerothermy and geothermal pumps should be made	Technologies are assessed in detail in section 9.4.	Francisco Javier Hurtado A	European Patent Office	Germany
13549	17	17			The Davis and Certler paper does not deal with solar photovoltaic	Changed in the text	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
46805	17				This figure depicts on very specific example of energy services. There are many other possibilities e.g. for the heating system (it need not be a heat pump, quite often there are boilers) or there could be cooling. It would be good to mention that this is only an example, or to have either a more comprehensive overview of possible energy services.	The figure was redone.	Jessica Grove-Smith	Passive House Institute	Germany
2021	18	4	18	7	Do the information on this page match the information on page 8? See also comment no.7	Yes	Thomas Lützkendorf	Karlsruhe Institute of TEchnology (KIT) - Research University of Helmholtz Association	Germany
39437	18	4	18	19	Figure 9.7: It seems all variables have increased over time while Non-residential Direct emissions decreased in the first time step (1990-200) and then increases. If it is correct, it would be nice to clarify on that, tech/innovation or policy impact?	Technologies are discussed in 9.3 and policies in 9.9	Leila Niamir	MCC	Germany
42667	18	6	18	7	Embodied emissions from cement and steel can be related to energy, process or others (e.g. tranport). A clarification on the scope of the embodied emissions could bring more clarity for the reader	Clarified	Idriss KATHRADA	Novasirhe	France
2015	18	7	18	11	Information on cement and steel should not be shown in the caption as embodied CO2 emission in the sector. They do not represent the full part of "embodied GHG emissions" - see also previous comments.	Embodied removed from teh caption	Thomas Lützkendorf	Karlsruhe Institute of TEchnology (KIT) - Research University of Helmholtz Association	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
36883	18	12	18	12	1.Include citation please. 2. Fix the sentence please. See this below: In 2018, direct emissions from CH4 and N2O were, negligible compared to direct CO2 emissions with 18 0.01Gt of CH4 emissions and 0.0001 Gt of N2O emissions.	added "based on IEA data"	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
22357	18	20	18	20	A Chapter "9.2.4. District, neighborhood and urban space approaches" is missing: The so-called "user-investor dilemma" often arises in the energy-efficient renovation of rental apartments. In addition, conflicts of interest may arise due to requirements of social policy as well as for environmental and monument protection reasons, which reduce the cost-effectiveness of energy-efficient renovation. District concepts can avoid these conflicting goals and reduce disproportionate burdens. Energy requirements and emissions requirements should not only be aligned towards individual consumption units, but integrated supply solutions and neighborhood concepts should be strengthened. See: dena project Urban Energy Transition, Part A: General findings and recommendations, page 10 (Part B: Catalog of options for action and practical experience, Part C: Expert report on regulatory challenges). in German: https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2019/dena_UrbWE_W_Abschlussbericht_Gesamtversion.pdf	See section 9.9	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
13015	18	22	18	25	Suggest to add source for the information in this statement.	Clarified. Reference is made to IEA data	Mafalda Leite de Faria Coe	International Energy Agency	France
36885	19	6	19	6	".. Coal in power generation", does not read well. Can "in" be changed to "for"?	Corrected	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36887	19	9	19	9	"..increase of their". Can "of" be change to in?	Corrected	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36889	19	12	19	12	The only decrease in emissions observed was in the non-residential Eurasian building stock which might be due to the slow economic activity in the major countries in the region. This statement needs a citation to justify this claim.	Clarified	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
13017	19	23	19	25	This table seems to be drawing from the World energy outlook (according to the reference). Nevertheless, given that it points to historical data (up to 2018), suggest to resort to the IEA database on CO2 emissions from fuel combustion (http://data.iea.org/payment/products/115-co2-emissions-from-fuel-combustion-2018-edition-coming-soon.aspx).	Reference to IEA statistics made	Mafalda Leite de Faria Coe	International Energy Agency	France
25139	19	26	19	26	Replace "Macedonia" with "Republic of North Macedonia"	Corrected	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
36891	19	30	19	30	Hu and Cabeza, 2020, inconsistency in citation/reference.	Corrected	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
33805	19	23			Please cite baseline. Percentage change does not mean much without knowing the reference point, i.e. per capita emissions in 2018 alongside the change since 2010.	Table 9.3 replaced by Figure 9.8 replaces which includes baselines	Debra Roberts	EThekwini Municipality	South Africa
45225	20	7	20	21	The decomposition does not mention the fuel switching effect, i.e. the gains from switching from gas to electricity or electricity to solar thermal, does doing the decomposition by end-use mean that this effect is split across the technical efficiency effect and the CO2 intensity effect ?	Decomposition clarified	Timothy Goodson	International Energy Agency	France
39439	20	10	20	30	The role of "non-technological and behavioural" is missing. I would suggest to add "Lifestyle and Behavioural" box next to Activity. Which potentially could link to Chapter 5.	non-technological and behavioral aspects are addressed in 9.5	Leila Niamir	MCC	Germany
13551	20	17	20	21	Climate and climate variations could also be mentioned in the relevant activities. It helps understanding the trajectories. For instance in Europe, the difference between 2010 and 2018 might be partly explained by climatic conditions. According to the Odyssee Database, the residential energy consumption decline is app. 11% without correcting for climate, but only 5% when accounting for climatic conditions (between 2010 and 2018).	Clarified. Climate impact cannot be assessed because data provided by the IEA are already climate corrected.	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
13019	20	29	20	29	Figure legend: Refers to the residential sector, not sub-sector.	Figure removed	Mafalda Leite de Faria Coe	International Energy Agency	France
29115	20	29	20	29	Suggest deleting the 'logic'. Decomposition could be fine	"logic" deleted	Minal Pathak	Ahmedabad University	India
9411	20				considering four identities (Figure 9.8) including: - do not repeat "identity" in the list as well	Figure deleted	ANNA LAURA PISELLO	DEPARTMENT OF ENGINEERING - UNIVERSITY OF PERUGIA, ITALY	Italy
7997	21	13	21	13	[Recommended] a slight increase → an increase	Corrected	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
1563	21	19	21	19	Incomplete sentence? "Similarly, the positive correlation... [insert: in developing countries..]" ?	Paragraph deleted	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
29119	21	19	21	22	Is it only lack of policies? Or could these trends also reflect the very low demand in developing countries and the income effects	Paragraph deleted	Minal Pathak	Ahmedabad University	India
36893	21	21	21	21	"...these regions..", which? Be specific	Paragraph deleted	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
42669	21	26	21	28	If Committee on climate change 2018 or bibliography source provides a figure on the annual quantity in m3 or tonne of timber used in the building sector it could be helpful to have a better understanding of the potential of abatement	Data not available	Idriss KATHRADA	Novasirhe	France
2207	21	28	21	28	Please, add a new sentence "...in countries where the availability of timber is high."	Added, see box on biomass	Miguel Angel Sanjuán	Technical University of Madrid	Spain
12527	21	28	21	28	Please, add the following sentence after "(Committee on Climate Change, 2018).": In particular, the embodied impact factor for concrete ranges between 0.05 and 5.15 kg CO2e/kg material and for wood products it ranges between 0.29 and 1.02 kg CO2e/kg material (Basbagill et al 2013). Then, a low-carbon concrete mix design produced with a low-carbon Portland cement will be another alternative within the context of the Climate Change mitigation (Akbarnezhad and Xiao 2017; Sanjuán et al. 2019; Sanjuán et al. 2020; CEMBUREAU 2020; Argiz et al 2014; Argiz et al 2017)." J. Basbagill, F. Flager, M. Lepech, M. Fischer. Application of life-cycle assessment to early stage building design for reduced embodied environmental impacts, Building and Environment, Volume 60, 2013, Pages 81-92. https://doi.org/10.1016/j.buildenv.2012.11.009 . Akbarnezhad, A.; Xiao, J. Estimation and Minimization of Embodied Carbon of Buildings: A Review. Buildings 2017, 7, 5. https://doi.org/10.3390/buildings7010005 Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. Energies 2019, 12(12), 2346; https://doi.org/10.3390/en12122346 Sanjuán, M.Á.; Andrade, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake by Cement-Based Materials: A Spanish Case Study. Appl. Sci. 2020, 10, 339. https://doi.org/10.3390/app10010339 CEMBUREAU 2020. https://lowcarboneconomy.cembureau.eu/5-years-on/the-5c-approach/recarbonation/ Cristina Argiz; Miguel Ángel Sanjuán; Esperanza Menéndez. Coal Bottom Ash for Portland Cement Production. Advances in Materials Science and Engineering /Volume 2017 (2017), Article ID 6068286, 7 pages.	See 9.4.2	MORA PERIS PEDRO	Profesor Titular de Universidad de la ETSI Minas y Energía de la Universidad Politécnica de Madrid	Spain
48197	21	29	21	29	Clean biomass: I feel this is very contentious. While the growing of a tree might absorb an amount of carbon, which is released when burning it, it likewise has to be equally replaced. The rate of replacement for most biomass is less than the rate of demand. Further, there are very good studies looking at the impact of 'clean' biomass burning in Europe on local air pollution and the result has been a number of jurisdictions banning new wood burning systems.	Rephrased, see box on biomass	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
36895	21	30	21	30	(Ortwein 2016)(Ericsson and Werner, 2016), lack of consistency with the others	Corrected	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
33895	21	6			Please include second bar series with per capita energy demand, which highlights equity discrepancies. Separating out the residential and non-residential would also make it easier to interpret.	Will be included in SOD	Debra Roberts	EThekwini Municipality	South Africa
42045	21	25			"The use of biomass in the form of wood, IN PARTICULAR OF LOCALLY AVAILABLE WOOD, as a ..."	Rephrased, see box on biomass	Francisco Javier Hurtado A	European Patent Office	Germany
45227	22	1	20	2	It is not the biomass itself that is traditional, it is the way it is combusted/used, hence we prefer the terminology 'Traditional use of biomass', this helps to reinforce the point that the same energy resources can be used safely and efficiently given the right equipment. This comment applies to all uses of the wording 'traditional biomass' in the text	Rephrased, see box on biomass	Timothy Goodson	International Energy Agency	France
45229	22	13	20	17	It is not clear in this instance what the text is referring to by traditional biomass. Traditional use of biomass is characterised by low efficiency of combustion (due to low temperatures) and resulting high levels of pollutant and CO output, as well as a low efficiency of heat transfer.	Rephrased, see box on biomass	Timothy Goodson	International Energy Agency	France
1565	22	1	22	7	Here, the main problem of biomass should be addressed that land use for energy from biomass competes with land use for agriculture. This can be a very local problem.	See chapter 7	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
10011	22	1	22	7	In addition to Dixon et al. (2015), similar studies arguing for improved stoves and higher efficiency charcoal to deal with negative impacts of traditional biomass in the developing world, include: - Van de Ven, D. J., Sampedro, J., Johnson, F. X., Bailis, R., Forouli, A., Nikas, A., ... & Doukas, H. (2019). Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa. Environmental Research Letters, 14(9), 094001. - Taylor, R., Wanjiru, H., Johnson, O. W., & Johnson, F. X. (2019). Modelling stakeholder agency to investigate sustainable charcoal markets in Kenya. Environmental Innovation and Societal Transitions.	Suggested references included, see box on biomass	Haris Doukas	School of Electrical and Computer Engineering, National Technical University of Athens	Greece
37505	22	2	22	2	Here it states that global traditional biomass consumption decreased by 3% from 2010-2018	Unclear comment	Michiel Schaeffer	Climate Analytics	Netherlands
13399	22	27	22	29	On the global electricity demand increase: is it possible to have a breakdown of the main drivers? The fact that the main driver is increased access to electricity is surprising	Rephrased but drivers are analysed for overall emissions and not per end-use.	Thibaud Voita	IFRI	Germany
7999	22	33	22	33	[Recommended] a slight increase → an increase	Modified	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
37509	22	19	25	3	How can it be that energy demand in residences considers only electricity? Oil? Natural gas? Biomass? Kerosene? Solar thermal?	Rephrased	Michiel Schaeffer	Climate Analytics	Netherlands
13553	22	5			Suggestion for literature: Hanna et al. (2016), "Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves", reports on a Randomized-Control-Triad study on a policy providing clean stoves to Indian households. With a high quality methodology, they show how the policies failed in improving long-term conditions	Reference included, see box on biomass	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
13555	22	27			Not clear whether the electricity consumption is the total electricity consumption or the buildings electricity consumption	Clarified, see box on electrification	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
17095	23	1	23	2	Nice picture. Would be useful to distinguish OECD and non-OECD. Which will show that electricity demand in OECD countries is not growing.	Figure 9.10 provides data per energy carrier and region	Kornelis Blok	Delft University of Technology	Netherlands
31909	23	2	23	2	The legend for the figure seems incorrect. Digital devices cannot be taking up such a large share of the buildings demand.	The figure is based on IEA data. See box on digitalisation for further details	Ashok Sreenivas	Prayas (Energy Group)	India
36897	23	10	23	11	hot water electricity demand: not clear	Rephrased, see box on electrification	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36899	23	12	23	12	water electricity demand, not clear	Rephrased, see box on electrification	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
37507	23	17	23	22	The discussion of electricity use for heating in buildings needs context. How does that increase compare to heating energy from NG or oil or biomass in direct heating applications? Are efficient heat pumps an important part of this trend?	Clarified, see box on electrification as well as paragraphs on end-uses and on energy carrier	Michiel Schaeffer	Climate Analytics	Netherlands
33049	23	28	23	30	While the statement emphasizes the decrease of electricity demand for lighting, the narrative could shed light on what has led to this decrease. For example, it could be either due to an increase in lighting efficiency or behavioral changes or sufficiency or combination of all.	Rephrased, see box on electrification and section on end-use	Melinda Yasaranji Matara	Qatar Green Leaders	Qatar
42047	23	9			This paragraph should include a reference to the contribution of hot water tanks to load levelling in power networks, and the fruitful synergy with solar thermal DHW production	See section 9.4 on technologies	Francisco Javier Hurtado A	European Patent Office	Germany
32503	24	6	24	13	In a warming world with a growing population and expanding middle-class, the demand for cooling is projected to rise substantially. Currently, there are 3.6 billion cooling appliances, which is projected to rise to 9.5 billion by 2050, though up to 14 billion would be required to provide adequate cooling for all. University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All ("Considering per capita equipment penetrations at regional level, it becomes clear that 9.5 billion cooling appliances by 2050 will, on the current technology pathways, not be sufficient to deliver universal access to cooling, let alone meet the UN SDGs 2030 targets. Food and medicine loss in the supply chain will still be high; food poisoning from lack of cold chain and domestic temperature management will still be significant; farmers will lack market 'connectivity' or 'access'; hundreds of millions of people will not have safe, let alone comfortable, living or working environments; medical centres will not have temperature-controlled services for post-natal care, etc... By 2050, would require a total of 14 bn cooling appliances – an additional 4.5 bn appliances compared to the baseline forecast – or 4 times as many pieces of cooling equipment than are in use today."); Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING.	Rephrased and suggested reference included, see box on cooling	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
32505	24	6	24	13	At the same time, increased demand for air conditioning will increase energy demand that will thus require additional energy production. Energy efficiency, including in equipment efficiency like air conditioners, can reduce this demand and help limit additional emissions that would further exacerbate climate change. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Biardeau, L.T., Davis, L.W., Gertler, P., Wolfram, C., 2020. Heat exposure and global air conditioning. Nature Sustainability 3, 25–28 (“Air conditioning adoption is increasing dramatically worldwide as incomes rise and average temperatures go up. Using daily temperature data from 14,500 weather stations, we rank 219 countries and 1,692 cities based on a widely used measure of cooling demand called total cooling degree day exposure. India, China, Indonesia, Nigeria, Pakistan, Brazil, Bangladesh and the Philippines all have more total cooling degree day exposure than the United States—a country that uses 400 terawatt-hours of electricity annually for air conditioning.”).	Rephrased and suggested reference included, see box on cooling	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32507	24	6	24	13	Reducing climate emissions from air conditioning while meeting cooling needs will require solutions that deliver cooling using less energy, i.e., more efficiently. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING. Addition of cooling capacity for buildings is currently outpacing addition of solar generation capacity. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 10 (“A case in point is that last year (2017), our record year of solar growth, with 94 GW of total solar generation deployed globally, was eclipsed by the incremental load of new RACs added to the grid, estimated at approximately 100 GW.”); International Energy Agency (2019) Perspectives for the Clean Energy Transition: The Critical Role of Buildings (“In fact, since 2000, the rate of electricity demand in buildings increased five-times faster than improvements in the carbon intensity of the power sector.”).	Rephrased and suggested reference included, see box on cooling	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
32509	24	6	24	13	For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs (as mandated by the Kigali Amendment to the Montreal protocol) provides an opportunity for revising the technologies to further improve energy efficiency. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All.	Rephrased and suggested reference included, see box on cooling	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32809	24	6	24	13	The demand for cooling is projected to rise substantially. Currently, there are 3.6 billion cooling appliances, which is projected to rise to 9.5 billion by 2050, though up to 14 billion would be required to provide adequate cooling for all. University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All ("Considering per capita equipment penetrations at regional level, it becomes clear that 9.5 billion cooling appliances by 2050 will, on the current technology pathways, not be sufficient to deliver universal access to cooling, let alone meet the UN SDGs 2030 targets. Food and medicine loss in the supply chain will still be high; food poisoning from lack of cold chain and domestic temperature management will still be significant; farmers will lack market 'connectivity' or 'access'; hundreds of millions of people will not have safe, let alone comfortable, living or working environments; medical centres will not have temperature-controlled services for post-natal care, etc... By 2050, would require a total of 14 bn cooling appliances – an additional 4.5 bn appliances compared to the baseline forecast – or 4 times as many pieces of cooling equipment than are in use today."); Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING.	Rephrased and suggested reference included, see box on cooling	Kristin Campbell	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
32811	24	6	24	13	At the same time, increased demand for air conditioning can increase energy demand that will thus require additional energy production. Energy efficiency, including in equipment efficiency like air conditioners, can reduce this demand and help limit additional emissions that would further exacerbate climate change. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All.	Rephrased and suggested reference included, see box on cooling	Kristin Campbell	Institute for Governance & Sustainable Development	United States of America
32813	24	6	24	13	Reducing climate emissions from air conditioning while meeting cooling needs will require solutions that deliver cooling using less energy, i.e., more efficiently. Addition of cooling capacity in buildings is currently outpacing addition of solar generation capacity. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 10 ("A case in point is that last year (2017), our record year of solar growth, with 94 GW of total solar generation deployed globally, was eclipsed by the incremental load of new RACs added to the grid, estimated at approximately 100 GW."); International Energy Agency (2019) Perspectives for the Clean Energy Transition: The Critical Role of Buildings ("In fact, since 2000, the rate of electricity demand in buildings increased five-times faster than improvements in the carbon intensity of the power sector.").	Rephrased and suggested reference included, see box on cooling	Kristin Campbell	Institute for Governance & Sustainable Development	United States of America
32815	24	6	24	13	For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All.	Rephrased and suggested reference included, see box on cooling	Kristin Campbell	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
33051	24	14	24	15	The phrase in the sentence 'to address global warming' can be wrongly interpreted to mean 'a solution to global warming'. Suggest to rephrase as 'to address increased ambient temperatures resulting from global warming'	Corrected, see box on cooling	Melinda Yasarani Matara	Qatar Green Leaders	Qatar
32511	24	14	24	20	Increased demand for air conditioning will increase energy demand that will thus require additional energy production. Energy efficiency, including in equipment efficiency like air conditioners, can reduce this demand and help limit additional emissions that would further exacerbate climate change. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Biardeau, L.T., Davis, L.W., Gertler, P., Wolfram, C., 2020. Heat exposure and global air conditioning. Nature Sustainability 3, 25–28 (“Air conditioning adoption is increasing dramatically worldwide as incomes rise and average temperatures go up. Using daily temperature data from 14,500 weather stations, we rank 219 countries and 1,692 cities based on a widely used measure of cooling demand called total cooling degree day exposure. India, China, Indonesia, Nigeria, Pakistan, Brazil, Bangladesh and the Philippines all have more total cooling degree day exposure than the United States—a country that uses 400 terawatt-hours of electricity annually for air conditioning.”).	Rephrased and suggested reference included, see box on cooling	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32513	24	14	24	20	Reducing climate emissions from air conditioning while meeting cooling needs will require solutions that deliver cooling using less energy, i.e., more efficiently. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING. Addition of cooling capacity in buildings is currently outpacing addition of solar generation capacity. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 10 (“A case in point is that last year (2017), our record year of solar growth, with 94 GW of total solar generation deployed globally, was eclipsed by the incremental load of new RACs added to the grid, estimated at approximately 100 GW.”); International Energy Agency (2019) Perspectives for the Clean Energy Transition: The Critical Role of Buildings (“In fact, since 2000, the rate of electricity demand in buildings increased five-times faster than improvements in the carbon intensity of the power sector.”).	Rephrased and suggested reference included, see box on cooling	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
32515	24	14	24	20	For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs (as mandated by the Kigali Amendment to the Montreal protocol) provides an opportunity for revising the technologies to further improve energy efficiency. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All.	Rephrased and suggested reference included, see box on cooling	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32817	24	14	24	20	Reducing climate emissions from air conditioning while meeting cooling needs will require solutions that deliver cooling using less energy, i.e., more efficiently. Addition of cooling capacity in buildings is currently outpacing addition of solar generation capacity. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute, 10 (“A case in point is that last year (2017), our record year of solar growth, with 94 GW of total solar generation deployed globally, was eclipsed by the incremental load of new RACs added to the grid, estimated at approximately 100 GW.”); International Energy Agency (2019) Perspectives for the Clean Energy Transition: The Critical Role of Buildings (“In fact, since 2000, the rate of electricity demand in buildings increased five-times faster than improvements in the carbon intensity of the power sector.”).	Rephrased and suggested reference included, see box on cooling	Kristin Campbell	Institute for Governance & Sustainable Development	United States of America
32819	24	14	24	20	For energy efficiency as it pertains to appliances and space cooling, the transition away from high-GWP HFCs provides an opportunity for revising the technologies to further improve energy efficiency. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All.	Noted, later version addressed this.	Kristin Campbell	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
35675	24	21	24	24	Comparing figure 9.11 to the previous two figures (9.9 and 9.10) we see that the same units are used (EJ) to display the energy demand of buildings in different regions of the world. I note that the vertical axis is not scaled the same way in each figure. The total energy demand in 2018 (figure 9.9) is approximately 125 EJ, the total electricity demand in 2018 (figure 9.10) is just 20 EJ and the total cooling demand (figure 9.11) is approximately 3EJ. Because of the graphic decision not to have the same scale in each table, these tables hide the real challenge in buildings which is related to the heating demand. Cooling demand (which is just about 2% of the total energy demand) might, as a result, be over-emphasised for the reader and distract attention away from where the real effort is needed in our buildings, reducing energy demand for space heating. In this context, it is interesting to note that the energy demand for digital services, figure 9.12 is already substantially greater than for cooling.	Heating demand is discussed in the section on energy demand per end-use and also in the box on electrification	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
36901	24	26	24	26	Energy demand of digital appliances, should "of" be changed to "for"?	Corrected, see box on digitalisation	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36905	24	26	24	26	please, define digital appliances and state examples.	Clarified, see box on digitalisation	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36903	24	33	24	33	Energy demand of digital appliances, should "of" be changed to "for"?	Corrected, see box on digitalisation	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
45231	24	26	25	15	Would benefit from a definition of what is included in digital appliances, as a provider of the data I'm not certain the numbers provided correspond to specific 'digital' uses.	Clarified, see box on digitalisation	Timothy Goodson	International Energy Agency	France
13557	24	28			Suggestion for literature: Gertler (2016) "The Demand for Energy-Using Assets among the World's Rising Middle Classes", shows how the combination of rising incomes, income distribution and the S-curves of ownership rates will account for a rapidly rising demand for appliances and energy. Related paper: Wolfram (2012) "How Will Energy Demand Develop in the Developing World"	Suggested reference included	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
36909	25	3	25	3	"efficiency level" that has improved or what?	Clarified, see box on digitalisation	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
36907	25	5	25	5	include a footnote and list the digital appliances considered in Fig 9.12	Done, see box on digitalisation	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8001	25	9	25	9	[Recommended] delete "only"	"only" deleted	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36911	25	19	25	19	Provide full meaning of IIASA please	Full meaning of IIASA provided	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
2643	25	15	26	12	<p>About the size of settlements</p> <p>While obviously it is very difficult for megapoles to reach carbon neutrality autonomously, and while if achieved this would not necessarily be part of the optimal mitigation solution, this suggests nevertheless to look into the size issue and try to assess what are the preferred sizes (mainly in terms of population) in a mitigation perspective.</p> <p>From this viewpoint the present FOD does not provide answers. Quoted references are focused on population density rather than size and on US rather than the whole world. Still, there should exist an optimal range of sizes such that the settlement would be able to supply the services expected from a city, offering at the same time a maximum autonomy (food, energy) when considering the built area and the land surrounding it within easy reach riding a bike..</p>	Drivers are assessed in terms of population and floor are per capita	Philippe Waldteufel	CNRS/IPSL/LATMO S	France
8015	26	3	26	3	[Recommended] but unfortunately → but unfortunately,	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8003	26	3	26	7	<p>In the report, zero-carbon building is stated. and it says "most of the research and review are not related to climate change mitigation."</p> <p>First of all, the difference between zero-carbon building in this report and "general" zero-energy building we think has to be demonstrated. In general, as we don't feel that much different between the zero-carbon building and zero-energy building, so "most of the research and review are not related to climate change mitigation" is not convincing.</p>	Noted, later version addressed this.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36913	26	7	26	7	In addition to Artificial Intelligence and IoT, you may consider KNX (https://www.myknxstore.co.uk/)	Not relevant "KNX" is claimed to be a "standard for home and building control". Here we are not considering control standards, but the inclusion of artificial intelligence and internet of things in the building control methods used.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
36915	26	15	26	15	"of costs" does not read well	Changed to "examples of costs"	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8017	26	16	26	16	[Recommended] a buildings → buildings	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36917	26	16	26	16	"a buildings" , plural or singular?	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8019	26	24	26	24	[Recommended] in achieving → to achieving	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8005	26	25	26	27	In this report, the general technologies to achieve zero-energy building is suggested through a reference(Cabeza and Chafer, 2020). However, there are some more technologies including LED light, vacuum insulation, elevator regenerative braking system, etc. So, more references are need to back up this topic. And, as the topic of this paragraph is "technologies and solutions after AR5 report", it is not appropriate to list up original technologies to achieve zero-energy building.	The reference given is a review with more than 219 references itself, so it compiles a lot of literature on the topic. About the comment on listing technologies prior to AR5, here the technologies with research on the last years are highlighted, therefore the authors feel that the tables are addequate.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
12529	26	27	26	27	Please add the following paragraph: Please, add the following sentence: " It should be considered that the selection of the cement type will promote the carbon dioxide absorption (CEMBUREAU 2020; Sanjuán et al 2019). New cement constituents will increase the durability of the concrete structures and improve the carbon dioxide absorption (Argiz et al 2014; Argiz et al 2017)." CEMBUREAU 2020. https://lowcarboneconomy.cembureau.eu/5-years-on/the-5c-approach/recarbonation/ Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. <i>Energies</i> 2019, 12(12), 2346; https://doi.org/10.3390/en12122346 Cristina Argiz; Miguel Ángel Sanjuán; Esperanza Menéndez. Coal Bottom Ash for Portland Cement Production. <i>Advances in Materials Science and Engineering /Volume 2017 (2017)</i> , Article ID 6068286, 7 pages. https://doi.org/10.1155/2017/6068286 C. Argiz, E. Menéndez, A. Moragues, M. A. Sanjuán. "Recent advances in coal bottom ash use as a new common Portland cement constituent". <i>SEI - STRUCTURAL ENGINEERING INTERNATIONAL</i> , 2014. Vol 24 Nº 4, pp. 503-508. http://dx.doi.org/10.2749/101686613X13768348400518 .	The section on materials has been completely rewritten and this comments has been taked into account	MORA PERIS PEDRO	Profesor Titular de Universidad de la ETSI Minas y Energía de la Universidad Politécnica de Madrid	Spain

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
2209	26	28	26	28	<p>Please add the following paragraph:</p> <p>“The concept of structural thermal energy storage used for active-demand response (ADR) has arisen because the scientific literature has demonstrated a substantial benefit in pre-cooling and pre-heating of buildings under specific conditions, i.e. for a specific type of building, equipment, control setup, comfort range, time periods for pre-cooling or pre-heating, and limited season (heating and cooling season). Most studies focus on the benefits and possible limitations in term of energy consumption savings during grid peaks and discuss the requirements to use thermal mass to create flexibility on grid level to its full potential. The flexibility provided by the thermal mass of the building fabric can lead to significant benefits such as the balancing of the grid infrastructure (e.g. peak reduction up to 50% of cooling load), investment and operating cost savings (operational savings up to 40%) and CO2 emission reductions (up to 25% CO2-reductions per dwelling) (Thomas et al 2016)”.</p> <p>Yannick Thomas, Filip Grillet, Ruben Baetens, Joerie Alderweireldt. FINAL REPORT, STRUCTURAL THERMAL ENERGY STORAGE IN HEAVY WEIGHT BUILDINGS – ANALYSIS AND RECOMMENDATIONS TO PROVIDE FLEXIBILITY TO THE ELECTRICITY GRID. 3E Reference: PR109637 (www.3e.eu). 20/10/2016. 36 p. https://cembureau.eu/media/1249/3e_structuralthermalenergystorageheavyweightbuildings_2016-10-25.pdf</p>	Noted, later version addressed this.	Miguel Angel Sanjuán	Technical University of Madrid	Spain
17093	26	1	41	7	Please pay attention to the use of hydrogen in buildings (e.g. in fuel cells or hybrid heat pumps). Now, the word hydrogen is not even occurring in the entire chapter.	Added in Table 9.6	Kornelis Blok	Delft University of Technology	Netherlands
17101	26	1	41	7	Would developments in heat pumps not deserve a separate section as a key technology for heating buildings?	Thanks, but the length of the report does not allow us to consider each technology by itself, this is why it is all summarised in 4 tables	Kornelis Blok	Delft University of Technology	Netherlands
39543	26	1	41	27	Countermeasures to fluorinated gas should be mentioned somewhere.(shown as in https://iopscience.iop.org/article/10.1088/1755-1315/294/1/012003)	This is considered in Section 9.3.1.3 - Trends in halocarbons emissions	Shunsuke Kawagishi	Mitsubishi Research Institute	Japan
46815	26	22			With insulation being an incredibly important aspect of improving the thermal performance of buildings, it should be included in the tables 9.4 & 9.5 for walls and roofs. Another "common" and available passive technology is shading of windows (table 9.7? passive strategy to reduce solar loads and thus cooling demand).	Added in Table 9.4	Jessica Grove-Smith	Passive House Institute	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
46817	26	22			<p>Suggestion to add and point out the importance of prioritising efficiency measures to be able to reach zero carbon solutions. It is important to lower the energy demand in order to be able to achieve substantial coverage with renewable energy systems.</p> <p>Literature example: (Grove-Smith et al 2018) J. Grove-Smith, V. Aydin, W. Feist, J. Schnieders, S. Thomas, Standards and policies for very high energy efficiency in the urban building sector towards reaching the 1.5°C target. Current Opinion in Environmental Sustainability. 30 (2018), pp. 103–114</p>	All the chapter is organized with the idea of sufficiency-efficiency-renewables, which answers this comment.	Jessica Grove-Smith	Passive House Institute	Germany
13559	26	23			The section 9.4.2 currently misses an analysis of the technological trends: which technologies are new? Have there been some breakthroughs in the recent years? This would be especially useful to readers not familiar with the specific technologies	Added in the text	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
37511	27	0	29	0	These are nice illustrations of wall constructions, but missing seems to be any discussion of technical approaches such as Passivhaus that relies on both high insulating structures and very thorough air-sealing of the wall and other seams and joints. It's not just the structural elements, but how they are assembled that matters.	Noted, later version addressed this.	Michiel Schaeffer	Climate Analytics	Netherlands
35677	27			30	The construction elements shown in these tables are, firstly, not technologies in the usually understood meaning of the word. They are construction techniques that can contribute to reduce the energy demand of buildings. Secondly they are substantially incomplete as there are many many more construction techniques that contribute to improving energy performance in buildings. Thirdly, it seems illogical to include these tables in a report on climate change mitigation potential of buildings, at least in the manner that they are included in the FOD. If such information is to be retained in the report, it should be complete information and it should appear as an annex either to this chapter or to the report as a whole. A key point about the techniques shown is that once in place, they do not consume energy to function and this is a great advantage that needs to be pointed out in the narrative. Choosing to use non-energy consuming techniques first before relying on energy consuming equipment and controls is a sustainable way to provide comfortable, functional buildings.	This is already considered in Section 9.4.7	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39365	27			30	Solutions referred to in Table 9.4 and 9.5 are not technological. These are construction techniques which effectively reduce energy demand and the associated GHG emissions. They should be moved to the non-technological solutions which should be moved up as the non-technological solutions avoid the demand of energy which is as specified in the introduction the first step towards the decarbonisation of the building stock.	Authors do not agree with the reviewer. Any solution related to the building itself is technological	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
2017	27	1	33	1	Mit table 9.4. wird eine Tabelle mit different wall strategies angegeben. Angegeben werden u.a. energy savings in %. Es wird nicht empfohlen, diese Tabellen beizubehalten. Sie sind (1) zu detailliert und für einen IPCC-Bericht nicht geeignet, (2) Angaben zur Energieeinsparung in Prozent ohne Hinweis auf Klima und Nutzung sind nicht sinnvoll und (3) er fehlen Angaben zu Energieaufwand und Emissionen bei Herstellung und im weiteren Lebenszyklus.	These technologies are the first to be considered to mitigate climate change. The energy savings are averages from many data found in the literature (see original sources). Emissions in the production of building materials are considered in the Industry chapter	Thomas Lützkendorf	Karlsruhe Institute of TEchnology (KIT) - Research University of Helmholtz Association	Germany
795	27				Including additional references would strengthen the overall argument for this section- table 9.4. Applies to comments below many books have been written to include here regarding PH enclosures design from EU and U.S. i.e. Details for Passive House , as well as books regarding designing for climate change from UK i.e. Kate Puckeet and Bill Gething and other book, Climate Design Peter Droege, and numerous strategy examples from state and local entities such as Climate Resilience Strategies for Buildings in New York State etc...	The reference given is a review with more than 219 references itself, so it compiles a lot of literature on the topic. The table also includes a few references that give values in energy savings.	Ann Kosmal	U.S. General Services Administration	United States of America
9413	27				tab 9.4 very nice, about cool envelope, you should mention roofs and walls. Winter penalties should be better analyzed. They correspond to less than 1/5 of summer benefit. Also, thermal mass should be mentioned as envelope passive mitigation and greenhouses associated to thermal mass-capacity, before Trombe wall	Added in the text	ANNA LAURA PISELLO	DEPARTMENT OF ENGINEERING - UNIVERSITY OF PERUGIA, ITALY	Italy
797	29				Including additional references would strengthen the overall argument for this section- table 9.5.	The reference given is a review with more than 219 references itself, so it compiles a lot of literature on the topic. The table also includes a few references that give values in energy savings.	Ann Kosmal	U.S. General Services Administration	United States of America
37513	31	0	31	0	Advantages and disadvantages of heat pumps? Blank there now	Added in the text	Michiel Schaeffer	Climate Analytics	Netherlands

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
39865	31	3	31	3	<p>the line regarding "heat pump" is empty, so here are a few suggestions if you want to add elements on heat pumps.</p> <p>Reference : "DECARBONIZING SPACE HEATING WITH AIR SOURCE HEAT PUMPS" BY NOAH KAUFMAN, DAVID SANDALOW, CLOTILDE ROSSI DI SCHIO AND JAKE HIGDON. Columbia report, anonymously peer-reviewed according to Acknowledgements</p> <p>Heat pumps benefits : "Heat pumps can be a highly efficient way to satisfy space heating needs. The vaporcompression process allows for a high coefficient of performance (COP) when the desired space temperature is close to the ambient temperature. For example, when the ambient temperature is 60°F (about 15.5°C) and the desired space temperature is 68°F (about 20°C), the COP of an ASHP may be around four, meaning that for every unit of electricity consumed by the heat pump, four units of thermal energy are added to the conditioned space."</p> <p>Another reference on heat pumps COPs : Table 6 in Bianco, Vincenzo, Federico Scarpa, and Luca A. Tagliafico. 2017. "Estimation of Primary Energy Savings by Using Heat Pumps for Heating Purposes in the Residential Sector." Applied Thermal Engineering 114 (March): 938–47. Several heat pump COPs per region in Italy are shown, varying according the local climate, but all around 3. In order words, a heat pump has an efficiency around 300%, which means dividing electricity consumption by 3 compared to classic electric heating, and if it uses decarbonized electricity, it involves both significant energy savings and CO2 emissions reductions.</p> <p>Other co-benefits : using a heat pump for cooling purposes (air - air HP)or domestic hot water in addition to space heating (air-water HP) - air-water heat pumps can also provide some kind of cooling by running cold water through the</p>	<p>Thanks, the table has been completed and this has been taken into consideration</p>	<p>Bianka SHOAI-TEHRANI</p>	<p>RTE, CentraleSupélec</p>	<p>France</p>

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
39867	31	3	31	3	<p>Following on the previous comment, reference : "DECARBONIZING SPACE HEATING WITH AIR SOURCE HEAT PUMPS" BY NOAH KAUFMAN, DAVID SANDALOW, CLOTILDE ROSSI DI SCHIO AND JAKE HIGDON. Columbia report, anonymously peer-reviewed according to Acknowledgements</p> <p>Disadvantages of heat pumps</p> <p>" Barriers to ASHP adoption include the following:</p> <p>Costs. In many climates, ASHPs are more expensive than natural gas furnaces (both in terms of up-front and lifetime costs).</p> <p>Performance. The COP advantage of ASHPs is reduced in colder climates. Infrastructure. Many existing buildings were not designed for ASHPs. Installing an ASHP may require costly ductwork or other retrofits.</p> <p>Stock turnover. Furnaces and boilers can last for decades. Unless furnaces are retired before the end of their useful lives, demand for ASHPs in many existing buildings will be low.</p> <p>Status quo bias. Consumers are more likely to stick with the equipment they have, and the space heating market is dominated by furnaces. Moreover, most heating systems are replaced only after they have failed, leaving homeowners very little time to shop for a new technology.</p> <p>Short termism. Consumers place considerable weight on up-front costs, whereas a key advantage of ASHPs is their efficiency, which can reduce long-term costs.</p> <p>Principal-agent problems. Builders are rarely incentivized to pay higher up-front costs for energy efficiency, because those costs make homes more expensive. Purchasers heavily weight up-front purchase price over future costs in purchase decisions.</p> <p>Contractor familiarity. Many contractors and construction managers may not be trained to recommend or install ASHPs, especially in regions with low ASHP</p>	Thanks, the table has been completed and this has been taken into consideration	Bianka SHOAI-TEHRANI	RTE, CentraleSupelec	France
39869	31	3	31	3	<p>Following on the previous comment, regarding "Contractor familiarity": incorrect parameter setting can setting can lead to severe performance losses, "energy consumption can be 50% higher than in the best performances".</p> <p>Reference : Tejada, 2014 "Energy Consequences of Non-optimal Heat Pump Parameterization" International High Performance Buildings Conference</p> <p>Tejada De La Cruz, Alberto, Philippe Riviere, Dominique Marchio, Odile Cauret, and Anamaria Milu. 2017a. "Hardware in the Loop Test Bench Using Modelica: A Platform to Test and Improve the Control of Heating Systems." Applied Energy 188 (February): 107–20.</p>	Thanks, the table has been completed and this has been taken into consideration	Bianka SHOAI-TEHRANI	RTE, CentraleSupelec	France
39633	31		31		<p>Table 9.6 : Evaporative condensers - Disadv. Of frost formation is a separate issue and not directly linked to the technology. No details provided for heat pumps.</p>	The frost formation is a problem of this technology, so it should be included here. Details on heat pumps were added	SANJEEV JAIN	IIT DELHI	India

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
39635	31		31		Table 9.6 (last row) Disadv needs better elaboration as heat recovery systems are extensively being used in buildings with mechanical ventilation system.	Tables 9.4 to 9.8 summarize the literature found. Details on each technology cannot be addressed in the length constraints of the report	SANJEEV JAIN	IIT DELHI	India
39641	31		33		There is some repetition in Tables 9.6-9.8 and the distinction is not very sharp. There are also typos in text e.g. depending on the type of systems	Table were revised and sharpened	SANJEEV JAIN	IIT DELHI	India
799	31				Including additional references would strengthen the overall argument for this section- table 9.7.	The reference given is a review with more than 219 references itself, so it compiles a lot of literature on the topic. The table also includes a few references that give values in energy savings.	Ann Kosmal	U.S. General Services Administration	United States of America
13561	31				Table 9.6. I guess this is planned to be filled for the next draft, but it is strange to see nothing for heat pumps	Added in the text	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
2357	32	1	32	1	Thermal energy storage: "Expensive both in capital and operation costs". Operation cost does not necessarily increase, especially if electricity tariffs are flexible.	Corrected in the text	Dieter Boer	Universitat Rovira i Virgili	Spain
2359	32	1	32	1	Heat recovery: "Expensive both in capital and operation costs". Not clear that operation cost is increasing, as energy consumption is reduced.	Corrected in the text	Dieter Boer	Universitat Rovira i Virgili	Spain
2361	32	1	32	1	Ground coupled: "Expensive both in capital and operation costs". Not clear that operation cost is increasing, as energy consumption is reduced.	Corrected in the text	Dieter Boer	Universitat Rovira i Virgili	Spain
39637	32		32		Table 9.7 : Direct and Indirect evap. Cooling : Comparison with VCS is inappropriate; Desiccant Cooling also includes Solid desiccant materials which do not have the given disadvantages. Disadvantage of DEC : RH > 40% is not sacrosanct. Not effective for higher RH values.	Corrected in the text	SANJEEV JAIN	IIT DELHI	India
39639	32		32		Both desiccant and ejector cooling are heat driven systems	Agree, but the text does not say the contrary	SANJEEV JAIN	IIT DELHI	India
36919	32				Table 9.7, What is the meaning of COP?	Added in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
2363	33	1	33	1	Ground source heat pump / disadvantages: Efficiency may decrease over time, if heat extraction and rejection differ.	Added in the text	Dieter Boer	Universitat Rovira i Virgili	Spain
4525	33		33		Does solar energy also refer to solar thermal cooling?	Solar cooling added in the text.	Leonardo Barreto	Austrian Energy Agency	Austria
13407	33		33		District energy (heating and cooling) is mentioned here, but would probably deserve a deeper dive through the report, given its important potential and the infrastructure it requires	District energy is considered in the buildings chapter, but the infrastructure required goes to the urban chapter	Thibaud Voita	IFRI	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
801	33				Including additional references would strengthen the overall argument for this section- table 9.8.	The reference given is a review with more than 219 references itself, so it compiles a lot of literature on the topic. The table also includes a few references that give values in energy savings.	Ann Kosmal	U.S. General Services Administration	United States of America
13563	33				Table 9.8: District heating and cooling is not mentioned here, despite its potential relevance and importance in climate change mitigation. E.g. Lund et al. (2018) "The status of 4th generation district heating: Research and results"	This table was completely redone	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
46819	33				Heat pumps should be added (currently listed in table 9.6). Many other technologies are also available, the list is not exhaustive.	Tables 9.4 to 9.8 summarize the literature found. Details on each technology cannot be addressed in the length constraints of the report	Jessica Grove-Smith	Passive House Institute	Germany
8009	34	1	34	34	The trend of devices and lighting is demonstrated through various of references. It would be better if trends according to detailed characteristics is added. Especially, in the case of device, there are different characteristics among urban, rural, developed and developing countries. Also, Recommend including the new technology development reflecting the industrial trend.	Not relevant any more	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8021	34	2	34	2	[Recommended] a household → household	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39369	34	2	34	10	There is a lack of consistency: the period analysed in this section should match with the one included in the section on trends and drivers	This section has been rewritten and this comment was taken into consideration	Emmanuel RAUZIER	NGO Association negaWatt	France
8007	34	5	34	10	Table 9.9 is the result of driver decomposition analysis of appliances by type from 2000 till 2007. But the explanation of this table needs to be added(ex. activity : number of household, structure : (number of product)/(number of household), Efficiency : (Energy consumption)/(number of product).	This table has been removed from the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8023	34	6	34	6	[Recommended] used variation of → used a variation of	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8025	34	8	34	8	[Recommended] impact in the total energy intensity growth → impact on the total energy intensity growth	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8027	34	10	34	10	[Recommended] in the traditional → in traditional	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39367	34	11	34	13	The data used in table 9.9 seem old and do seem to match with those included in the previous section on trends	This part was removed since it is already covered in Section 9.3.	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
45233	34	11	34	13	Do not understand why the period 2000 to 2007 has been chosen for this analysis, also not clear if it is for the world or a regional subset. Happy to discuss the data and how to best present the effects, as it is surprising/wrong to have 0 energy efficiency gains from plug loads. We would also label plug loads as 'other plug loads'	This part was removed since it is already covered in Section 9.3.	Timothy Goodson	International Energy Agency	France
13021	34	12	34	13	Suggest to replace with more recent data, as the data in the table only goes up to 2007. The latest IEA Energy efficiency report may have some useful information (https://www.iea.org/reports/energy-efficiency-2019). Also note that the IEA Energy efficiency indicators database (http://data.iea.org/payment/products/120-energy-efficiency-indicators.aspx) has detailed information on both energy consumption and stocks and diffusion of appliances covering IEA member countries (not global) - a graph may possibly be more effective in communicating this message	This part was removed since it is already covered in Section 9.3.	Mafalda Leite de Faria Coe	International Energy Agency	France
36921	34	14	34	15	Ownership of appliances, the use of appliances, and the power demand of the appliances are key contributors (Jones et al. 2015). Contributors to what?	Changed in the text: "key contributors to domestic electricity consumption"	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
39371	34	14	34	24	There are some repetitions.	All text has been revised to eliminate repetitions.	Emmanuel RAUZIER	NGO Association negaWatt	France
13023	34	19	34	20	Suggest to revise sentence "Appliances consume electricity and not fuels (fossil or renewable), with a relatively high carbon footprint" - as this depends largely on a specific country's electricity mix	Text has been revised to: "Appliances used in developed countries consume electricity"	Mafalda Leite de Faria Coe	International Energy Agency	France
8029	34	20	34	20	[Recommended] Rapid increase → The rapid increase	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
48199	34	20	34	20	The appliance doesn't not have an operating carbon footprint, the electricity does. So, it is fair to say that appliances consume electricity and not fuels, which often have a relatively high carbon footprint.	Changed in the text	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
8031	34	22	34	22	[Recommended] the substantial increasing in → the substantial increase in	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8033	34	23	34	23	[Word spacing] 2019a).But → 2019a). But	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36923	34	23	34	23	space , before But	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
13401	34	24	34	26	Element missing in the sentence : "Research on energy efficiency... in different countries"	Changed in the text	Thibaud Voita	IFRI	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
36925	34	24	34	26	Research on energy efficiency for different appliances worldwide and showed that this research started in different time frames in different countries (Figure 9.13) (Cabeza and Verez 2020). This does not read well. It should be fixed	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
39373	34	25	34	35	I suggest that bibliometric research (like here) be moved to an annex.	Bibliometric analysis was used to review and assess the literature. Here, the findings of such assessment are shown with the purpose of the full report.	Emmanuel RAUZIER	NGO Association negaWatt	France
33053	34	30	34	31	The sentence 'An interesting point highlighted before is the relation between water consumption and appliances energy efficiency' seems out of place in the paragraph narrative.	Changed in the text	Melinda Yasararaji Matara	Qatar Green Leaders	Qatar
36927	34	33	34	34	this last one related to digital television or smart phones. This is not clear! Which one? Also, the sentence reads odd with "related" in the past tense	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
17099	34			35	Given that appliances and lighting are responsible for the majority of emissions (blue bar + part of yellow bar in Figure 9.7), I find just 2 pages for this topic insufficient. Figure 9.13 shows there is abundant literature after 2014!	The page availability in the report is very little, therefore all topics need to be treated in a very concise manner.	Kornelis Blok	Delft University of Technology	Netherlands
803	34				Including additional references would strengthen the overall argument for this section-9.4.3	Changed in the text	Ann Kosmal	U.S. General Services Administration	United States of America
13565	34				In the 9.9 Table title, is it really 2007 and not 2017?	This part was removed since it is already covered in Section 9.3.	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
37063	35	4	35	5	When analysing when research started in a country, it is interesting to see that in most cases, the research started after the policies were implemented or labelling standards were developed. This does not read well, especially with 2 "when" in one sentence	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
39375	35	6	35	7	The first energy label for domestic refrigerators in the EU was introduced in 1994-95.	Changed in the text	Emmanuel RAUZIER	NGO Association negaWatt	France
8035	35	12	35	12	[Recommended] the global → global	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39377	35	12	35	35	Data on consumption repeat those in the section on trends and the period analysed here is older than the one considered in the trends section. Analyses on trends should be all grouped in the trend section and should not repeated in other sections. It's enough to reference the trend section.	This part was removed since it is already covered in Section 9.3.	Emmanuel RAUZIER	NGO Association negaWatt	France
8037	35	14	35	14	[Recommended] decrease of energy → decrease in energy	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
1567	35	15	35	17	Addition to the text: there is also a phase out of linear fluorescent lamps and recently halogen lamps in the EU, following Ecodesign rules.	Thanks, added to the text	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
36929	35				Figure 9.13: These text fonts for all your Figures are Calibri while your in-text New Times Romans. you want to be consistent throughout	Formatting will be carried out following IPCC rules and recommendations	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36931	36	11	36	11	"This last one..." , which? be specific please! Please , rewrite the whole sentence to read better.	The whole sentence has been rewritten	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36933	36	14	36	14	You have to consider KNX the world's only open STANDARD for all applications in home and building control, ranging from lighting and blind control to systems for heating, ventilation, air conditioning, monitoring, alarming, water control, energy management, metering as well as household appliances, audio - AV and lots more. (https://www.energy-meter.co.uk/index.php?option=com_content&view=article&id=6&Itemid=111). You can consider this in section 9.4.4.1	Standards are not considered in this section of the chapter, but in the policies one.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
48201	36	14	36	14	I don't agree with this conceptualization of where smart buildings came from. The 'smart' concept has always been applied to the system communication with each other and users. I agree it might have been applied to HVAC first, with energy system and IOT devices following.	Agreed. Text revised	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
8831	36	9	37	29	It would be helpful to highlight and provide a quantitative result on the additional electricity demand from sensors, control systems and optimisation tools - how much do they eat up of the energy/electricity savings they bring? In addition, the benefits of sector coupling (buildings and power systems) should be spelled out more clearly, besides improving energy efficiency, such as grid integration of distributed renewables, advanced demand response techniques and integration of utility-scale renewable energy generators.	Literature was not found. But please visit the box on digitalisation to find trends	Saygin Değer	SHURA Energy Transition Center	Turkey
35679	36	9	37	29	Significant effort is being made by the construction sector to digitalise activities along the value chain. This includes the widespread use of building information modelling (BIM), mass-customisation through digital production methods, 3-D printing of elements of construction, use of robotics to reduce material waste and time on site etc. All of these digitalisation activities are overlooked in this section and should be included. Many of these emerging practices will assist in the decarbonisation of buildings when properly and intelligently deployed as briefly mentioned in section 9.4.6	Accepted. Considered in the digitalization box.	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39379	36	9	37	29	The digitalisation section should also include the digitalisation of the construction sector (3D printing..) which is expected to reduce GHG of buildings. See for reference: https://ec.europa.eu/growth/content/report-supporting-digitalisation-construction-sector-and-smes_en See also: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC116074/kjna29702enn.pdf	Accepted. Considered in the digitalization box.	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
16321	36	9			In Section 9.4.4 Digitalization in buildings (IoT and smart buildings), consider adding a short description of electrosensitivity and increased risk of morbidity (e.g. certain types of cancers) in vulnerable populations. There are not enough data generally to make recommendations, but including information on these topics will help to make the reader aware of the issue, which is to their benefit.	Accepted. Considered in the digitalization box.	Daniel Helman	College of Micronesia-FSM	Micronesia, Federated States of
13567	36				In figure 9.14: what are the buildings classes?	This figure has been removed from the text	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
8039	37	3	37	3	[Recommended] change of → change in	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36935	37	5	37	5	not good to start a sentence with "But"	Changed in the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8041	37	13	37	13	[Recommended] increase exposure → increased exposure	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
48203	37	14	37	14	This is not a well evidence trade-off. There are two important studies in the USA in California that have debunked this claim. Standard coil meters emit more electromagnetic radiation than the (yes higher but temporary) burst radiation of a smart meter. See: https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/smart-meters.html#a2 And: https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/current-health-topics/radiofrequency-and-health/smart-meter-and-cancer-risk-statement Please remove that statement or further qualify it as a risk that is less than the frequent daily use of mobile telephones - more common than smart meters.	Literature was not found. But please visit the box on digitalisation to find trends	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
8011	37	19	37	27	This paragraph refers to classification standard used in smart devices' monitoring. However, it is limited to suggest only the classification standard. So, recommend to demonstrate how these monitoring technologies are utilized for greenhouse gas reduction.	Accepted. Considered in the digitalization box.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8043	37	21	37	21	[Recommended] review on → review of	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
48205	37	32	37	33	The use of oil-based products, such as EPS and other foams, along with mineral rock (gypsum) and plasters are substantial and are a major component of building materials which are affixed to a building. These have not been estimated in terms of their production, but are likely amount to a substantial value.	Although the authors agree with the comment, at this time it was not possible to include absolutely all materials used in buildings	Ian Hamilton	University 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
8045	37	36	37	36	[Recommended] this frames → these frames	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
10731	37	36	37	37	The following red text should be added to the draft text; Concrete, a man-made material, is the most widely used building material, and directly takes up 15 to 27% of CO2 emitted under the cement production from the atmosphere during the decades long life of the building (Shinneider 2019).	This section has been completely rewritten and this concept has been included	NAOKI AOKI	Japan Cement Association	Japan
13115	37	30	38	7	authors do not reports the recent findings for reducing CO2 emission linked to concrete production. These include the carbon capture and sequestration in cement industry, the development of new cement based materials like, Limestone calcined clay technology (LC3), Alkali-activated Cement/concrete and geopolymer, etc.	This section has been completely rewritten and this concept has been included	Jean Noël Yankwa Djobo	Ministry of Scientific Research and Innovation/Local Materials Promotion Authority (MIPROMALO)	Cameroon
2019	37	30	38	27	Section 9.4.5. unilaterally focuses on embodied energy and embodied carbon in building materials/construction products. In particular, attention is drawn to bandwidths in the data with respect to selected products without addressing potential causes such as differences in electricity mix, differences in manufacturing processes, etc. The way data is presented is suitable for unsettling potential readers and users and questioning LCA as a method. It is surprising that there is no section dealing with the topic "embodied energy and embodied carbon in buildings". Such a section should address (1) the status of international standardization (including ISO 21931 and other standards within the group ISO TC 59 SC17), (2) the results of IEA EBC Annex 57 and the interim results of IEA EBC Annex 72, and (3) the state of the scientific discussion - see also Röck et al. from the introduction. New studies show that the proportion of "embodied emissions" in the life cycle already reaches 50% in the case of energy efficient buildings. Members of IEA EBC Annex 72 offer short-term support in the development of a proposal for a corresponding section.	This section has been completely rewritten and this concept has been included	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
805	37				Including additional references would strengthen the overall argument for this section-9.4.5	Agree, references were added	Ann Kosmal	U.S. General Services Administration	United States of America
8047	38	6	38	6	[Recommended] that is finding → that are finding	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
26117	38	8	38	26	The Chapter could benefit from the discussion of natural concrete alternatives, such as hemp, to reduce embodied carbon emissions in buildings sector. Some references that could be used: https://doi.org/10.1016/j.jclepro.2019.05.035 , http://dx.doi.org/10.1016/j.rser.2015.06.002 , https://doi.org/10.1016/j.promfg.2019.02.205 , http://dx.doi.org/10.1016/j.conbuildmat.2014.05.039	This section has been completely rewritten and this concept has been included	Mykola Shlapak	N/A	Ukraine

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
36939	38	8	38	26	All data in this section with units [MJ/Kg] , cannot be embodied energy. The units for embodied energy is energy units (MJ) and embodied energy intensity or embodied energy coefficients is [MJ/Kg]. Authors should correct this please.	This section has been completely rewritten and this concept has been included	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
37515	38	8	38	26	The comparisons made here of different embodied energies in terms of MJ/kg do not make much sense unless the mass of different building materials is related to its functionality as a structure or insulating element. That piece is missing.	This section has been completely rewritten and this concept has been included	Michiel Schaeffer	Climate Analytics	Netherlands
39381	38	8	38	26	The figures mentioned in this section could be placed in a table to facilitate the understanding	This section has been completely rewritten and this concept has been included	Emmanuel RAUZIER	NGO Association negaWatt	France
8013	38	12	38	26	This paragraph refers to examples of LCA analysis result of building materials by analyzing several references. Recommend that this part be written in table.	This section has been completely rewritten and this concept has been included	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36937	38	13	38	13	[2.58 MJ/Kg], this is not embodied energy. embodied energy unit is MJ. Are you sure, this is not embodied energy coefficient or embodied energy intensity. You need to reconsider this in the whole of this section. Also the example of china has been used. authors should investigate more and use exampoles from other developing countries especially sub saharan africa. check this: https://www.aimspress.com/fileOther/PDF/energy/20140102.pdf . there are many other publications about embodied energy for othder developoing countries. in drawing from the literature from developing countries make sure care is taking to clearly state the sources of embodied energy coefficients used in their computation.	This section has been completely rewritten and this concept has been included	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8049	38	18	38	18	[Recommended] accounted using → accounted for using	Agreed. Much of that discussion was left as a placeholder in the FOD and is explored in the SOD. This should be improved in SOD.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
30825	38	18	38	19	It is not substantiated, unnecessary and we believe it is untrue to say "Masonry is mainly accounted using a cradle to gate LCA, giving values....". (we believe ratio of cradle to gate EPDs to cradle to grave EPDS would be similar across materials - but it would be quite an undertaking to prove this - and in fact it is irrelevant). It is also unwise to provide a single number for masonry when masonry can be made from clay or stone or one of several forms of concrete. However to minimise amends, propose rewrite this to "Masonry has a range of values depending on how it is manufactured and what from, but an example when considered from cradle to gate has values...."	This section has been completely rewritten and this concept has been included	Claude Lorea	Global Cement and Concrete Association	Belgium

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
22359	38	27	38	27	<p>The energy consumption and greenhouse gas emissions over the entire life cycle should also be considered. Some of the key messages of a german study: The steering effect of existing building energy standards is limited. The specification of a building energy standard concerning the operation phase does not guarantee a saving in CO2 emissions or "KEA" (=accumulated energy expenditure) and does not lead to energy-optimized buildings over the entire lifecycle by itself. Depending on the selected heat supply and the implementation of photovoltaic systems, the energy expenditure within the building energy standards varies significantly. Decentralized energy generation by photovoltaic systems with direct energy use contributes to a massive reduction in energy consumption at no costs. Key technologies are heat pumps and district heating. Ventilation systems with heat recovery are a matter of comfort and only useful in combination with fossil heat supply.</p> <p>See: Boris Mahler, Simone Idler, Tobias Nusser, Johannes Gantner: Energy expenditure for building concepts in the entire life cycle. publisher: Federal Environment Agency, Dessau 2019. page 14 ff.</p> <p>In German with English summary.</p> <p>https://www.umweltbundesamt.de/publikationen/energieaufwand-fuer-gebaeudekonzepte</p>	This section has been completely rewritten and this concept has been included	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
36941	38	28	38	29	<p>This heading is too long and odd.</p> <p>Secondly, why focus on 3D printing?</p> <p>There are many methods of construction that can reduce emissions. Modern Methods of Construction (e.g. Off-site manufacture or prefabricated components) actually leads to lower emissions during construction.</p> <p>Also, this is a Western perspective only.</p> <p>If Modern Methods of Construction is considered in Africa, it will lead to job losses with low skill workers. If this happens, then may be potential job searchers will engage in other activities that will bring more emissions into the atmosphere. A balance writing style should be adopted.</p>	This section has been completely rewritten and this concept has been included	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
39383	38	28	38	40	This section could be beef-up, Cf comment 22	This section has been completely rewritten and this concept has been included	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
2211	38	36	38	36	<p>Please, add the following paragraph: "Some new concrete mix designs will be able to absorb a significant amount of carbon dioxide by a chemical process known as carbonation (Wang 2019; Sanjuán et al 2018). In particular, the type of cement will influence the carbon dioxide uptake potential (Goñi et al 2002). Carbonation rate is higher in blended cements (Andrade, 2020; Argiz et al 2014; Argiz et al 2017; Sanjuán et al 2019)."</p> <p>Wang, X.-Y. Impact of Climate Change on the Optimization of Mixture Design of Low-CO2 Concrete Containing Fly Ash and Slag. Sustainability 2019, 11, 3394. https://doi.org/10.3390/su11123394</p> <p>Goñi, S.; Gaztañaga, M.; Guerrero, A. Role of cement type on carbonation attack. J. Mater. Res. 2002, 17, 1834–1842. https://doi.org/10.1557/JMR.2002.0271</p> <p>Miguel Ángel Sanjuán, Esteban Estévez, Cristina Argiz, Daniel del Barrio. Effect of curing time on granulated blast-furnace slag cement mortars carbonation. Cement and Concrete Composites 90 (2018) 257–265. https://doi.org/10.1016/j.cemconcomp.2018.04.006</p> <p>Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. Energies 2019, 12(12), 2346; https://doi.org/10.3390/en12122346</p> <p>Cristina Argiz; Miguel Ángel Sanjuán; Esperanza Menéndez. Coal Bottom Ash for Portland Cement Production. Advances in Materials Science and Engineering /Volume 2017 (2017), Article ID 6068286, 7 pages https://doi.org/10.1155/2017/6068286</p> <p>C. Argiz, E. Menéndez, A. Moragues, M. A. Sanjuán. "Recent advances in coal bottom ash use as a new common Portland cement constituent". SEI - STRUCTURAL ENGINEERING INTERNATIONAL, 2014. Vol 24 Nº 4, pp. 503-508. http://dx.doi.org/10.2749/101686613X13768348400518</p>	This section has been completely rewritten and this concept has been included	Miguel Angel Sanjuán	Technical University of Madrid	Spain

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
12531	38	36	38	36	<p>Please, add the following paragraph: "Some new concrete mix designs will be able to absorb a significant amount of carbon dioxide by a chemical process known as carbonation (Wang 2019; Sanjuán et al 2018). In particular, the type of cement will influence the carbon dioxide uptake potential (Goñi et al 2002). Carbonation rate is higher in blended cements (Andrade, 2020; Argiz et al 2014; Argiz et al 2017; Sanjuán et al 2019)."</p> <p>Wang, X.-Y. Impact of Climate Change on the Optimization of Mixture Design of Low-CO2 Concrete Containing Fly Ash and Slag. Sustainability 2019, 11, 3394. https://doi.org/10.3390/su11123394</p> <p>Goñi, S.; Gaztañaga, M.; Guerrero, A. Role of cement type on carbonation attack. J. Mater. Res. 2002, 17, 1834–1842. https://doi.org/10.1557/JMR.2002.0271</p> <p>Miguel Ángel Sanjuán, Esteban Estévez, Cristina Argiz, Daniel del Barrio. Effect of curing time on granulated blast-furnace slag cement mortars carbonation. Cement and Concrete Composites 90 (2018) 257–265. https://doi.org/10.1016/j.cemconcomp.2018.04.006</p> <p>Sanjuán, M.Á.; Estévez, E.; Argiz, C. Carbon Dioxide Absorption by Blast-Furnace Slag Mortars in Function of the Curing Intensity. Energies 2019, 12(12), 2346; https://doi.org/10.3390/en12122346</p> <p>Cristina Argiz; Miguel Ángel Sanjuán; Esperanza Menéndez. Coal Bottom Ash for Portland Cement Production. Advances in Materials Science and Engineering /Volume 2017 (2017), Article ID 6068286, 7 pages https://doi.org/10.1155/2017/6068286</p> <p>C. Argiz, E. Menéndez, A. Moragues, M. A. Sanjuán. "Recent advances in coal bottom ash use as a new common Portland cement constituent". SEI - STRUCTURAL ENGINEERING INTERNATIONAL, 2014. Vol 24 Nº 4, pp. 503-508. http://dx.doi.org/10.2749/101686613X13768348400518</p>	This section has been completely rewritten and this concept has been included	MORA PERIS PEDRO	Profesor Titular de Universidad de la ETSI Minas y Energía de la Universidad Politécnica de Madrid	Spain
33055	38	43	38	43	Reference to work done by IEA Joint SHC Task 40 would be beneficial to this section. http://task40.iea-shc.org/	This section has been completely rewritten and this concept has been included	Melinda Yasaranji Matara	Qatar Green Leaders	Qatar
45087	38	43	38	46	In addition to net-zero energy buildings, relevant literature on net-zero exergy buildings and communities may also be relevant for the scope of the chapter, including the recent final report of IEA Annex 64 on "LowEx Communities - Optimised Performance of Energy Supply Systems with Exergy Principles (Annex 64)" that is available at < https://www.iea-ebc.org/projects/project?AnnexID=64 >	Communities are out of the scope for this chapter, they are considered in the "Urban" chapter	Siir Kilkis	The Scientific and Technological Research Council of Turkey	Turkey
36943	38		39		section 9.4.5 to 9.4.6, the english of these sections are below standard. It should be re-written.	This section has been completely rewritten and this concept has been included	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36945	38		39		section 9.4.7.1, the english is below standard and should be re-written	This section has been completely rewritten and this concept has been included	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
35681	38	42	40	1	I note that the exemplary buildings mentioned are all new buildings. It is essential to also refer to deep energy and positive-energy renovations of existing buildings to also demonstrate that they have a huge role to play. Also, as for earlier tables containing useful information, these exemplary buildings would be better formulated as an annexe and not as an interruption to the flow of the narrative in the Chapter	Added case study on retrofits	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39385	38	42	40	1	Could this section on pilote buildings be moved to an annex?	This is considered an essential part of the message to be given by the chapter. Moreover, other comments suggested to enhance this table.	Emmanuel RAUZIER	NGO Association negaWatt	France
33915	38		40		Building performance evaluation of low/net zero energy buildings should be included. See the emerging work in Indian green building market place that will be valid for many developing countries: - Gupta, R., Gregg, M., Manu, Vaidya, P and Dixit, M (2019) Customized performance evaluation approach for Indian green buildings, Building Research & Information, 47:1, 56-74	Noted, later version addressed this.	Rajat Gupta	Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
42049	38	7			At the end of this paragraph and in the context of the mentioning of bamboo and rammed earth, other materials suitable construction in developing countries could be mentioned, like materials of vegetal origin (thatching or straw), of animal origin (wool or feathers) or recycled materials (used tires, bumpers or newspapers).	This section has been completely rewritten and this concept has been included	Francisco Javier Hurtado A	European Patent Office	Germany
48207	38	28			Section 9.4.6 - This section could be expanded. There is a lot being done on pre-fabricated construction processes.	This section has been completely rewritten and this concept has been included	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
36947	39	5	39	5	Why have "bing" on Figure 9.15?	Sorry, it was a typo	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
791	39		39		Suggest capitalizing Passive House when referring to the standard - previously capitalized.	Changed in the text	Ann Kosmal	U.S. General Services Administration	United States of America
33907	39		40		The case studies included in Table 9.12 mention EPI but it is not clear if this is modelled or measured performance. Given the issue with performance gap (between modelled and measured performance), it is important to focus on measured EPI.	The cases are of measured EPI	Rajat Gupta	Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
33909	39		40		Please only include case studies in Table 9.12 which have proper post-occupancy evaluations done and these studies are published in peer reviewed papers. Including case studies of green buildings based on claims by designers or owners should not be encouraged in the IPCC report.	We are citing examples from peer reviewed literature.	Rajat Gupta	Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
13569	39				In table 12, first data row: What is EPI? Check units (mWh/m2)	Correct unit to kWh/m2 in first data row of table 12. Also add citation	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
46821	39				Built examples in different climate zones are documented in Schnieders, J., Eian, T.D., Filippi, M. et al. Design and realisation of the Passive House concept in different climate zones. Energy Efficiency (2019). https://doi.org/10.1007/s12053-019-09819-6	This examples are included in the figure. See the referenced paper	Jessica Grove-Smith	Passive House Institute	Germany
1569	40	3	40	3	An important point to stress here is that energy consumption by data centres is fastly growing, worldwide. Which can be a near-term threat for existing electricity infrastructure (network capacity) as wel as an even greater long-term threat for GHG reduction.	Accepted. Text revised. More data to come in the final draft.	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
39387	40	3	40	14	The section on datacentres needs to be further developed and backed up with data	Accepted. Text revised.	Emmanuel RAUZIER	NGO Association negaWatt	France
39643	40	10	40	13	Cooling energy is supposed to be much less than IT energy. A well designed data centre in tropical climates would have annualized values of 20%-40% of IT energy. Absorption cooling is not common in datacentres. Heat recovery part is not clear	Accepted. See box on cooling	SANJEEV JAIN	IIT DELHI	India
8051	40	12	40	13	[Recommended] In addition, the heat recovery → In addition, heat recovery	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
1571	40	15	40	15	A considerable share of the non residential building stock are warehouse/industrial/manufacturing/production buildings, which are different in terms of energetic characteristics. For example poor insulation, possibly from being exempted in new building codes, or absence of heating or cooling system. However electricity use can be significant, so for example energy management systems are still required. And these buildings are difficult to address because of a lack of data (also a general issue for all commercial and public buildings).	This was considered in the tables about technologies. But not really difference between building types was not done due to lack of data.	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
8833	40	15	40	24	There is no mention of cold storage facilities for the food industry, which are major drivers of energy demand and that come along with high potential to improve energy efficiency.	Industry is not for this chapter	Saygın Değer	SHURA Energy Transition Center	Turkey
8053	40	21	40	21	[Recommended] an increasing → increasing	Changed in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36949	40	13			heat recovery, should this be heat recovery system?	Not really, heat recovery is a concept, a heat recovery system is its implementation	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
807	40				Including additional references would strengthen the overall argument for this section-.9.4.7.3	Accepted. Text revised	Ann Kosmal	U.S. General Services Administration	United States of America
36951	41	9	41	9	Mitigation non-technological options and strategies does not read well. Could it be non-technological mitigation options and strategies?	Accepted - text changed.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
25141	41	11	41	16	Delete "Broadly speaking, ... technical mitigaion measures." as this is a repetition (see p. 5)	Unclear - I do not see a comment by this reviewer in p.5, but p.5 is the introduction and therefore more general. Some definitions are appropriate in this section.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
37517	41	13	41	14	"efficiency" behaviours, which are one-time decisions to adopt low carbon solutions such as installing solar panels, " cannot be considered as a non-technological intervention	Unclear - The reviewer's statement is not supported by references or reasoning. In any case, the title of section 9.5 has been updated.	Michiel Schaeffer	Climate Analytics	Netherlands
8055	41	18	41	18	categorization	The language will be revised for coherence through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8057	41	22	41	22	categorized	The language will be revised for coherence through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8059	41	23	41	23	organizational	The language will be revised for coherence through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8061	41	23	41	23	[Recommended] shared economy → sharing economy	Accepted - text changed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8063	41	27	41	27	organizational	The language will be revised for coherence through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36953	41	30	41	31	Factors of 3 to 10 differences were found worldwide in non-residential and residential energy use for buildings with same function, occupancy and comfort levels. This does not read well	Accepted - text changed.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8065	41	32	41	32	[Recommended] with same function → with the same function	Accepted - text changed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8067	41	41	41	41	[Typo] in the long term → in the long term	Accepted - text changed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39389	41	9	47	32	These Non-technological options and strategies are referred and belong to sufficiency measures as defined in the introduction section. Could this section be described as sufficiency measures? The two paragraphs are inconsistent and the overall section is inconsistent and an important part of the section is solely dedicated to behavior change. Clarifying what this section is about would help the reader understanding its relevance in terms of carbon mitigation.	Noted - Section 9.5 includes sufficiency but goes beyond. These and other paragraphs have been rewritten to make this clear.	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
35683	41	9	48	4	This whole part is, in effect, a discussion of energy sufficiency and should therefore carry that title. It would be useful to fully review the section to ensure consistency and to check that all matters addressed are fully emerging from research on energy sufficiency and not from other forms of research.	Noted - Section 9.5 includes sufficiency but goes beyond, at the same time, sufficiency also goes beyond lifestyles and includes e.g. wellbeing, routines and infrastructures. These and other paragraphs have been rewritten to make this clear.	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39395	41	9	49	11	The section on non-technological solutions and low-carbon economy should be merged with first the definition of sufficiency, followed by different non-technological solutions which contribute to reduction carbon emissions. A balance between different solutions should be kept and the focus on behavior should be avoided, see references included in comment 28 about the contribution of behavior versus other non-technological solutions to carbon reductions	Noted - Section 9.5 has been reordered. The references have been included in the Chapter.	Emmanuel RAUZIER	NGO Association negaWatt	France
8069	42	6	42	6	[Recommended] An interest on electricity use → An interest in electricity use	Accepted - text changed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8071	42	13	42	13	[Recommended] other indicators of size → other indicators of a size	Editorial, thank you	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
25143	42		42		Table 9.13 to present information on renewables and not on "green" power	Noted - Although we understand the point, the table is based on the information that the literature can provide. At the same time, the table addresses end uses, services and fuels, whereas renewable energy sources on-site would be technologies.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
34827	42		42		Authod(s) should consider redrawing the "Table 9.13 Key determinants of buildings energy demand for end uses, services and fuels. It looks awkward	Accepted - The figure has been updated, but the feedback from the reviewer is rather unprecise.	Onema Adojoh	Missouri University of Science and Technology, Rolla, USA	United States of America
39441	42	15	43	17	Table 9.13, the literature requires improvement. See these empirical studies, particularly for Building, Demographic and Behavioural characteristics: Niamir, Ivanova, et al. 2020 (https://doi.org/10.1016/j.erss.2019.101356) ; Niamir, Kisewetter, et al. 2020 (https://doi.org/10.1007/s10584-019-02566-8) ; Ameli & Brandt 2015 (https://iopscience.iop.org/article/10.1088/1748-9326/10/4/044015/meta) ; Mills & Schleich 2012 (https://doi.org/10.1016/j.enpol.2012.07.008) ; Abrahamse & Steg 2009 (https://doi.org/10.1016/j.joep.2009.05.006); ...	Accepted - References included where appropriate in the chapter (not necessarily in this table).	Leila Niamir	MCC	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
39391	42	1	44	42	The discussion included in this section should be based on the analyses of the drivers in 9.2 and estimates of mitigation potential of each driver should be provided to allow policy-makers a better understanding of the main drivers, see for reference: https://www.carbone4.com/wp-content/uploads/2019/06/Publication-Carbone-4-Faire-sa-part-pouvoir-responsabilite-climat.pdf and https://europeanclimate.org/content/uploads/2019/11/09-18-net-zero-by-2050-from-whether-to-how.pdf	Noted - The drivers of Section 9.2 are provided are macro-level. Potentials and costs are provided in Section 9.6, whereas this section provides insights from many bottom-up studies. We have made clear how these sections differ from Section 9.5.2 and incorporated the suggested references.	Emmanuel RAUZIER	NGO Association negaWatt	France
8073	43	1	43	1	[Typo] (Chen and Pitt 2017)) → (Chen and Pitt, 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8075	43	1	43	1	[Typo] (Filippini and Hunt 2012)) → (Filippini and Hunt, 2012)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8077	43	1	43	1	[Typo] (Molinos-Senante et al. 1 2016)) → (Molinos-Senante et al., 1 2016)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8079	43	2	43	2	[Typo] (Sreekanth et al. 2011)) → (Sreekanth et al., 2011)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8081	43	2	43	2	(Summerfield et al. 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8083	43	2	43	2	[Typo] (Tilov et al. 2019)) → (Tilov et al., 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8085	43	2	43	2	[Typo] (Xing et al. 2015)) → (Xing et al., 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8087	43	2	43	2	(Zhang and Lahr 2018)) → (Zhang and Lahr, 2018)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8089	43	2	43	3	Bernstein & Madlener 2011; Asche et al. 2012; Brounen et al. 2012	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8091	43	3	43	3	(Harold et al. 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8093	43	3	43	3	[Typo] (Aghdaei et al. 2017)) → (Aghdaei et al., 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8095	43	3	43	3	[Typo] (Couture, 2012 → (Couture, 2012)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8097	43	3	43	3	(Couture et al. 2012) → (Couture et al., 2012)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8099	43	4	43	4	[Typo] (Engvall et al. 2014)) → (Engvall et al., 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8101	43	4	43	4	[Typo] (Fazeli et al. 2016)) → (Fazeli et al., 2016)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8103	43	4	43	4	[Typo] (Lasshof and Stoy 2016); → (Lasshof and Stoy, 2016)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8105	43	4	43	4	[Typo] (Lindberg et al. 2019)) → (Lindberg et al., 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8107	43	4	43	4	[Typo] (Rafiee et al. 2019)) → (Rafiee et al., 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8109	43	4	43	5	[Typo] (Surmann and Hirsch 2016)) → (Surmann and Hirsch, 2016)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8111	43	5	43	5	[Typo] (Weber and Gill 2016)) → (Weber and Gill, 2016)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8113	43	5	43	5	(Singh et al. 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8115	43	5	43	5	[Typo] (Bissiri et al. 2019)) → (Bissiri et al., 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8117	43	5	43	5	[Typo] (Hansen 2016)) → (Hansen, 2016)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8119	43	6	43	6	[Typo] Ali, 2011 → (Ali, 2011)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8121	43	6	43	6	[Typo] (Ayoub 2019)) → (Ayoub, 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8123	43	6	43	6	[Typo] Oh, 2019) → (Oh, 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8125	43	6	43	7	[Typo] ((Rosenberg 2014)) → (Rosenberg, 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8127	43	7	43	7	[Typo] (Ayoub 2019)) → (Ayoub, 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8129	43	7	43	7	(Kavousian et al. 2015a);	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8131	43	7	43	7	[Typo] (Arawomo 2019)) → (Arawomo, 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8133	43	7	43	8	[Typo] (Makki et al. 2013a)) → (Makki et al., 2013a)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8135	43	8	43	8	[Typo] (Asci et al. 2017)) → (Asci et al., 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8137	43	8	43	8	[Typo] (Ashoori et al. 2016)) → (Ashoori et al., 2016)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8139	43	9	43	9	[Typo] (Dhungel, 2014; Dhungel, 2014) → (Dhungel, 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8141	43	9	43	9	[Typo] (Ghavidelfar, 2017)Ghavidelfar, 2017) → (Ghavidelfar, 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8143	43	9	43	11	[Typo, Add () to every quotation] Motlagh, 2017; Yao, 2014; Sakah, 2019; Romero-Jordan, 2016; Romero-Jordan, 2014; Rhodes, 2014; Ye, 2018; Karuppusamy, 2014; Silva, 2017; Cetinkaya, 2015; Cuddington, 2015; Arisoy, 2014; Gautam, 2018; Okajima, 2013; Labandeira, 2012; Zhou, 2013; Shen, 2017; →(Motlagh, 2017)(Yao, 2014)(Sakah, 2019) (Romero-Jordan, 2016)(Romero-Jordan, 2014)(Rhodes, 2014)(Ye, 2018)(Karuppusamy, 2014)(Silva, 2017)(Cetinkaya, 2015)(Cuddington, 2015)(Arisoy, 2014) Gautam, 2018)(Okajima, 2013)(Labandeira, 2012)(Zhou, 2013)(Shen, 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8145	43	14	43	15	[Typo, Add () to every quotation] Altinay, 2016, Burke, 2016, Chalal, 2017, Harold, 2015, Kontokosta, 2017, Li, 2018, Lim, 2019, Majcen, 2013, Malzi, 2019, Oliver, 2016; Payne, 2011; Steadman, 2014; Tian, 2015; Tian, 2016; Yu, 2014; Propane: Shenoy, 2011; →(Altinay, 2016)(Burke, 2016)(Chalal, 2017)(Harold, 2015)(Kontokosta, 2017)(Li, 2018)(Lim, 2019)(Majcen, 2013)(Malzi, 2019)(Oliver, 2016)(Payne, 2011)(Steadman, 2014)(Tian, 2015)(Tian, 2016)(Yu, 2014)(Propane: Shenoy, 2011)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8147	43	15	43	15	[Typo] Kristofel, 2016; → (Kristofel, 2016);	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8149	43	16	43	16	[Typo] Gillingham, 2019.→(Gillingham, 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8151	43	20	43	20	[Typo] (Tol et al. 2012;)(Harold et al. 2015)) → (Tol et al., 2012)(Harold et al., 2015).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8153	43	22	43	22	(Ouyang et al. 2014).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8155	43	23	43	23	[Recommended] whereas cooling load are of a more intermittent nature. → whereas cooling load are more intermittent nature.	Editorial, thank you	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
6059	43	28	43	28	(Huang 2015; ...	The citations will be homogeneously edited through the report before final publication.	Andreas Oberheitmann	FOM University of Applied Sciences	Germany
8157	43	28	43	29	(Huang 2015)(Miah et al, 2011; Feng et al 2011; Zhao et al. ,2012; Huang, 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8159	43	29	43	29	(Niu et al, 2012)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8161	43	30	43	30	urbanization	The language will be revised for coherence through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8163	43	33	43	34	(Mashhoodi et al. 2019)→(Mashhoodi et al., 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39443	43	36	43	52	The literature requires improvement. Recent and relevant publications are missing: #1) Niamir, et al. 2020 (https://doi.org/10.1016/j.erss.2019.101356) show among dwelling characteristics, the type, size, and age of the residence have a strong influence on residential energy investments and conservation. #2) Ameli & Brandt 2015 (https://iopscience.iop.org/article/10.1088/1748-9326/10/4/044015/meta) and Mills & Schleich 2012 (https://doi.org/10.1016/j.enpol.2012.07.008) and Michelsen & Madlener 2012 and ... are also emphasize on type of building as well as the location (rural vs. urabn area).	Accepted - References included where appropriate in the chapter (not necessarily in this table).	Leila Niamir	MCC	Germany
46823	43	41	43	43	Clarification needed: Is it the "specific" electricity consumption is higher in multifamily buildings i.e. the energy with respect to floor area or per falt or per occupant? Or is it the "absolute" electricity consumption?	Accepted - text changed.	Jessica Grove-Smith	Passive House Institute	Germany
8165	43	42	43	42	[Recommended] town houses → townhouses	The language will be revised for coherence through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8167	43	43	43	43	(Kavousian et al, 2013)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8169	43	44	43	44	(Harold et al. 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8171	43	44	43	45	[Typo] (Brounen et al. 2012; → (Brounen et al., 2012)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8173	43	45	43	45	(Kavousian et al. 2013)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8371	43	45	43	45	[Typo] "Harold et al." is repeated twice	We have erased the repetition.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8175	43	47	43	48	(Mangold et al, 2016; Osterbring et al, 2018)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8177	43	49	43	49	home owners→homeowners	The language will be revised for coherence through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8373	43	49	43	49	[Typo] "Harold et al." is repeated twice	We have erased the repetition.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8179	43	49	43	50	(Meier & Rehdanz 2010, Harold et al, 2015) → (Meier & Rehdanz, 2010)(Harold et al., 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13573	43	49	43	52	Suggestion for literature: Gillingham (2012) Split Incentives in Residential Energy Consumption. Davis (2012) Evaluating the Slow Adoption of Energy Efficient Investments: Are Renters Less Likely to Have Energy Efficient Appliances?	Accepted - The suggested references have been included (not necessarily in this subsection).	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
46825	43	50	43	52	Seems to be contradiction within the sentence. Possibly replace "...also consume more electricity" with "...still consume more electricity"	Accepted - text changed.	Jessica Grove-Smith	Passive House Institute	Germany
8181	43	51	43	52	(Kavousian et al. 2015b; Huang 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13571	43	18			9.5.2.1: A discussion of the impact of temperature on thermal comfort and work productivity, which in the end drives energy demand, might also enrich the section. (Fanger, 1970 Thermal Comfort. Analysis and Applications in Environmental Engineering), Nicol and Humphreys (2002) Adaptive thermal comfort and sustainable thermal standards for buildings, (Hsiang, 2010) Temperatures and cyclones strongly associated with economic production. For more references on that topic: Levesque et al(2019) "Halving buildings energy demand from buildings: The impact of low consumption practices".	Noted - As the report focuses on climate mitigation science from AR5, some of the suggested references are disregared for being unspecific or old. The Levesque reference has been incorporated to Chapter 9 (not necessarily in this section).	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
13575	44	2	44	9	The work of Roger Fouquet is highly relevant here. For an entry point: Fouquet(2014) Long-Run Demand for Energy Services: Income and Price Elasticities over Two Hundred Years	Rejected - As the report focuses on climate mitigation science from AR5, the suggested reference is disregarded for presenting results for the time period 1800-2000.	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
39445	44	2	44	21	The literature requires improvement #1) See socio-demographic analysis in Niamir, et al 2020. #2) Regarding L16018: The evidence regarding the impact of age of household is mixed: some studies suggest that there is a negative correlation (e.g. Li et al 2017 (https://doi.org/10.1016/j.apenergy.2017.06.067); Mahapatra 2008 (https://doi.org/10.1016/j.enpol.2007.10.006)) , other studies report that middle-aged people are more active in this regard compared to youngsters. #3) In contrast of L18-19, our empirical study (Niamir, et al 2020) highlighted educated households are more active in improving their energy efficiency. Basically, a higher level of education enables more insight, knowledge, and awareness of environment–climate–energy issues, which all consequently affect personal norms and lead to behavior change.	Accepted - The suggested references have been included (not necessarily in this subsection).	Leila Niamir	MCC	Germany
48209	44	2	44	21	While I think it is important to highlight there are differences among demographics and energy consumption, I am not sure how universal these are. There will be considerable differences between family structures and the amount of energy services required depending on the countries they are within.	Noted - the text has changed.	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
8183	44	3	44	3	(Kavousian et al. 2015b)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8185	44	4	44	4	(Ouyang et al. 2014; Andr and Carvalho 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8375	44	4	44	4	[Typo] (Ouyang et al. 2014; Andr and Carvalho 2014) → (Ouyang et al., 2014 ; de Maria Andre and Carvalho, 2014).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
6061	44	7	44	7	Why is energy demand e.g. in Ireland so income elastic?	Accepted - text changed.	Andreas Oberheitmann	FOM University of Applied Sciences	Germany
8187	44	7	44	8	(MacNaughton et al. 2018)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
46827	44	11	44	11	Clarification would be beneficial: What is consumed more? Energy? Electricity? Water?	Noted - the text has changed.	Jessica Grove-Smith	Passive House Institute	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
4527	44	11	44	21	The influence of energy poverty in energy consumption patterns in buildings could be briefly mentioned here as a link to 9.8.4.1. For instance, it could be briefly mentioned that "energy poor households experience inadequate levels of essential energy services (...) due to a combination of high energy expenditure, low household incomes, inefficient buildings and appliances, and specific household energy needs" (Bertoldi, 2020, https://www.cares.eu/fileadmin/cares/PublicArea/Joint_workshop_presentations/Session_6_JRC_Energy_Poverty.pdf).	We have linked to Section 9.8.4.	Leonardo Barreto	Austrian Energy Agency	Austria
8189	44	12	44	12	(Harold et al. 2015)(Brounen et al., 2012; Harold et al 2015)	We have deleted the repetition.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13403	44	12	44	13	Element missing in the sentence : "Retired occupants... status and males"	Indeed, we have updated the sentence.	Thibaud Voita	IFRI	Germany
46829	44	13	44	13	The adjective is missing: More or less water consumption?	Indeed, we have updated the sentence.	Jessica Grove-Smith	Passive House Institute	Germany
8191	44	13	44	14	(Makki et al, 2013; de Maria Andre and Carvalho, 2014; Kavousian et al, 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8193	44	15	44	16	(Bedir et al, 2013; Kavousian et al, 2013; 2015; Huang, 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8195	44	15	44	18	(Huang 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8197	44	19	44	19	(Hidalgo et al, 2018; Harold et al., 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8199	44	21	44	21	(Makki et al. 2013b)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8201	44	26	44	27	(Harold et al. 2015; Hidalgo et al. 2018)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8203	44	28	44	28	(Li et al. 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8205	44	30	44	30	[Recommended] have significant impact → have a significant impact	We have updated the sentence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8207	44	31	44	31	(Khosla et al. 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8209	44	32	44	32	(Kavousian et al. 2015b)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39447	44	32	44	42	#1) Link to Chapter 5 ; #2) See Niamir, et al. 2018 (https://doi.org/10.1016/j.enpol.2018.03.045) ; Rai & Rabinson 2015 (https://doi.org/10.1016/j.envsoft.2015.04.014) ; Niamir et al. 2020 (https://doi.org/10.1007/s10584-019-02566-8) regarding households energy behavioral change modeling, awareness, personal and social dynamics ; #3) See Poortinga & Steg 2004 (https://doi.org/10.1177/0013916503251466) and Niamir & Filatova 2016 (https://scholarsarchive.byu.edu/iemssconference/2016/Stream-A/74/) particularly on awareness (L32-36)	We have included these references where appropriate in the chapter (not necessarily in this subsection). The link to Chapter 5 is already made in the beginning of Section 9.5.	Leila Niamir	MCC	Germany
36955	44	33	44	33	demonstrated that efficient behaviour leads to more efficient behaviour. This does not read well.	We have rewritten the sentence.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8211	44	34	44	34	[Recommended] to higher awareness of their PV systems → to a higher awareness of their PV systems	We have rewritten the sentence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8213	44	41	44	41	(Shipworth, 2013; Gaetani et al. 2016;)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
46835	44	42	44	42	<p>The question of relative impact of design-driven and behaviour driven energy savings is highly critical, yes. It would be useful to include an indication as part of this report. It depends, of course somewhat on the energy use, on the building typology and the climate but with regard to heating and cooling there is substantial evidence to show that design driven measures have significantly higher energy saving potentials than relying only on behavioural change:</p> <p>" With respect to the user influence, Pitts [70] notably points out that "... occupants have relatively less impact on building performance in very low energy design than other types". Statistical analysis proves that the differences in absolute energy consumption caused by user influence in highly efficient buildings is significantly smaller and becomes almost negligible in comparison to the achieved savings of effective energy efficiency measures [42]."</p> <p>Citation from: J. Grove-Smith, V. Aydin, W. Feist, J. Schnieders, S. Thomas, Standards and policies for very high energy efficiency in the urban building sector towards reaching the 1.5°C target. Current Opinion in Environmental Sustainability. 30 (2018), pp. 103–114</p> <p>[70]: Pitts A: Passive House and low energy buildings: barriers and opportunities for future development within UK practice. Sustainability 2017, 9:272.</p> <p>[42]: Feist W, Ottinger O, Peper S: Energy consumption — a comparison between predicted and measured performance. In Proceedings of 9th International Conference Improving Energy Efficiency in Commercial Buildings and Smart Communities (IEECB&SC'16). Edited by Bertoldi P. Proceedings of 9th International Conference Improving Energy Efficiency in Commercial Buildings and Smart Communities (IEECB&SC'16) 2016:935-948.</p>	We have updated the text and included the suggested references.	Jessica Grove-Smith	Passive House Institute	Germany
8215	44	46	44	46	(van Sluiseveld et al., 2016) Creutzig et al, 2018; Mundaca et al, 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
46831	44	2			The section jumps between energy demand water demand and electricity demand. Consider restructuring for clearer message.	We have updated the subsection.	Jessica Grove-Smith	Passive House Institute	Germany
46833	44	33			"efficient behaviour leads to more efficient behaviour"?	We have updated the text.	Jessica Grove-Smith	Passive House Institute	Germany
13577	44	46			Suggestion for literature: Levesque (2019) "Halving buildings energy demand from buildings: The impact of low consumption practices". The paper goes in a similar direction as the Sluiseveld paper but investigates more closely the buildings sector.	We have included the suggested reference (not necessarily in this subsection).	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
9415	44				9.5.2.4 Behaviour and policies - or here 9.5.3.1 Active and passive management and operation - SHOULD MENTION HUMAN-CENTERED APPROACH, like human based energy retrofits	Although we understand the point, we have not found literature linking human-centered approaches to climate mitigation.	ANNA LAURA PISELLO	DEPARTMENT OF ENGINEERING - UNIVERSITY OF PERUGIA, ITALY	Italy

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8217	45	1	45	2	(Ruparathna et al. 2016; 1 Vence and Pereira 2019; Verez and Cabeza 2020)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39449	45	2	45	11	The literature requires improvement. See also Creutzig, et al. 2016 (https://doi.org/10.1146/annurev-environ-110615-085428) ; Dietz et al. 2009 (https://www.pnas.org/content/106/44/18452) ; Niamir et al. 2020 (https://doi.org/10.1007/s10584-019-02566-8) ; Eyre et al. 2010 ; Lin & Deng 2004 ; ...	We have included the suggested reference (not necessarily in this subsection). Eyre et al. 2010 ; Lin & Deng 2004 ; could not be identified without the full citation.	Leila Niamir	MCC	Germany
8219	45	8	45	8	(van Sluisveld et al. 2016b)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8221	45	10	45	11	(Eom et al. 2012; Chaturvedi et al. 2014; Zhou et al. 2014; Wang et al. 2018; Gambhir et al. 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36957	45	13	45	13	classification proposed in this section takes the departure on the analysis of literature. This does not read well	We have updated the sentence.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8223	45	19	45	19	[Typo] (Van Den Wymelenberg 2012; Markandya et al. 2015; Ruparathna et al. 2016; Singh 2016; Alders 2017; → (Van Den Wymelenberg, 2012)(Markandya et al., 2015)(Ruparathna et al., 2016)(Singh, 2016)(Alders, 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8225	45	20	45	20	[Typo] Sun and Hong 2017; Talele et al. 2018; Galassi and Madlener 2018); Active management: (Darby et al. 2016; Volochovic et al. 2012; → (Sun and Hong, 2017)(Talele et al., 2018)(Galassi and Madlener, 2018) Active management: (Darby et al., 2016)(Volochovic et al., 2012)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8227	45	21	45	21	[Typo] Tokuda et al. 2013; Ayoub et al. 2014; Rafsanjani et al. 2015; Peng et al. 2015; Dong et al. 2015; Ruparathna et al. 2016; Singh 2016; → (Tokuda et al., 2013)(Ayoub et al., 2014)(Rafsanjani et al., 2015)(Peng et al., 2015)(Dong et al., 2015) Ruparathna et al. 2016; Singh 2016;	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8229	45	22	45	22	[Typo] Taniguchi et al. 2016; Alders 2017; Hansen and Hauge 2017; Sanguinetti et al. 2017; Sun and Hong 2017; Kusumadewi and → (Taniguchi et al., 2016)(Alders, 2017)(Hansen and Hauge, 2017)(Sanguinetti et al., 2017)(Sun and Hong, 2017) Kusumadewi and	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8231	45	23	45	23	[Typo] Limmeechokchai 2017; Skold et al. 2018; Rakha et al. 2018; Valencia et al. 2018; Ahl et al. 2019; Sanchez-Garcia et al. 2019; →(Limmeechokchai, 2017)(Skold et al., 2018)(Rakha et al., 2018)(Valencia et al., 2018)(Ahl et al., 2019)(Sanchez-Garcia et al., 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8233	45	23	45	24	[Typo] van der Grijp et al. 2019; Talele et al. 2018); Flexible comfort levels: (Volochovic et al. 2012; Brown et al. 2013; Ayoub et al. 2014; Cao et al. 2014; → (van der Grijp et al., 2019)(Talele et al., 2018) Flexible comfort levels: (Volochovic et al., 2012)(Brown et al., 2013)(Ayoub et al., 2014)(Cao et al., 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
25145	45		45		Table 9.14 not to report information on undefined terms such as "green schedule" and "green leasing"	We have defined the terms in the text.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
39451	45	17	46	6	The literature requires improvement. Recent and relevant publications are missing. please see above	We have included the suggested references (not necessarily in this subsection).	Leila Niamir	MCC	Germany
8235	46	1	46	1	[Typo] Dong et al. 2015; Singh 2016; Andersen et al. 2016; Taniguchi et al. 2016; Sanguinetti et al. 2017; Sun and Hong 2017; 1 Chang et al. 2017; → (Dong et al., 2015)(Singh, 2016)(Andersen et al., 2016)(Taniguchi et al., 2016)(Sanguinetti et al., 2017)(Sun and Hong, 2017)(Chang et al., 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8237	46	2	46	2	[Typo] Skold et al. 2018; Galassi and Madlener 2018; Ahl et al. 2019; van der Grijp et al. 2019; Talele et al. 2018); → (Skold et al., 2018)(Galassi and Madlener, 2018)(Ahl et al., 2019)(van der Grijp et al., 2019)(Talele et al., 2018)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8239	46	2	46	2	[Recommended, needs quotation] Flexible demand over time: ~	References have been added.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8241	46	3	46	3	[Typo] Circular and shared economy: (Hasegawa 2016; Ala-Mantila et al. 2017; Hansen and Hauge 2017; Fell et al. 2014); → Circular and shared economy: (Hasegawa, 2016)(Ala-Mantila et al., 2017)(Hansen and Hauge, 2017)(Fell et al., 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8243	46	4	46	4	[Typo] professional skills: (Ruparathna et al. 2016; D'Oca et al. 2014; Salo et al. 2016; Dixon et al. 2015); → professional skills: (Ruparathna et al., 2016)(D'Oca et al., 2014)(Salo et al., 2016)(Dixon et al., 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8245	46	4	46	5	[Typo] Green leasing: (Roussac and Bright 2012; Purohit and Höglund-Isaksson 2017) Hewitt 2018, Isaksson et al 2019; Unspecified behavioural changes: (Day and O'Brien 2017). → Green leasing: (Roussac and Bright, 2012)(Purohit and Hoglund-Isaksson, 2017)(Hewitt, 2018)(Isaksson et al., 2019) Unspecified behavioural changes: (Day and O'Brien, 2017).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
48211	46	7	46	42	Section 9.5.3.1 - I think there needs to be more consideration for developing countries in this section and the next.	Indeed. We have updated the sections.	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
8247	46	12	46	12	[Typo] (Christidou et al. 2014; Volochovic et al. 2012). → (Christidou et al., 2014)(Volochovic et al., 2012).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8249	46	14	46	14	[Recommended] for instance as probability→for instance as the probability	We have updated the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
36959	46	14	46	15	indoor globe temperature . What does this mean?	We have defined the terms in the text.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8251	46	15	46	15	(Rijal et al. 2012).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8253	46	17	46	18	(Rafsanjani et al. 2015; Klein et al. 2012).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8255	46	20	46	20	(Christidou et al. 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8257	46	21	46	21	(van der Grijp et al. 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8259	46	22	46	22	(Parag and Sovacool 2016).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36961	46	22	46	22	evaluted should be in presence tense	We have updated the text.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36963	46	25	46	25	the latter being is a very effective measure . This does not read well	We have updated the text.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8261	46	26	46	26	(Dixon et al. 2015; Taniguchi et al. 2016).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8263	46	28	46	28	(Salem and Elwakil 2017).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8265	46	29	46	29	(Rakha et al. 2018)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8267	46	30	46	30	[Recommended] fit size of cooking pan → fit the size of cooking pan	We have updated the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8269	46	30	46	30	[Recommended] use pressure cooker → use the pressure cooker	We have updated the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8271	46	32	46	32	[Recommended] includes to unplug the mobile charger → includes unplugging the mobile charger	We have updated the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8273	46	33	46	33	(Dixon et al. 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8275	46	36	46	36	(Christidou et al. 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8277	46	36	46	36	[Recommended] A summary of the current adoption rates of these practices are shown in Table 9.16 and Figure 9.18. → A summary of the current adoption rates of these practices is shown in Table 9.16 and Figure 9.18.	We have updated the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8279	46	37	46	39	[Typo] (Teng et al. 2012; Berezan et al. 2013; Hsiao et al. 2014; Abrahamse and Steg 2013; Peschiera and Taylor 2012; Volochovic et al. 2012) → (Teng et al., 2012)(Berezan et al., 2013)(Hsiao et al., 2014)(Abrahamse and Steg, 2013)(Peschiera and Taylor, 2012)(Volochovic et al., 2012)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36965	46	39	46	39	High behaviour? What is high behaviour?	We have updated the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8281	46	40	46	40	(Ayoub et al. 2014; Skold et al. 2018).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8283	46	41	46	41	[Recommended] Technical measures to that could trigger passive management → Technical measures that could trigger passive management	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36967	46	41	46	41	Technical measures to that could ... be specific. Not clear	We have updated the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8287	46	48	46	49	[Typo] results in savings of of → results in savings of	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
13117	46	48	46	49	There is a typos remove "of"	We have updated the text	Jean Noël Yankwa Djobo	Ministry of Scientific Research and Innovation/Local Materials Promotion Authority (MIPROMALO)	Cameroon
8285	46	49	46	49	[Typo] °C→°C	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13579	46	48	47	9	For the impact of indoor temperatures on long term energy demand projections, Levesque et al. (2019) "Halving buildings energy demand from buildings" might be relevant	We have updated the text	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
46837	46	37			check numbering of table and figure	We have updated the text	Jessica Grove-Smith	Passive House Institute	Germany
36969	47	1	47	1	<<are adjusted to occupant presence>> not clear	We have updated the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8289	47	1	47	2	[Typo] (Ayoub et al. 2014; Christidou 1 et al. 2014; Sun and Hong 2017; Taniguchi et al. 2016)(Da and Hong, 2013) → (Ayoub et al., 2014)(Christidou et al., 2014)(Sun and Hong, 2017)(Taniguchi et al., 2016)(Da and Hong, 2013)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36971	47	2	47	2	<< each a 1 °C decrease >> not ckear	We have updated the text	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8291	47	4	47	4	(Brown et al. 2013).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8293	47	5	47	5	(Sun and Hong 2017).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8295	47	7	47	8	(Talele et al. 2018)(O Brien and Gunay 2014)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8297	47	9	47	9	(Taniguchi et al. 2016).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
37519	47	10	47	15	A broad statement that refers to one survey result of theoretical reductions in four wealthy European countries. The main measures examined were also for food and travel behavior, not buildings	We have updated the text	Michiel Schaeffer	Climate Analytics	Netherlands
8299	47	12	47	12	[Typo] 1C → 1°C	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8301	47	15	47	15	[Typo] 3C → 3°C	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8303	47	15	47	15	(Skold et al. 2018).	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8305	47	15	47	15	[Recommended] Needs detailed explanation of "NZEB"	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8307	47	18	47	18	(van der Grijp et al. 2019).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8309	47	18	47	18	[Typo] (Zimmermann 2009; Gils 2014, Stotzer et al., 2015) → (Zimmermann, 2009)(Gils, 2014)(Stotzer et al., 2015)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8311	47	22	47	22	[Recommended] Needs detailed explanation of "DSM"	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
46839	47	22	47	25	Suggest to clarify abbreviations DSM & ToU	We have updated the text	Jessica Grove-Smith	Passive House Institute	Germany
8313	47	28	47	28	[Recommended] Behavioral benefits are identified in terms of increased → Behavioural benefits are identified in terms of the increased	We have updated the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8377	47	28	47	28	Behavioral	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8379	48	2	48	4	This data refers to type of load up-scaled at the country level. And figure 9.16 is concentrated on European countries including France, Germany, Sweden, United Kingdom. Etscs. Need more examples other than European countries including developing countries.	Indeed. The section has been rewritten.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8315	48	8	48	8	(Harris et al. 2008).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8317	48	11	48	11	(Heindl and Kanschik 2016).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8319	48	11	48	11	[Recommended] The sufficiency concept was introduced in early nineties → The sufficiency concept was introduced in the early nineties	The section has been rewritten.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
25147	48	11	48	12	Delete "The sufficiency concept ... Sachs (1993)." as it is a repetition	The section has been rewritten.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8321	48	13	48	13	(Toulouse et al. 2019).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
837	48	15	48	35	The sections here and in other parts of the chapter on sufficiency will likely cause significant push back and dismissal from actors which perceive this topic as a code word for deprivation of access, privilege and even freedom. Added emphasis recognizing this value gap and nothing the connection of this aspect of social science to buildings would help to explain why so much space in this chapter is given to this topic rather than architecture, engineering and financial investment practices.	Noted - The section has been updated.	Ann Kosmal	U.S. General Services Administration	United States of America
8323	48	18	48	18	(Darby and Fawcett 2018).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8325	48	19	48	20	(Fawcett and Darby 2019).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8327	48	24	48	24	(Fawcett and Darby 2019).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8329	48	24	48	24	(Darby and Fawcett 2018).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8331	48	31	48	31	[Typo] (Thomas et al. (2017). → (Thomas et al., 2017).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8333	48	35	48	35	(Bierwirth and Thomas 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
35685	48	6	49	34	This part should appear in the re-worked section on energy sufficiency referred to in the comment above.	Noted - The section has been updated.	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39393	48	7	49		The definition of sufficiency should come before the discussion on non-technological solutions which all fall under the sufficiency concept.	Noted - The section has been updated.	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
25149	48	15	49	3	When referring to energy sufficiency it is important to also consider matters related to reliability and affordability	Noted - The section has been updated.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
46841	48				Not clear why there are substantial differences for the different countries. Further explanation would be helpful.	Noted - The section has been updated.	Jessica Grove-Smith	Passive House Institute	Germany
8335	49	3	49	3	(Darby and Fawcett 2018).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
823	49	4	49	6	Design and professional training to design for changing climatic conditions is not common let alone sufficiency . See Maxwell, K., S. Julius, A. Grambsch, A. Kosmal, L. Larson, and N. Sonti, 2018: Built Environment, Urban Systems, and Cities. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 438–478. doi: 10.7930/NCA4.2018.CH11	We have updated the text.	Ann Kosmal	U.S. General Services Administration	United States of America
813	49	4	49	13	Might there be an opportunity to support sufficiency topic by leveraging capabilities to operate on less when energy services are interrupted.	We have updated the text.	Ann Kosmal	U.S. General Services Administration	United States of America
8337	49	15	49	15	(Brischke et al. 2015).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8339	49	17	49	17	(Bierwirth and Thomas 2019).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8341	49	21	49	21	[Recommended] At national level → At the national level	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8343	49	24	49	24	(Brischke et al. 2015).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8345	49	24	49	24	[Recommended] (in kWh yr-1 or in %) → (in kWh yr-1 or %)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8347	49	29	49	30	(Toulouse et al. 2017).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
46843	49	32	49	34	Sufficiency saving potential really twice as high as efficiency savings potential? The source Brischke et al. 2015 is missing in the list of references, so wasn't able to check for details in the original source. Might be a misunderstanding but efficiency savings potential are up to 75-95% as stated on pg. 39 for heating and cooling when going all the way to Passive House standard. Heating is a dominant energy demand in climate of Germany for the total final energy demand, which would lead to at least similar savings potential as the 50% sufficiency savings quoted here for the German household example. Undoubtedly both sufficiency and efficiency are needed for climate goals. Suggest to leave out the comparison to efficiency savings (second part of the sentence ..."and twice as much...").	We have updated the text.	Jessica Grove-Smith	Passive House Institute	Germany
8349	49	33	49	33	(Virage-Energie 2016).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8351	49	34	49	34	(Brischke et al. 2015).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8353	49	39	49	39	(Sauve et al. 2016).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8355	49	40	49	40	[Recommended] demolition waste are recycles or reused → demolition waste are recycled or reused	We have updated the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8357	49	42	49	42	(Kirchherr et al. 2017)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8359	49	44	49	44	[Recommended] It relies on a principle of reduce → It relies on a principle of reducing	We have updated the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8361	49	44	49	45	[Typo] (Preston 2012; Ghisellini 2016; Fischer and Pascucci 2017). → (Preston, 2012)(Ghisellini, 2016)(Fischer and Pascucci, 2017).	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8363	49	48	49	48	[Recommended] could make economy more circular → could make the economy more circular	We have updated the text.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
25151	50	9	50	9	Delete "(Kirchherr et al. 2017)"	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
8381	50	19	50	19	organizations	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8383	50	22	50	22	organizational	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8365	50	23	50	23	[Recommended] and property rights operate → and property rights operation	The language in the suggestion is not correct.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
25153	50	24	50	24	Delete "(Fischer and Pascucci 2017)"	Deleted.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
31311	51	1	51	10	Sharing of space is an effective measure to reduce emissions from the building sector. For example, office floor reduction by free address system, cool sharing (many people stay together in the same room for reducing cooling energy).	We have updated the subsection.	Yoshiyuki Shimoda	Osaka University	Japan
8385	51	3	51	3	utilization	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8367	51	9	51	9	(Rademaekers et al. 2017; Ludmann 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8369	51	9	51	9	(Hertwich et al. 2020),	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
35687	51	12	51	13	This part seems strangely placed and the sources for the information in the table seem unclear. Also several of the reasons shown on the left hand side seem incomplete and the way the cells are filled out is confusing and difficult to read. If the table is retained, it must be more clearly linked to the flow of the chapter and the information it contains more legible.	We have updated the subsection.	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
42671	51	21	52	1	A column is dedicated to Efficient technic systems. To be align with the mitigations solutions, a column could be dedicated to "Efficient building envelope"	We have updated the subsection.	Idriss KATHRADA	Novasirhe	France
37521	51	12	55	15	The subsections here should correspond to and be in the same order as those listed in the table 9.15	We have updated the subsection.	Michiel Schaeffer	Climate Analytics	Netherlands
39397	51	12	55	15	Unclear how this section fits with the rest. There should be a logic in the flow of the analysis to avoid losing your audience	We have updated the subsection.	Emmanuel RAUZIER	NGO Association negaWatt	France
7977	52	19	52	19	behavioural	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
2365	52	21	52	21	You might include: Extending range of comfort temperatures.	Noted thank you	Dieter Boer	Universitat Rovira i Virgili	Spain

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
7979	52	21	52	21	behavioural	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7981	52	22	52	22	behavioural	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
17103	52	18	53	28	I think the term "sufficiency" is not a correct title of this section. Virtually all measures are about more energy-efficient practices. Sufficiency for me would be refraining of energy services (for example smaller TVs, lower room temperatures).	Accepted - We have updated the text to explain more clearly what is included in "sufficiency" and updated the headings to be more specific.	Kornelis Blok	Delft University of Technology	Netherlands
25155	52		53		Fill all information in Table 9.16 (columns on geographical and sectorial specificities)	Noted - The table is however not included in the SOD.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
36973	52		53		The last two columns of Table 9.16 needs to be completed	Noted - The table is however not included in the SOD.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
46847	52	19			Sentence incomplete. Verb missing.	Accepted - We have updated the text.	Jessica Grove-Smith	Passive House Institute	Germany
815	52				Section 9.5.5.1 The balance of policy overtones in relationship to the use of science, may cause some readers to dismiss the findings of this chapter regarding aspects of distribution and equity.	Accepted - We have updated the text.	Ann Kosmal	U.S. General Services Administration	United States of America
46845	52				Details missing for geographical and sectorial specificities	Accepted - We have updated the text.	Jessica Grove-Smith	Passive House Institute	Germany
46849	53	2	53	28	The topics discussed (thermal performance of envelope, insulation) seem to fall more into category of "efficiency" rather than "sufficiency". Suggest adding subheading after table 9.16 "Efficiency measures to avoid energy demand"?	Accepted - We have updated the text.	Jessica Grove-Smith	Passive House Institute	Germany
817	53	14	53	16	Regarding practioners and training Reference to Maxwell, K., S. Julius, A. Grambsch, A. Kosmal, L. Larson, and N. Sonti, 2018: Built Environment, Urban Systems, and Cities. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 438–478. doi: 10.7930/NCA4.2018.CH11	We have looked at the reference and incorporated it in the text.	Ann Kosmal	U.S. General Services Administration	United States of America
4529	53	31	53	45	Please include if possible studies/findings related to the adoption of renewable heat	Noted - We agree it would be relevant, but have not found relevant literature.	Leonardo Barreto	Austrian Energy Agency	Austria
7983	53	44	53	44	[Typo] Being → being	Noted - Copyediting.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
25157	53	30	54	2	Sub-section 9.5.5.2 to make reference to reliability issues for RES as well	Accepted - RES are discussed more broadly in section 9.5.3.3 and Table 9.3 of the SOD.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
12867	53	36		42	Investment costs for residential PV system have decreased significantly since 2013/15 (see JRC PV Status Report 2019, doi 10.2760/326629). In addition, the wildfire related blackouts in California have highlighted the role of PV energy as a path to resilience. Third, the uptake of usage of PV generated electricity in multi apartment buildigs is getting more tracktion (e.g. doi:10.1109/PVSC.2018.8547583)	Noted - Such issues are also addressed in section 9.5.2.3	Arnulf JÄGER-WALDAU	European Commission, JRC	Italy
45235	54	3	54	15	This section seems to be lacking a discussion defining demand side management, there is no mention of users changing demand habits to suit grid needs, and the flexibility of certain end-uses, and how this flecibility can complement other resources such as solar PV and storage. I think this section would benefit from a more holistic discussion of what 'digitalisation' and 'smart' can mean in buildings, and how this can benefit individuals and accelerate decarbonisation. It is also important to stress that DSM does not require additional physical assets as storage and PV systems do, all electricity usrs can therefore participate in providing DSR services	Noted - Such issues are also addressed in section 9.5.2.3	Timothy Goodson	International Energy Agency	France
7985	54	5	54	5	[Typo] digitalizaiton [Section 9.4.4]) → (Section 9.4.4) ~	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7987	54	15	54	15	[Typo] (Seidi et al (2019) → (Seidi et al 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
7989	54	21	54	21	[Typo] (Seidi et al (2019) → (Seidi et al 2019)	The citations will be homogeneously edited through the report before final publication.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39871	54	23	54	23	To enrich your approach regarding willingness to adopt : it was extensively studied in : Li, Pei-Hao, Ilkka Keppo, and Neil Strachan. 2018. "Incorporating Homeowners' Preferences of Heating Technologies in the UK TIMES Model." Energy 148 (April): 716–27. The authors did a literature review of willingness to adopt different kind of heating technologies and model it to assess the heating systems fleet deformation over time compared to the fleet obtained with a cost-optimization model.	Accepted - The suggested reference is included in the review Peñaloza et al (2021).	Bianka SHOAI-TEHRANI	RTE, CentraleSupelec	France
36975	54	23	54	24	Figure 9.18 is not clear at all especially the text. The text is not readable.	accepted and revised	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
35689	54	23	54	25	Figure 9.18 is illegible in the current format and seems to contain a great qua,tity of information	The figure has been improved.	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
2367	54	24	54	24	Figure better in vertical format, otherwise characters are too small.	The figure has been improved.	Dieter Boer	Universitat Rovira i Virgili	Spain

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
7991	54	28	54	28	behavioural	The final text will be edited for coherence.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
34829	54		54		The figure 9.18 "Willingness to adopt different low-carbon measures for buildings" is very messy. Instead of using "source" it should be "after"Sköld et al 2018. All should be in one sentence. The excel plot should be replotted and neatly pasted. In addition, all table should be carefully inserted in one page.	The figure has been improved.	Onema Adojoh	Missouri University of Science and Technology, Rolla, USA	United States of America
42041	54	12			"Smart building, digitalization and demand-supply flexibility" . This can be done only in the context of smart grids. I have made a similar remark for chapter 6 and for chapter 9 (previous comment, in fact) as well. In fact smart grids are instrumental in any link of the energy chain, including EV and HEV. For "the public", smart grids are mainly known as ICT supporting the integration, operation and integration of smart grids into power networks. But smart grids are much more than this and, in fact, and cover also the interaction with the prosumers which can be energy consumers and also producers (with a high relevance of billing and other interactions between providers of power or energy services), and many of them having (at least in the future) a vehicle connected to network for charging from or supporting the power network, parked in the dwelling of the prosumer. Smart building, digitalization and demand-supply flexibility cannot be approached without a reference to smart grids	Accepted - We have incorporated the reference to the determina	Francisco Javier Hurtado A	European Patent Office	Germany
13581	54	23			Figure 9.5.5.4 is not readable	The figure has been improved.	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
46851	54				Fig 9.18 illegible	The figure has been improved.	Jessica Grove-Smith	Passive House Institute	Germany
36977	55	11	55	12	experienced consumers or planning to invest could be the first target group of new energy pricing, these consumers are more likely to accept it (Liang et al. 2017). This is not clear!	Noted - Section 9.5.5.5 however is not included in the SOD.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36979	55	18	55	20	the two sentences here are not clear at all.	Accepted. Thank you for your comment. The section was rewritten and the text was replaced.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36981	55		56		the language is below standard. It should be re-written. The section headings don't read well. For example, in 9.6.1, <<..calculating potentials and costs...>> of what?	Accepted. Thank you for your comment. The sections in this chapter were rewritten. The report will also go through language editing after the final review.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
36983	56	10	56	16	the authors failed to provide an in-depth analysis on costs. An analysis of cost for the different regions should be provided.	Noted. Thank you for your comment. The discussion of mitigation costs was replaced and the previous text is not relevant anymore.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
39873	57	1	57	1	Suggestion to include an Italian case study. In Bianco, Vincenzo, Federico Scarpa, and Luca A. Tagliafico. 2017. "Estimation of Primary Energy Savings by Using Heat Pumps for Heating Purposes in the Residential Sector." Applied Thermal Engineering 114 (March): 938–47. The paper assess energy savings in natural gas if the 25% of building surface existing switches from gaz boiler to heat pump, considering that the electricity for heat pumps will use exclusively gas-powered electricity through CCGT power plants. "The analysis demonstrates long term natural gas savings in the order of 20%. A global reduction of 1.7 Mt of carbon emissions can be also obtained."	Noted. Thank you for your comment. The section aims to review literature which calculates the potential from the application of numerous decarbonisation technologies at sector level rather than from the application of an individual technology. This is why, other studies were used.	Bianka SHOAI-TEHRANI	RTE, CentraleSupelec	France
39875	57	1	57	1	Suggestion for a French case study, to be published (IAEE2020 June) Shoai-Tehrani et al, 2020. "Decarbonisation of energy consumption through electrification : right or wrong ? The case of heating in France." results to be confirmed : electrifying about 10% of households with heat pumps could mean emissions reductions 3 MtCO2/year in France - however, since France is interconnected with other countries and is usually a net exporter around 40 to 60 TWh a year, more electricity consumption in France may just reduce exports of decarbonated electricity and provokes fossil fuelled power generation in another countries. Taking these effects into account and depending on how France achieve their targets for renewable deployment, emissions reduction related to electrification via heat pump could be between 1,5 - 3 MtCO2 in 2035. Results to be confirmed in final paper. The same approach was developed to study emissions cuts from electrification of vehicles (De Lauretis et al, 2020, and of hydrogen production, Le-Du, Tejada and Françon, 2020, both to be published at the IAEE2020 conference,	Noted. Thank you for your comment. Due to the conclusion presented in the paper of Shoai-Tehrani et al 2020, we consider studies which first reduce the demand including sufficiency, deep retrofits and low energy construction, and then meet it with advanced technologies. Without dramatic reduction in energy demand vs its reference development, the decarbonisation is unlikely to be possible in any region of the world.	Bianka SHOAI-TEHRANI	RTE, CentraleSupelec	France
31575	57	0	63	0	There is reseach on Japan: Momonoki, Taniguchi-Matsuoka, Yamaguchi, Shimoda: Evaluation of the Greenhouse Gas Reduction Effect in the Japanese Residential Sector Considering the Characteristics of Regions and Households, Proceedings of Building Simulation 2017, http://www.ibpsa.org/proceedings/BS2017/BS2017_718.pdf Sugiyama, Taniguchi-Matsuoka, Yamaguchi, Shimoda: Required Specification of Residential End-use Energy Demand Model for Application to National GHG Mitigation Policy Making Proceedings of Building Simulation 2019	Accepted. Thank you for your comment. In the current round of assessment, we included the other publication for Japan. We will additional publications, including these two, to the next round of review.	Yoshiyuki Shimoda	Osaka University	Japan

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
13583	62				Table 9.17: Levesque et al. (2019) "Halving buildings energy demand from buildings" for another global projection of the buildings energy demand potential	Accepted. Thank you for your comment. We added this publication to the review of non-technological and technological energy efficiency potential.	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
25159	64	1	65	1	The methodology used to estimate costs is based on an IEA's WEO 2019 scenario; yet the 2019 edition considers the current policy scenario as the "stated policies scenario". Please revise accordingly	Notes. Thank you for your comment. We exchanged the baseline with the current policy scenario provided by IEA's WEO 2020. We used the current policy scenario and not stated policy scenario to avoid taking account policies which are not in place yet. Using the stated policy scenario may make an impression of less amount of efforts to be applied.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
25161	65	3	68	16	Analysis presented in sub-section 9.6.3 is case specific, therefore a cautious presentation of general arguments is required	Noted. Thank you for your comment. FOD was only able to present the review of studies calculating the potential and costs of GHG mitigation. In SOD, we expanded the review, conducted detailed analysis, and presented its conclusions.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
37523	66	13	66	19	Discussion of buildings in the US would need to be fleshed out. Examples in the Table 9.19 refer to LEED certification levels that have little to do with final energy consumption levels, and in any case are not usually tested to see what energy performance actually is. Very few would qualify as near-zero energy. See for example Amiri et al Sustainability 2019, 11, 1672; doi:10.3390/su11061672 for a meta-analysis	Noted. Thank you for your comment. We expended the review for the United States, as well as for other countries, and replaced old studies selecting the best available. The review of technological potentials is now not presented as a figure.	Michiel Schaeffer	Climate Analytics	Netherlands
37525	66	13	66	19	Confusion again between energy consumption and emissions. Discussion here is about energy consumption in buildings; however, mention is made of the decreasing cost of RE installations, which has nothing to do with energy consumption in a building. Decreasing costs of solar pv cannot be a cause for decreasing costs of energy consumption in buildings.	Noted. Thank you for your comment. The discussion of mitigation costs was replaced and the previous text is not relevant anymore.	Michiel Schaeffer	Climate Analytics	Netherlands
36985	66		68		the language is below standard. It should be re-written (sections 9.6.3.2 to 9.6.3.3) .	accepted and revised	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
8409	68	18	68	27	Need more detailed explanation of how climate change affects building structure, construction methods, building material's characteristics and building energy consumption. ⇒ Need more explanation of building structure and construction methods designed for climate adaptation.	Agreed. Much of that discussion was left as a placeholder in the FOD and is explored in the SOD. This should be improved in SOD.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8387	68	19	68	19	[Recommended] long lasting → long-lasting	Fixed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8389	68	24	68	24	[Recommended]] buildings → building	There isn't the word 'building' in pag 68, line 24.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39401	68	18	70	28	Clearly reference to the role of adaptation deserve more attention. There exist more arguments than those presented here.	This subsection is focused on the impacts, while the next (9.7.2) discusses adaptation with focus on its interactions with mitigation. We agree that the role of adaptation needs to be better discussed and this was improved for the SOD.	Emmanuel RAUZIER	NGO Association negaWatt	France
33913	68		70		In this section on adaptation, it is vital to discuss the overheating implications of improving the air tightness of buildings. A lot of work has happened to quantify the overheating risk esp in temperature climates, since mal adaptation could be installation of AC. Here are some papers: - Gupta, R., Gregg, M. and Williams, K. (2015): Cooling the UK housing stock post 2050s, Building Services Engineering Research & Technology, 36 (2), 196-220 - Gupta, R. and Gregg, M. (2018) Assessing energy use and overheating risk in net zero energy dwellings in UK, Energy and Buildings, 158, 897-905 - Rajat Gupta, Matt Gregg & Robert Irving (2019) Meta-analysis of summertime indoor temperatures in new-build, retrofitted, and existing UK dwellings, Science and Technology for the Built Environment, 25:9, 1212-1225,	Indeed overheating is an important issue to discuss. We have discussed this on two occasions: one paragraph in section 9.7.1, that deals with impacts; one paragraph in section 9.7.2, that deals with the interactions between mitigation and adaptation. We thank the reviewer for the suggested references.	Rajat Gupta	Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8407	69	1	69	43	9.7.1 needs more information about building sector that affects climate change including building structure, construction method and building materials.	Agreed. This was left as a placeholder in the FOD and is explored in the SOD.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8411	69	1	69	43	9.7.1 needs detailed explanation that cloud formation affects solar energy development.	We think that such process should be discussed within the scope of WGI. We have, nevertheless, improved the referencing here.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8539	69	1	69	43	9.7.2 needs examples about mitigation or adaptation policies of building sector that promote energy consumption and comparison between mitigation and adaptation policies.	Indeed it is relevant to discuss policies. But we do not have the space to do so in this section. There is a section on policy at the end of the chapter.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
9211	69	1	69	43	Buildings should be viewed as assets in relation to adaptation. They interact with other assets (financial, social, place-based) when prioritizing adaptation to extreme temperatures, for example. As a result, we need to take into account how all these variables interact with each other. Some insights on these interactions can be found here: Nunes, A.R. (2019). General and specified vulnerability to extreme temperatures among older adults. <i>International Journal of Environmental Health Research</i> , DOI: 10.1080/09603123.2019.1609655 ; Nunes, A.R. (2018). The contribution of assets to adaptation to extreme temperatures among older adults. <i>PLoS ONE</i> , 13 (11): e0208121.	Buildings are defined as assets in the introduction to the section.	Ana Raquel Nunes	University of Warwick, UK	United Kingdom (of Great Britain and Northern Ireland)
39399	69	2	69	2	How much is the majority referred to here? Is this based on the bibliometric analysis mentioned earlier?	We are writing a systematic literature review paper, from which we should have a good measure to add here. Forthcoming.	Emmanuel RAUZIER	NGO Association negaWatt	France
32517	69	2	69	8	The increased energy demand that goes with increased demand for cooling often occurs during peak energy usage, especially during heat waves. Increased energy efficiency of cooling appliances can reduce how much energy needs to be generated and thus can limit additional growth in emissions from increased demand of cooling equipment. International Energy Agency (2018) <i>Future of Cooling: Opportunities for Energy Efficient Air conditioning</i> ("Space cooling can account for a large share of peak demand, placing further stress on the power system, especially during periods of extreme heat. Cooling demand typically jumps during a heatwave, placing greater demands on the power system, the reliability of which can be further undermined by hot equipment increasing the risk of outages. ...For instance, the heatwave in France in August 2003, when temperatures rose to around 40°C across most of the country, boosted power needs by about 4 000 megawatts (MW), or around 10%, compared with normal peak summer electricity demand. In China, demand for cooling pushed overall electricity demand to record highs during the summer heatwave in 2017. In some places, such as Beijing on the 13 July 2017, more than 50% of the daily peak load was related to cooling."); Abel, D.W., Holloway, T., Martínez-Santos, J., Harkey, M., Tao, M., Kubes, C., Hayes S. (2019). Air Quality-Related Health Benefits of Energy Efficiency in the United States, <i>Environmental Science & Technology</i> 53 (7), 3987–3998 ("Increasing temperatures increase air conditioning use, this increases electricity demand, which in turn increases power plant emissions (Abel et al., 2017), and this may play a larger role in public health as air conditioning demand increases under a warmer climate (Abel et al., 2018)."); Shah, N., Wei, M., Letschert, V. and Phadke, A. (2015). Benefits of Leapfrogging to Superefficiency and Low-Global Warming Potential Refrigerants in Room Air Conditioning. U.S.A.: Ernest Orlando Lawrence Berkeley National Laboratory ("We estimate that shifting the 2030 world stock of room air conditioners from the low efficiency technology using high-GWP	Energy efficiency is regarded as a mean to reduce potential trade-offs between thermal comfort adaptation in buildings and emissions. We have improved this discussion in section 9.7.2 and added new references. Some of the references provided could not be added since they are grey literature.	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
32821	69	2	69	8	The increased energy demand that goes with increased demand for cooling often occurs during peak energy usage, especially during heat waves. Increased energy efficiency of cooling appliances can reduce how much energy needs to be generated and thus can limit additional growth in emissions from increased demand of cooling equipment. International Energy Agency (2018) Future of Cooling: Opportunities for Energy Efficient Air conditioning (“Space cooling can account for a large share of peak demand, placing further stress on the power system, especially during periods of extreme heat. Cooling demand typically jumps during a heatwave, placing greater demands on the power system, the reliability of which can be further undermined by hot equipment increasing the risk of outages. ...For instance, the heatwave in France in August 2003, when temperatures rose to around 40°C across most of the country, boosted power needs by about 4 000 megawatts (MW), or around 10%, compared with normal peak summer electricity demand. In China, demand for cooling pushed overall electricity demand to record highs during the summer heatwave in 2017. In some places, such as Beijing on the 13 July 2017, more than 50% of the daily peak load was related to cooling.”); Abel, D.W., Holloway, T., Martínez-Santos, J., Harkey, M., Tao, M., Kubes, C., Hayes S. (2019). Air Quality-Related Health Benefits of Energy Efficiency in the United States, Environmental Science & Technology 53 (7), 3987–3998 (“Increasing temperatures increase air conditioning use, this increases electricity demand, which in turn increases power plant emissions (Abel et al., 2017), and this may play a larger role in public health as air conditioning demand increases under a warmer climate (Abel et al., 2018.”); Shah, N., Wei, M., Letschert, V. and Phadke, A. (2015). Benefits of Leapfrogging to Superefficiency and Low-Global Warming Potential Refrigerants in Room Air Conditioning. U.S.A.: Ernest Orlando Lawrence Berkeley National Laboratory (“We estimate that shifting the 2030 world stock of room air conditioners from the low efficiency technology using high-GWP	Same comment as #32517	Kristin Campbell	Institute for Governance & Sustainable Development	United States of America
8391	69	5	69	5	[Word spacing] (Wan et al. 2012a; Li et al. 2012; Andrić et al. 2019) . → (Wan et al. 2012a; Li et al. 2012; Andrić et al. 2019).	Editorial, thank you	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
32519	69	9	69	20	<p>The increased energy demand that goes with increased demand for cooling often occurs during peak energy usage, especially during heat waves. Increased energy efficiency of cooling appliances can reduce how much energy needs to be generated and thus can limit additional growth in emissions from increased demand of cooling equipment. International Energy Agency (2018) Future of Cooling: Opportunities for Energy Efficient Air conditioning (“Space cooling can account for a large share of peak demand, placing further stress on the power system, especially during periods of extreme heat. Cooling demand typically jumps during a heatwave, placing greater demands on the power system, the reliability of which can be further undermined by hot equipment increasing the risk of outages. ...For instance, the heatwave in France in August 2003, when temperatures rose to around 40°C across most of the country, boosted power needs by about 4 000 megawatts (MW), or around 10%, compared with normal peak summer electricity demand. In China, demand for cooling pushed overall electricity demand to record highs during the summer heatwave in 2017. In some places, such as Beijing on the 13 July 2017, more than 50% of the daily peak load was related to cooling.”); Abel, D.W., Holloway, T., Martínez-Santos, J., Harkey, M., Tao, M., Kubes, C., Hayes S. (2019). Air Quality-Related Health Benefits of Energy Efficiency in the United States, Environmental Science & Technology 53 (7), 3987–3998 (“Increasing temperatures increase air conditioning use, this increases electricity demand, which in turn increases power plant emissions (Abel et al., 2017), and this may play a larger role in public health as air conditioning demand increases under a warmer climate (Abel et al., 2018.”); Shah, N., Wei, M., Letschert, V. and Phadke, A. (2015). Benefits of Leapfrogging to Superefficiency and Low-Global Warming Potential Refrigerants in Room Air Conditioning. U.S.A.: Ernest Orlando Lawrence Berkeley National Laboratory (“We estimate that shifting the 2030 world stock of room air conditioners from the low efficiency technology using high-GWP</p>	Same comment as #32517	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
32521	69	9	69	20	<p>The urban heat island effect amplifies the demand for cooling. Cities can be 1–3 °C warmer than surrounding areas, and in the evenings, this difference can be as high as 12 °C. Urban heat island effects lead to increased energy consumption and elevated emissions of air pollutants and greenhouse gases. To alleviate the additional heat and increased demand for cooling, making roofs and pavements more reflective as well as increasing vegetation can help counteract the urban heat island effect. Further, tree canopies can also lower city temperatures. Akbari H., et al. (2001) Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas, <i>Solar Energy</i> 70(3):295–310; International Energy Agency (2018). <i>Future of Cooling: Opportunities for Energy Efficient Air Conditioning</i>; US EPA, “Heat Island Effects”, https://www.epa.gov/heat-islands; Lawrence Berkeley National Laboratory, “Heat Island Group, Cool Roofs”, https://heatisland.lbl.gov/coolscience/cool-roofs; Ziter C. D., et al. (2019) Scale-dependent interactions between tree canopy cover and impervious surfaces reduce daytime urban heat during summer, <i>PROC. NAT’L. ACAD. SCI.</i> 116(15):7575–7580; Al-Obaidi K. M., et al. (2014) Passive cooling techniques through reflective and radiative roofs in tropical houses in Southeast Asia: A literature review, <i>FRONTIERS ARCHITECTURAL RESEARCH</i> 3(3):283–297; Santamouris M. (2014) Cooling the cities – A review of reflective and green roof mitigation technologies to fight heat island and improve comfort in urban environments, <i>Solar Energy</i> 103:682–703; Oliveira S., et al. (2011) The cooling effect of green spaces as a contribution to the mitigation of urban heat: A case study in Lisbon, <i>Building & Env’t.</i> 46(11):2186–2194.</p>	<p>These effects have the potential to increase/decrease energy consumption in buildings. However, this section deals with interactions between mitigation and adaptation. Therefore, we investigate how eventual climate change impacts and the consequent adaptation measures may interact with mitigation. The measures suggested by the reviewers are important and should be considered among the mitigation alternatives discussed in the chapter. But here we only discuss how they are affected by climate change or are used as adaptation measures. This is discussed, to some extent, in section 7.2.2.</p>	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
32823	69	9	69	20	The increased energy demand that goes with increased demand for cooling often occurs during peak energy usage, especially during heat waves. Increased energy efficiency of cooling appliances can reduce how much energy needs to be generated and thus can limit additional growth in emissions from increased demand of cooling equipment. International Energy Agency (2018) Future of Cooling: Opportunities for Energy Efficient Air conditioning (“Space cooling can account for a large share of peak demand, placing further stress on the power system, especially during periods of extreme heat. Cooling demand typically jumps during a heatwave, placing greater demands on the power system, the reliability of which can be further undermined by hot equipment increasing the risk of outages. ...For instance, the heatwave in France in August 2003, when temperatures rose to around 40°C across most of the country, boosted power needs by about 4 000 megawatts (MW), or around 10%, compared with normal peak summer electricity demand. In China, demand for cooling pushed overall electricity demand to record highs during the summer heatwave in 2017. In some places, such as Beijing on the 13 July 2017, more than 50% of the daily peak load was related to cooling.”); Abel, D.W., Holloway, T., Martínez-Santos, J., Harkey, M., Tao, M., Kubes, C., Hayes S. (2019). Air Quality-Related Health Benefits of Energy Efficiency in the United States, Environmental Science & Technology 53 (7), 3987–3998 (“Increasing temperatures increase air conditioning use, this increases electricity demand, which in turn increases power plant emissions (Abel et al., 2017), and this may play a larger role in public health as air conditioning demand increases under a warmer climate (Abel et al., 2018.”); Shah, N., Wei, M., Letschert, V. and Phadke, A. (2015). Benefits of Leapfrogging to Superefficiency and Low-Global Warming Potential Refrigerants in Room Air Conditioning. U.S.A.: Ernest Orlando Lawrence Berkeley National Laboratory (“We estimate that shifting the 2030 world stock of room air conditioners from the low efficiency technology using high-GWP	Same comment as #32517	Kristin Campbell	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
32523	69	21	69	25	In a warming world with a growing population and expanding middle-class, the demand for cooling is projected to rise substantially. Currently, there are 3.6 billion cooling appliances, which is projected to rise to 9.5 billion by 2050, though up to 14 billion would be required to provide adequate cooling for all. University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All (“Considering per capita equipment penetrations at regional level, it becomes clear that 9.5 billion cooling appliances by 2050 will, on the current technology pathways, not be sufficient to deliver universal access to cooling, let alone meet the UN SDGs 2030 targets. Food and medicine loss in the supply chain will still be high; food poisoning from lack of cold chain and domestic temperature management will still be significant; farmers will lack market ‘connectivity’ or ‘access’; hundreds of millions of people will not have safe, let alone comfortable, living or working environments; medical centres will not have temperature-controlled services for post-natal care, etc... By 2050, would require a total of 14 bn cooling appliances – an additional 4.5 bn appliances compared to the baseline forecast – or 4 times as many pieces of cooling equipment than are in use today.”); Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING.	We have pointed out three effects that affect cooling energy demand: (1) higher use of AC; (2) higher thermal loads; (3) increase in appliance ownership. The reviewer's comment refer to the third effect, whose discussion was further developed and new references were added.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32525	69	21	69	25	At the same time, increased demand for air conditioning will increase energy demand that will thus require additional energy production. Energy efficiency, including in equipment efficiency like air conditioners, can reduce this demand and help limit additional emissions that would further exacerbate climate change. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All; Biarreau, L.T., Davis, L.W., Gertler, P., Wolfram, C., 2020. Heat exposure and global air conditioning. Nature Sustainability 3, 25–28 (“Air conditioning adoption is increasing dramatically worldwide as incomes rise and average temperatures go up. Using daily temperature data from 14,500 weather stations, we rank 219 countries and 1,692 cities based on a widely used measure of cooling demand called total cooling degree day exposure. India, China, Indonesia, Nigeria, Pakistan, Brazil, Bangladesh and the Philippines all have more total cooling degree day exposure than the United States—a country that uses 400 terawatt-hours of electricity annually for air conditioning.”).	We have addressed these issues in the FOD and have expanded the discussion on the SOD. We thank the reviewer for the suggested references, some of which we cannot used for being grey literature.	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
32825	69	21	69	25	The demand for cooling is projected to rise substantially. Currently, there are 3.6 billion cooling appliances, which is projected to rise to 9.5 billion by 2050, though up to 14 billion would be required to provide adequate cooling for all. University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All ("Considering per capita equipment penetrations at regional level, it becomes clear that 9.5 billion cooling appliances by 2050 will, on the current technology pathways, not be sufficient to deliver universal access to cooling, let alone meet the UN SDGs 2030 targets. Food and medicine loss in the supply chain will still be high; food poisoning from lack of cold chain and domestic temperature management will still be significant; farmers will lack market 'connectivity' or 'access'; hundreds of millions of people will not have safe, let alone comfortable, living or working environments; medical centres will not have temperature-controlled services for post-natal care, etc... By 2050, would require a total of 14 bn cooling appliances – an additional 4.5 bn appliances compared to the baseline forecast – or 4 times as many pieces of cooling equipment than are in use today."); Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING.	Same as comment #32523	Kristin Campbell	Institute for Governance & Sustainable Development	United States of America
32827	69	21	69	25	At the same time, increased demand for air conditioning can increase energy demand that will thus require additional energy production. Energy efficiency, including in equipment efficiency like air conditioners, can reduce this demand and help limit additional emissions that would further exacerbate climate change. Sachar et al. (2018) Solving the Global Cooling Challenge: How to Counter the Climate Threat from Room Air Conditioners. Dreyfus G., et al. (2020) ASSESSMENT OF CLIMATE AND DEVELOPMENT BENEFITS OF EFFICIENT AND CLIMATE-FRIENDLY COOLING; Rocky Mountain Institute; Shah, N., Wei, M., Letschert, V. and Phadke, A. (2019). Benefits of Energy Efficient and Low-Global Warming Potential Refrigerant Cooling Equipment. U.S.A: Lawrence Berkeley National Laboratory; Shah N., et al. (2015) Benefits Of Leapfrogging To Superefficiency And Low Global Warming Potential Refrigerants In Air Conditioning, Ernest Orlando Lawrence Berkeley National Laboratory; IEA (2018) Future of Cooling; Sustainable Energy for All (2018) Chilling Prospects: Providing Sustainable Cooling for All; and Birmingham Energy Institute, University of Birmingham (2018) A Cool World: Defining the Energy Conundrum of Cooling for All.	Same as comment #32525	Kristin Campbell	Institute for Governance & Sustainable Development	United States of America
8393	69	23	69	23	[Recommended] end use → end-use	Fixed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8395	69	25	69	25	[Recommended] a higher → higher	Fixed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8397	69	31	69	31	[Recommended] starts and stops of can affect the operation of central heating systems (Andrić et al. 2019). → starts and stops can affect the operation of central heating systems (Andrić et al. 2019).	Fixed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
25163	69	31	69	33	Reformulate the sentence "Climate change may affect ... (Andric et al. 2019)." as currently is not complete	Fixed.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8399	69	38	69	38	[Recommended] on site → on-site	Fixed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8401	69	40	69	40	[Recommended] Also, the efficiency of solar photovoltaic panels decrease with → Also, the efficiency of solar photovoltaic panels decreases with	Fixed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
46853	69				On the topic of higher cooling and lower heating due to a warming climate an additional interesting aspect is the timely correlation between available renewable energy supply and energy demand. The times when cooling is needed correlate much better with renewable energy supply (especially solar/PV) than heating does. This adds to the complexity and is currently rarely taken into account during simulations and impact assessment on GHG emissions. Suitable assessment methods could be e.g. seasonally varying emission factors. Some examples described in literature are given in section "Interplay of energy efficiency and renewable energies" of J. Grove-Smith, V. Aydin, W. Feist, J. Schnieders, S. Thomas, Standards and policies for very high energy efficiency in the urban building sector towards reaching the 1.5°C target. Current Opinion in Environmental Sustainability. 30 (2018), pp. 103–114 (Grove-Smith et al. 2018)	Thank you for the suggestion, which has been incorporated into the text.	Jessica Grove-Smith	Passive House Institute	Germany
8413	70	1	70	28	9.7.2. needs specific examples about energy-efficient policies implemented for reducing electric use to deal with climate change.	Thank you for the suggestion. Energy-efficiency policies are dealt with in section 9.9.3	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
38045	70	2	70	28	Common typology of residential buildings considering energy efficiency and climate change vulnerability may reduce the costs and improve the building's mitigation and adaptation potentials. (Hrabovszky-Horváth et al, 2013) Reference: Hrabovszky-Horváth, S., Pálvölgyi, T., Csoknyai, T., and A. Talamon, 2013. Generalized residential building typology for urban climate change mitigation and adaptation strategies: The case of Hungary. Energy and Buildings, Volume 62, Pages 475–485	Thank you for the suggested reference.	Tamás Pálvölgyi	Budapest University of Technology and Economics, Department of Environmental Economics	Hungary
6063	70	12	70	17	In these houses, ventilation is very important as there are risks of moulding.	We have included the risk of humidity to buildings' users health,	Andreas Oberheitmann	FOM University of Applied Sciences	Germany
811	70	20	70	28	Regarding codes and adaptation Reference to Maxwell, K., S. Julius, A. Grambsch, A. Kosmal, L. Larson, and N. Sonti, 2018: Built Environment, Urban Systems, and Cities. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 438–478. doi: 10.7930/NCA4.2018.CH11	Thank you for the suggested reference.	Ann Kosmal	U.S. General Services Administration	United States of America
8403	70	22	70	22	[Recommended] which can lead to poor design of thermal comfort → which can lead to the poor design of thermal comfort	Fixed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8405	70	24	70	24	[Recommended] However, adaptation measures incur in costs today → However, adaptation measures incur costs today	Fixed.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
46739	70	37	70	37	Please add Mikael Karlsson, Eva Alfredsson & Nils Westling (2020) Climate policy co-benefits: a review, Climate Policy, DOI: 10.1080/14693062.2020.1724070.	Taken into account - This paper is a very good review of the multiple benefits associated with climate policies. It is not included in this part of the text as it does not provide focused information on the buildings sector. However, it is mentioned in other parts of this section, in the analysis of specific co-benefits associated with mitigation actions in buildings	Mikael Karlsson	KTH Royal Institute of Technology	Sweden
8415	70	41	70	41	[Recommended] wellbeing → well-being	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
19739	70	31	77	23	The multiple benefits of energy efficient buildings are currently framed in a sustainable development goals context. But there is also a body of evidence showing the leveraging the value of non-energy benefits to businesses can be used as a policy lever in its own right given that the value of the energy cost savings are marginal for most organisations. Fawcett, T. & Killip, G. (2019). Re-thinking energy efficiency in European policy: practitioners' use of 'multiple benefits' arguments. Journal of Cleaner Production 210, 1171-1179. doi.org/10.1016/j.jclepro.2018.11.026 Freed, M & Felder, F. (2017). Non-energy benefits. Workhorse or unicorn of energy efficiency programs? Electricity Journal 30, 43-46. dx.doi.org/10.1016/j.tej.2016.12.004 International Energy Agency (2019). The multiple benefits of energy efficiency. https://www.iea.org/reports/multiple-benefits-of-energy-efficiency/asset-values#abstract	Taken into account - this is discussed at the end of sub-section 9.8.1. In addition, the entire section 9.8 puts emphasis in quantifying and to the extent possible monetizing the multiple benefits of mitigation actions with a view to facilitate their inclusion in decision making processes. Some of the proposed references were included in text.	Peter Mallaburn	University College London	United Kingdom (of Great Britain and Northern Ireland)
25165	71	3	71	13	Table 9.2 does not present the interactions between mitigation options and the SDGs. Please revise accordingly	Accepted - comments added to the table showing the main interactions between mitigation options and SDGs	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8417	71	7	71	7	[Typo, Concerning context, table 9.2 doesn't fit] table 9.2 → table 9.21	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8419	71	13	71	13	[Typo, Concerning context, table 9.2 doesn't fit] table 9.2 → table 9.21	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8461	71	14	71	14	[Recommended] interacts → interact	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8463	71	16	71	16	[Recommended] a more → more	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8421	71	22	71	22	[Recommended] wellbeing → well-being	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8423	71	31	71	31	[Word spacing] 2015)showed that → 2015) showed that으로 수정	Editorial – copyedit to be completed prior to publication	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8465	71	34	71	34	[Recommended] were → was	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8467	71	34	71	34	[Recommended] Even in these studies several effects → Even in these studies, several effects	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8455	72	2	72	7	In this section, It would be good to add details on the adverse effects of rising prices due to the spread of clean fuel. For example, if the price of clean fuel rises, it will use existing fuel that is relatively cheap. It need to describe the need for a policy that takes into account certain matters and the good or bad effects that may arise when deploying the policy.	Taken into account - it is mentioned in the 3rd paragraph of this section but also in Section 9.8.1. No space for more detailed discussion.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
25167	72	2	72	31	Energy access should be considered also in the context of reliability and affordability	Noted - this section discusses to what extent mitigation actions in the building sector, particularly in poor developing countries, could be combined with policies enhancing energy access and the health implications of this transformation. It is out of the scope of this analysis an integrated discussion about energy access; this is done elsewhere in the report. The issue of affordability is mentioned (please see the 3rd paragraph of the section 9.8.2.1). The issue of reliability, although important, is not relevant to the discussion here.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8425	72	7	72	7	[Word spacing] (WHO 2016 ; IEA,IRENA,UNSD,World Bank 2018; ~ → (WHO 2016; IEA, IRENA, UNSD, World Bank 2018	Editorial – copyedit to be completed prior to publication	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8427	72	10	72	10	[Typo, Concerning context, stoke is not disease] stokes → strokes	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8429	72	10	72	10	[Word spacing] (WHO 2016 ; IEA,IRENA,UNSD,World Bank 2018; ~ → (WHO 2016; IEA, IRENA, UNSD, World Bank 2018	Editorial – copyedit to be completed prior to publication	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8469	72	21	72	21	[Recommended] are → is	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8471	72	26	72	26	[Recommended] in this case → in this case,	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
10013	72	27	72	29	Similarly: - Van de Ven, D. J., Sampedro, J., Johnson, F. X., Bailis, R., Forouli, A., Nikas, A., ... & Doukas, H. (2019). Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa. Environmental Research Letters, 14(9), 094001. - Taylor, R., Wanjiru, H., Johnson, O. W., & Johnson, F. X. (2019). Modelling stakeholder agency to investigate sustainable charcoal markets in Kenya. Environmental Innovation and Societal Transitions.	Taken into account - Van de Ven et al (2019) included. Taylor et al (2019) is not relevant to this part of the text.	Haris Doukas	School of Electrical and Computer Engineering, National Technical University of Athens	Greece
13585	72	27	72	31	To underpin the statement "Most studies" vs. "only few", it would be best to cite more papers for the first point than for the second.	Accepted - text revised to be more balanced	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
13587	72	27	72	31	A very interesting study, unfortunately with rather negative findings, is Hanna and Duflo (2016), "Up in Smoke". In a RCT study, they find that providing households with clean cookers did not help much in alleviating indoor pollution	Accepted - the reference included and the text revised to highlight the points made by the paper. Thanks	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
36987	72		72		Table 9.20 is about co-benefits, which are largely qualitative. It will be great to include another column stating the quantitative benefits. Quantitative benefits are more convincing the qualitative benefits.	Taken into account - Table 9.20 deleted. An overview of the multiple impacts associated with mitigation actions in buildings is presented in Section 9.8.1. A more analytical discussion on the impacts that can be quantified as well as their magnitude is presented in sub-sections 9.8.2-9.8.5	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
45237	72	3			Suggest using the World Energy Outlook 2019 for the latest (2018) data on energy access, with the number of those without access well below 3 billion, or the upcoming tracking SDG7 report), please note that populations lacking access to electricity, and lacking access to clean cooking are not additive.	Accepted - text revised on the basis of the latest (2019) SDG7 Report.	Timothy Goodson	International Energy Agency	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
10015	73	1	73	2	<p>Table 9.20</p> <p>Macroeconomic impacts: Apart from decline of energy prices due to reduced energy demand, there are literature signals that self-consumption based on RES installations in buildings and net metering could, sometimes, increase market uncertainties as well as lead to increased prices during some months of the year, due to generators counterbalancing revenue losses:</p> <p>- Nikas, A., Stavrakas, V., Arsenopoulos, A., Doukas, H., Antosiewicz, M., Witajewski-Baltvilks, J., & Flamos, A. (2018). Barriers to and consequences of a solar-based energy transition in Greece. <i>Environmental Innovation and Societal Transitions</i>.</p> <p>- Nikolaidis, A. I., Milidonis, A., & Charalambous, C. A. (2015). Impact of fuel-dependent electricity retail charges on the value of net-metered PV applications in vertically integrated systems. <i>Energy Policy</i>, 79, 150-160.</p> <p>- Chatzisideris, M. D., Laurent, A., Christoforidis, G. C., & Krebs, F. C. (2017). Cost-competitiveness of organic photovoltaics for electricity self-consumption at residential buildings: A comparative study of Denmark and Greece under real market conditions. <i>Applied energy</i>, 208, 471-479.</p> <p>- Azarova, V., Engel, D., Ferner, C., Kollmann, A., & Reichl, J. (2018). Exploring the impact of network tariffs on household electricity expenditures using load profiles and socio-economic characteristics. <i>Nature Energy</i>, 3(4), 317-325.</p> <p>- Rubino, A. (2018). Network charges in a low CO₂ world. <i>Nature Energy</i>, 3(4), 255-256.</p> <p>Impact on social wellbeing: Energy efficiency interventions could also lead to increased climate injustices and increased living costs (in the form of increased real estate prices):</p>	<p>Taken into account - Table 9.20 deleted and its contents were included in Section 9.8.1 The point on macroeconomic impacts was added. The point on social well-being was already there (e.g., changes in disposable income from distributional costs of new policies; Reduced energy access (in cases of increases in the cost of energy, high investment costs needed, etc.).</p>	Haris Doukas	School of Electrical and Computer Engineering, National Technical University of Athens	Greece
29121	73	1	73	2	<p>Since this table does not address specific interventions, you might consider merging with the subsequent table which does a great job of linking building actions to SDGs. Might reduce some overlap with text as well</p>	Accepted - Table deleted	Minal Pathak	Ahmedabad University	India
8431	73	4th cat	73	4th cat	[Recommended] wellbeing → well-being	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
48213	73	1			Under 'Health Impact' explicitly include thermal exposure, heat and cold.	Accepted - text revised but now included in Section 9.8.1 as Table 9.20 was deleted	Ian Hamilton	University 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
835	73				Table 9.20 Might some on these energy efficiency/mitigation actions be categorized as risk management actions ?	Noted - The table deleted. A categorization of the multiple impacts associated with climate mitigation actions in buildings is presented in Section 9.8.1. Some of them also result in better management of various risks. This is obvious in some categories (e.g., under energy security or under environmental impact). However, adding a separate category of co-benefits related to risk management would lead to several repetitions.	Ann Kosmal	U.S. General Services Administration	United States of America
10017	74	1	74	8	<p>Table 9.21</p> <p>There is a +1 connection between "Accelerating energy sufficiency and energy efficiency improvements" and SDG8 in:</p> <p>- Nikas, A., Ntanos, E., & Doukas, H. (2019). A semi-quantitative modelling application for assessing energy efficiency strategies. <i>Applied Soft Computing</i>, 76, 140-155.</p> <p>There is a +2 connection between all three mitigation options and SDG10, in:</p> <p>- Song, L., Lieu, J., Nikas, A., Arsenopoulos, A., Vasileiou, G., & Doukas, H. (2020). Contested energy futures, conflicted rewards? Examining low-carbon transition risks and governance dynamics in China's built environment. <i>Energy Research & Social Science</i>, 59, 101306.</p> <p>There is a +1 connection between "Improved access and fuel switch to modern low carbon energy" and SDGs 7, 8, 9, in:</p> <p>- Nikas, A., Stavarakas, V., Arsenopoulos, A., Doukas, H., Antosiewicz, M., Witajewski-Baltvilks, J., & Flamos, A. (2018). Barriers to and consequences of a solar-based energy transition in Greece. <i>Environmental Innovation and Societal Transitions</i>.</p> <p>There is a +2 connection between "Improved access and fuel switch to modern low carbon energy" and SDGs 3, 7, 13, in:</p> <p>- Van de Ven, D. J., Sampedro, J., Johnson, F. X., Bailis, R., Forouli, A., Nikas, A., ... & Doukas, H. (2019). Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa. <i>Environmental Research Letters</i>, 14(9), 094001.</p>	<p>Taken into account - The point on SDG10 is not supported by the suggested reference. The results presented in the paper depends on the implemented policies. Some of the other references proposed have been included in the sources of Table 9.21.</p>	Haris Doukas	School of Electrical and Computer Engineering, National Technical University of Athens	Greece
9213	74	1	74	20	<p>An overarching reference linking the SDGs and the achievement of health and well-being can be found here: Nunes, A.R., Lee, K. and O'Riordan, T. (2016). Rethinking the Sustainable Development Goals under a health and well-being framework. <i>BMJ Global Health</i>, 1 (3): e000068.</p>	Noted - Interesting paper, but irrelevant to this table, which provides information on how different mitigation actions in buildings affect various SDGs.	Ana Raquel Nunes	University of Warwick, UK	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
8435	74	6thcate	74	6thcate	[Recommended] wellbeing → well-being	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8433	74	SDG3	74	SDG3	[Recommended] wellbeing → well-being	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8457	75	1	75	7	In this section, it would be better to provide more details on how building sector mitigation activities affect indoor environmental quality.	Noted - It is discussed in the 3rd paragraph of the section 9.8.2.2	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
9207	75	1	75	37	Buildings, thermal comfort, ability to stay warm in winter and ability to stay cool in summer are put to test with extreme temperatures such as heatwaves and cold spells. Mixed methods research has found that the ability of vulnerable groups such as the elderly to achieve thermal comfort is complex and relates to vulnerability, resilience and adaptation, as well as assets. Financial, physical, social, place-based assets all play a role in being able to achieve thermal comfort. See: Nunes, A.R. (2019). General and specified vulnerability to extreme temperatures among older adults. International Journal of Environmental Health Research, DOI: 10.1080/09603123.2019.1609655; Nunes, A.R. (2018). The contribution of assets to adaptation to extreme temperatures among older adults. PLoS ONE, 13 (11): e0208121.	Accepted - text revised	Ana Raquel Nunes	University of Warwick, UK	United Kingdom (of Great Britain and Northern Ireland)
8473	75	20	75	20	[Recommended] installing → to install	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13643	75	28	75	30	For a more recent reference on the importance of 'folk first approaches to tackling energy poverty may I suggest our article in Nature Energy: Baker, K.J., Mould, R., & Restrict, S., 2018. Rethink fuel poverty as a complex problem. Nature Energy, 2nd July 2018. DOI: https://doi.org/10.1038/s41560-018-0204-2 Available at: https://rdcu.be/2j8E	Taken into account - it is acknowledged that fuel poverty is a multidimensional social problem (the proposed reference was added in Section 9.8.4.1). In this context, energy efficiency and more generally mitigation actions in buildings is part of the solution, contributing to energy poverty alleviation. It is not a one-size-fits-all solution, and this has been clarified in the text.	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
39403	75	1	76	7	At international level, energy poverty refers to the lack of access to energy while what is described in this section is more fuel poverty which is considered in the EU as energy poverty.	Accepted - text revised accordingly	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
42051	75	1			In this section (9.8.2.2) it should be mentioned that in developing countries warmer temperatures compromises food security, not only because of the impact on crops even livestock, but also because of the impact in food preservation or conservation	Noted - This section does not review the health implications of a warmer climate but potential benefits/risks on health that are generated by carbon mitigation actions in buildings. This comment is addressed in Section 9.7	Francisco Javier Hurtado A	European Patent Office	Germany
8437	76	10	76	10	[Word spacing] (WHO 2016 ; IEA,IRENA,UNSD,World Bank 2018; ~ → (WHO 2016; IEA, IRENA, UNSD, World Bank 2018	Taken into account - the reference changed	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8475	76	11	76	11	[Recommended] only in china → only in china,	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8439	76	24	76	24	[Recommended] In developed economies the estimated → In developed economies, the estimated	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13645	76	33	77	23	Might be worth mentioning here that policies to reduce the embodied energy of buildings through using local / natural / sustainable building materials and switching to alternative fuel sources can be used to leverage new supply chains (e.g. for forestry products), which in turn bring further environmental, social and economic benefits to local communities.	Accepted - text revised. In this section the environmental benefits are highlighted, while in section 9.8.5.3 the economic benefits are also mentioned.	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
8441	77	13	77	13	[Word spacing] 406 kg → 406kg	Editorial – copyedit to be completed prior to publication	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8443	77	15	77	15	[Word spacing] 706 kg → 706kg	Editorial – copyedit to be completed prior to publication	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8445	78	14	78	14	[Word spacing] (WHO 2016 ; IEA,IRENA,UNSD,World Bank 2018; ~ → (WHO 2016; IEA, IRENA, UNSD, World Bank 2018	Taken into account - references changed	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
4531	78	37	78	39	Energy poverty can also be included in Energy Efficiency Obligation Schemes under the EU energy efficiency directive, whereby savings achieved in low-income households are weighted with a higher factor	Noted - This sentence describes the outcomes of specific study undertaken in EU. The point made here could be addressed in the policies section.	Leonardo Barreto	Austrian Energy Agency	Austria

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
13647	78	1	79	10	<p>The original concept of fuel / energy poverty was first defined (as affordable warmth) in 1983 [1], and although Brenda Boardman's seminal 1991 work retains this restriction [2] she was an early proponent of the 'all essential energy needs' definition. However, the big problem with expanding the definition is how to define an international figure for what percentage of household expenditure on other energy needs could reasonably be used as a threshold for determining if a household is in energy poverty - and this is one of the reasons we have argued that threshold values need to be replaced by dynamic metrics [3]. So whilst it would be more harmonious to extend the definition to include cooling energy demand, we foresee great difficulty in apportioning an internationally acceptable figure for other energy needs (aside from perhaps a tiny figure for access to the internet) because of the degree of variation in national cultures / building traditions / normative behaviours / geographies, etc.</p> <p>The problem with Stefan and co's definition (p. 78, L1) is that it leaves this problem as the next step towards defining a meaningful set of metrics that would ultimately need a robust technical definition (as used for heating in the Scottish, Welsh, Northern Irish, Irish, etc, definitions). Yet we would argue that this is better addressed by reconceptualising fuel / energy poverty as an emergent property of a complex system of predominantly social conditions (encompassing aspects such as access to services) for which (in many cases) suitable metrics already exist [4]. Based on our own experience and those of the support organisations we work with, we would also argue that such a reconceptualisation would better drive the targeting of more appropriate support to fuel poor and otherwise vulnerable householders [5]. The irony here is that you have a group of social scientists arguing for a more technical definition and a group of building scientists arguing for a more social definition (!).</p>	<p>Taken into account - the requirement that "all essential energy needs" should be taken into account for evaluating the levels of fuel poverty is widely acknowledged. If there are no appropriate metrics to this end, this is a knowledge gap. It is already highlighted in the text saying that there is no single and commonly accepted definition of fuel poverty, while the application of different measurement methodologies often leads to divergent results. The need to utilize dynamic metric is mentioned now in the text. In addition, it is acknowledged that fuel poverty is a complex multidimensional social problem and energy efficiency could be part of the policies targeting its alleviation.</p>	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
39405	78	1	79	36	<p>This is the second section on energy poverty. The two sections should be merged into one to avoid repetitions and to improve the flow.</p>	<p>Noted - The multiple benefits of mitigation actions in the sector of buildings are categorized in 5 main types, namely health implications, environmental effects, impacts on social well-being, and economic effects. The whole section is organized across these categories. To the extent that some of these mitigation options contribute in energy/fuel poverty alleviation this affects both health impacts and social well-being.</p>	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
22361	78	2	79	11	Supplement to the chapter 9.8.4.1 Energy poverty alleviation: It's not just about energy poverty, it's also about housing costs. In countries where the costs of energy-saving renovation in social housing or for people with low incomes are not paid by the state, investments have to be refinanced through rent. (Like Sweden, Netherlands, Austria, Germany) Existing subsidies does not compensate for this. Problems result from increasingly subject to European state aid law. The investment costs exceed the possible savings by a multiple. This creates the social question of housing overburden rate. See Andreas Pfnür, Nikolas Müller (2013): Energy-efficient building renovation in Germany, study Part II: Forecasting the costs of alternative renovation schedules and analysis of the financial burden for owners and tenants by 2050. In: Andreas Pfnür (ed.), Working Papers on Real Estate Research and Practice, Volume No. 28. In German: https://www.real-estate.bwl.tu-darmstadt.de/media/bwl9/dateien/arbeitspapiere/Energetische_Gebauudesanierung_in_Deutschland_Teil_2_2.pdf	Taking into account - It is true that in most cases the investment costs exceed the possible savings. The entire section 9.8 attempts to quantify the multiple benefits of mitigation actions with a view to include them in an integrated cost-benefit analysis (it is highlighted at the end of section 9.8.1). The issue of increased housing values/costs associated with the implementation of energy renovations is discussed in section 9.8.5.2. The necessity for appropriate policies to support low-income households to improve the energy performance of their homes or to afford living in buildings with improved energy performance is also discussed in section 9.9.	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
36989	79	2	79	2	duplication of sentence	Accepted - text revised	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
8447	79	2	79	5	[Typo, this sentence is repeated twice] needs to be deleted	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13589	79	4	79	5	Repetition of the sentence	Accepted - text revised	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
25169	79	4	79	5	Delete "Several recent studies recognise ... Mashhoodi et al. 2019)." as this a repetition	Accepted - text revised	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8449	79	25	79	25	[Word spacing] 1.3-1,9 \$ → 1.3-1.9\$	Editorial – copyedit to be completed prior to publication	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8477	79	40	79	40	[Recommended] well-designed, operated, and → well-designed, operated and	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
42053	79	37			In the context defined by the paragraph beginning in this line, smart meter can strongly support the role of consumers (better to say prosumers) by for instance the use of meters which determine the environmental impact of user behavior and, of course, with smart meters monitoring the performance of renewable electricity generating systems (of solar panels).	Taken into account - this section analyses the economic implications of mitigation actions. The role of smart meters and their contribution in lifestyle changes and developing low carbon buildings is presented in Section 9.4.4.2 and 9.9.3.	Francisco Javier Hurtado A	European Patent Office	Germany
39407	80	3	80	3	Why do you refer to energy efficient buildings only while the previous sections refer to decarbonised buildings? Consistency in the terminology used across the whole chapter is needed	Accepted - text revised	Emmanuel RAUZIER	NGO Association negaWatt	France
8451	80	27	80	27	[Word spacing] 10.4 to 20.8 €/m2 → 10.4 to 20.8€/m2	Editorial – copyedit to be completed prior to publication	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
809	80	31	81	4	Did your research find any studies which show an increased asset value in these low energy buildings due to their high performance enclosures and sustems' ability to support continuity of operations, disaster resilience, thermal resilience? If so please include, if not note in the research gaps.	Noted - the studies reviewed do not provide this information. Nevertheless, the analysis presented in this section provides an indication to what extent energy efficiency improvements may increase asset values. This information could be useful to overcome some barriers hindering the implementation of energy efficiency intervention in buildings such as the the split incentive barrier between tenants and landlords.	Ann Kosmal	U.S. General Services Administration	United States of America

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
19737	80	30	82	1	<p>This section doesn't cover commercial and public buildings, where the potential impact of an asset uplift is likely to be significantly more than in households. The evidence for this is not as extensive compared to households, but is there. Several studies have shown a positive relationship between high energy performance and increased asset values resulting from higher rents, lower operational costs, longer lease lengths and lower void times.</p> <p>Commonwealth of Australia (2015). Commercial Building Disclosure Program Review. Report by Acil Allen Consulting to the Department of Industry and Science. Final report. March 2015.</p> <p>Eichholtz, P., Kok, N. & Quigley, J. (2010). Doing Well by Doing Good? Green Office Buildings. American Economic Review, 100, 2492–2509.</p> <p>International Energy Agency (2014). Capturing the multiple benefits of energy efficiency. https://webstore.iea.org/capturing-the-multiple-benefits-of-energy-efficiency</p> <p>International Energy Agency (2019). The multiple benefits of energy efficiency. https://www.iea.org/reports/multiple-benefits-of-energy-efficiency/asset-values#abstract</p> <p>Investment Property Databank (IPD, 2019). IPD/Department of Industry NABERS Office Energy Analysis. IPD September 2013.</p>	<p>Taken into account - this section puts emphasis on residential buildings as the majority of GHG emissions from the sector are attributed to this type of buildings. However, the section also includes data related to non-residential buildings (please see the last paragraph), but there is no space for a more detailed analysis. Most of the studies suggested are included in the review study EC (2016), which is presented in the section. The findings of the study Commonwealth of Australia (2015) were added.</p>	Peter Mallaburn	University College London	United Kingdom (of Great Britain and Northern Ireland)
45483	80	30			<p>About this section 9.8.5.2, Giraudet 2020 (http://www.sciencedirect.com/science/article/pii/S0140988320300372) contains an extensive review of the literature, with a lot of tables. The main insight is that capitalization of energy efficiency is observed in home sales (even in the absence of energy performance certificates). Capitalization is observed in rental housing, too, but the resulting market equilibrium can be seen as inefficient in that rented dwellings are less energy efficient than owner-occupied ones.</p>	Accepted - text revised and the suggested reference included.	Louis-Gaëtan Giraudet	CIRE, Ecole des Ponts ParisTech	France
8459	82	2	82	24	<p>In this section, the main point is that it is imperative that developing countries spend domestically funded funds. Therefore, it would be more convincing if the section briefly describes policies that support.</p>	Noted - this section focuses on the multiple economic benefits associated with mitigation actions and the conditions for their maximization. The discussion on policies that can support the domestic spending of the costs required to realize these mitigation actions is out of the scope of this review.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8479	82	18	82	18	[Recommended] be spend → be spent	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
13591	82	4				Accepted - explanations are provided in glossary. In the revised text only GVA is mentioned.	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
13649	83	35	83	47	I think some mention of thermal storage is needed here. Experience from Denmark and others has shown that using large-scale solar thermal and inter-seasonal thermal stores can leverage significant cost and carbon efficiencies for district heating (e.g. https://stateofgreen.com/en/partners/ramboll/solutions/world-largest-thermal-pit-storage-in-vojens/). And we would also point to the potential for domestic thermal batteries (which have much lower embodied costs than electric batteries) for reducing emissions and energy costs - see: https://www.sunamp.com/	Taken into account - due to space restrictions the text was shortened. As this section does not focus on technologies, such a discussion can not be made here.	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
15111	83	35	83	47	Based on only 2 references the authors only discuss heat pumps in relation to energy security. As heat pumps compete with other heating alternatives, including waste heat from other processes, research covering this should be included. Drawing such simple conclusions that are not technology neutral is below IPCC quality standards. How does switching from gas heating to heat pump reduce peak demand and grid infrastructure investment. This can only be true if the base scenario is electric radiators, but not if the base scenario is BAU!	Rejected - this paragraph explores the implications of mitigation actions and particularly those related to electrification of final demand and the promotion of low energy buildings in the structure and reliability of the power sector. It is not about evaluation of alternative mitigation options. Due to space limitations the text on heat pumps was deleted.	Levihn Fabian	KTH - Royal Institute of Technology	Sweden
827	83	36	83	36	Regarding reliability of the power sector suggest mention causes of i.e. observed and expected extreme events due to climatic change, suggest noting the ability to continue occupancy, operations, business continuity etc.	Please see Section 9.7	Ann Kosmal	U.S. General Services Administration	United States of America
831	83	39	83	39	Deep energy retrofits - many references i.e. IEA Annex 61	Noted - this section does not analyze deep energy retrofits in general, but the potential implications of various mitigation options (including deep energy retrofits) to the power system. We didn't identify any relevant references on this IEA study.	Ann Kosmal	U.S. General Services Administration	United States of America
8453	83	44	83	44	[Word spacing] 165 TWh/y → 165TWh/y	Editorial – copyedit to be completed prior to publication	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
15115	83	35	84	4	Discusions on how heat pumps can be used in relation to intermittent renewables is fosocused on local heatpumps in buildings only. This one side of an old discussion on the topic of centralized heat pumps in district heating v.s. decentralized heatpumps in individual buildings. These are copeting technologies. For example Lund et al (2018) [https://doi.org/10.1016/j.energy.2018.08.206] showed a great potential for using CHP and cnetralized heatpumps to provide the system service of ballancing intermittent renewables - e.g. produce electricity when intermittents are scarce and power to heat when intermittents are abundant. This has been confirmed in practice for Stockholm in Levihn (2017) CHP and heat pumps to balance renewable power production: Lessons from the district heating network in Stockholm. [https://doi.org/10.1016/j.energy.2017.01.118].	Taken into account - this section presents in brief the energy security implications of mitigation actions in buildings. Due to space restrictions no mention on technologies is made in the revised text .	Levihn Fabian	KTH - Royal Institute of Technology	Sweden
25171	84	1	84	4	Further elaborate on the changed "character of threats regarding energy security from political to technical."	Taken into account - text deleted	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8481	84	8	84	8	[Word spacing] Kirchoff and Strunz 2019) . → Kirchoff and Strunz 2019).	Accepted - text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13411	84	18	84	43	This part should also include capacity building issues. Number of people working in the field lack the necessary skills to refurbish buildings or install different equipement. This is especially true in developing countries, but not only (see the tragic story in Australia - https://www.theaustralian.com.au/nation/climate/warning-of-deaths-over-solar-panel-installations/news-story/dccd1f4a8169cadb5941b6d99591ee7a)	Accepted: barriers raleted to skills has been added	Thibaud Voita	IFRI	Germany
13413	84	18	84	43	Appliances and lighting are not much covered within the chapter, and it is unclear whether this is done on purpose (focus on building envelope as I assumed reading the document) or not (some parts cover them). If they are to be included, then the report requires significant edits and additions - on how to promote energy performance of these products (especially in developing countries where setting up codes and standards is a challenge), the links with HFCs...	Accepted: policies for appliances and lighting cleraly covered in the section, and added to this subsection.	Thibaud Voita	IFRI	Germany
37527	84	18	84	43	Barriers to adoption of rationally and economically efficient measures would seem to be a critical topic to expand upon. It is given very short mention here, whereas the section below on policies is much longer. The barriers, both apparent and real, should be discussed in much more detail so that the relevant policies can be related back to barriers.	Party Accepted: section on barriers is shortly expanded due to lack of space, more details are provided in the references.	Michiel Schaeffer	Climate Analytics	Netherlands
8485	84	19	84	43	It needs more categorized characteristics about barriers. And sentence needs division for better readability.	Accepted: section on barriers has been revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39409	84	19	84	43	Once again the focus is on consumers behavior which narrows the scope of policies and makes this section inconsistent with the previous ones. See references included in comment 28	Nor Accepted: several barriers presented in the section are related to market, finance, governance, instituions, which are not directly impacting the consumer behaviour.	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
39411	84	19	84	43	The section on willingness (see comment 31) would fit better here.	Noted thank you	Emmanuel RAUZIER	NGO Association negaWatt	France
8483	84	21	84	21	[Recommended] Cattano → Cattaneo	Thank you, but Cattano is correct!	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
36991	84	24	84	25	Reddy (Reddy, 1991), Weber (Weber 1997), Sorrell (Sorrell et al., 2000), Reddy (Reddy, 2002), Sorrell (Sorrell e al., 2011). Except the last two, these references are too old for such an evolving field. Recent references should be considered.	Partly accepted, these "old" references are key milestone in literatures, however more recent references have been added as requested.	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
10019	84	33	84	34	There is a recent, detailed list of barriers to promoting energy efficiency in China, as acknowledged by citizens and other stakeholders, in: - Song, L., Lieu, J., Nikas, A., Arsenopoulos, A., Vasileiou, G., & Doukas, H. (2020). Contested energy futures, conflicted rewards? Examining low-carbon transition risks and governance dynamics in China's built environment. Energy Research & Social Science, 59, 101306.	Accepted , reference added	Haris Doukas	School of Electrical and Computer Engineering, National Technical University of Athens	Greece
33901	84			91	It is surprising to see no mention of the growing issue of 'energy performance gap' in buildings. This is the gap between design intent and actual outcomes and is widely researched. EPG has potential to undermine national and international carbon targets. A whole section needs to be devoted to this issue. A few papers are given here that can be referred to: - Gupta, R., Gregg, M., Passmore, S. and Stevens, G. (2015) Intent and outcomes from the Retrofit for the Future programme: key lessons, Building Research and Information, 43:4, 435-451 - Gupta, R. and Gregg, M. (2016) Do deep low carbon domestic retrofits actually work?, Energy and Buildings, Volume 129, Pages 330-343 - Gupta, R. and Kotopouleas, A. (2018) Magnitude and extent of building fabric thermal performance gap in UK low energy housing, Applied Energy, 222(C), pp.673-686	Accepted short section on energy performance gap added	Rajat Gupta	Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
33903	84			91	Section 9.9 needs to have a sub-section to emphasise the quality assurance procedures when installing energy saving measures that are necessary for realising actual energy reductions from buildings.	Accepted short section on energy performance gap added	Rajat Gupta	Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
33905	84			91	Although building codes (and building regulations) have been mentioned at various places in Chapter 9, it is important to emphasise that building codes and regulations do not cover all end uses of energy in buildings. Usually as built performance is covered by building codes/regulations. If we have to move towards net zero carbon, it is vital to have address the actual in-use performance of buildings.	Accepted short section on energy performance gap added	Rajat Gupta	Oxford Brookes 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
13593	84	24			The economic literature is absent from the list of studies cited, even though this is a highly economical topic (energy efficiency gap). Here a list of relevant review papers: Golove and Eto (1996), Gillingham (2014) "Bridging the Energy Efficiency Gap: Policy Insights from Economic Theory and Empirical Evidence"; Gerarden (2017) "Assessing the Energy-Efficiency Gap"; Gillingham et al. (2009) "Energy Efficiency Economics and Policy "; Tietenberg (2009) "Reflections—Energy Efficiency Policy: Pipe Dream or Pipeline to the Future?". An interesting, and controversial paper is Allcott (2012) which challenges the idea that the energy efficiency gap is large ("Is there an energy efficiency gap?").	Noted thank you	Antoine Levesque	Potsdam Institute for Climate Impact Research	Germany
8487	85	28	85	28	[Recommended] prebound → rebound	small typos were revised in the text	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
35691	85	28	85	33	The discussion of prebound and the implication that energy poor households are more prone to rebound effects should be more carefully worded. In reality the benefits of being able to comfortably heat more of a home should not be considered as a rebound effect as this is to paint this effect as negative. In reality this is a comfort take that the improvement in the EE of the building permits. The resulting increased well-being is a positive and should be presented as such.	Accepted, text revised	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39413	85	28	85	33	The conclusion included here should be nuanced or revisited. The access of the poorest part of the population to warm homes should not be considered as a rebound effect. It should rather be considered as a co-benefit which ensures the access to comfortable homes for all.	All conclusions section was rewritten	Emmanuel RAUZIER	NGO Association negaWatt	France
39877	85	37	85	37	The rebound effect for heating after a building retrofit has been assessed around 20% in Table 2 in Cayla, Osso, 2013, Does energy efficiency reduce inequalities? Impact of policies in residential sector on household budget, ECEE conference proceedings, peer-reviewed paper. https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2013/5a-cutting-the-energy-use-of-buildings-projects-and-technologies/does-energy-efficiency-reduce-inequalities-impact-of-policies-in-residential-sector-on-household-budget/	Accepted, text revised	Bianka SHOAI-TEHRANI	RTE, CentraleSupélec	France
2649	85	1	86	11	Subsection 9.9.2 has the same title as subsection 5.4.5.5. In both cases, there is a focus on energy, and at the same time an attempt to provide general, possibly generic definitions: e.g. the presents text split the effect into 4 components. One expects indeed to find rebound analyses in chapter 5, as it seems that rebound effects from the demand side generally prevail. However supply side may be present, and a logical sharing between chapters 5 and 9 may be found along these lines. Finally lines 7-8 on page 86 are surprizing to say the least. Rebound a co-benefit? We all know that in some cases mitigation action will go against well being, on the short tem at least. This has to be adressed. Still, rebound are a partial failure and it would be surprizing that they be assimilated to co-benefits in an IPCC AR.	the rebound effect text was revisited in all the chapter	Philippe Waldteufel	CNRS/IPSL/LATMO S	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8489	85	37	86	6	Too many contents are listed up. Need arrangement.	Accepted, text revised	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
1079	85	47	86	3	"...which stems from the end-uses included in the analysis,..." Rebound also occurs in energy intermediate uses -- the energy used by producers to provide final end-use goods and services. In the intermediates sector, rebound magnitudes show as being different from, and higher than, rebound magnitudes in end-use sectors. See reference #1, below:	the rebound effect text was revisited in all the chapter	Harry Saunders	Carnegie Institution for Science	United States of America
1081	85	47	86	3	1.Saunders, Harry D. 2013. Historical evidence for energy efficiency rebound in 30 US sectors and a toolkit for rebound analysts. Technol. Forecast. Soc. Change 80(7):1317-30 Implications for Climate Change Models. Energy J. 36(1):23-48	the rebound effect text was revisited in all the chapter	Harry Saunders	Carnegie Institution for Science	United States of America
1093	85	47	86	3	"...which stems from the end-uses included in the analysis,..." Rebound also occurs in energy intermediate uses -- the energy used by producers to provide final end-use goods and services. In the intermediates sector, rebound magnitudes show as being different from, and higher than, rebound magnitudes in end-use sectors. See reference [*], below:	the rebound effect text was revisited in all the chapter	Harry Saunders	Carnegie Institution for Science	United States of America
1095	85	47	86	3	* Saunders, Harry D. 2013. Historical evidence for energy efficiency rebound in 30 US sectors and a toolkit for rebound analysts. Technol. Forecast. Soc. Change 80(7):1317-30 Implications for Climate Change Models. Energy J. 36(1):23-48	the rebound effect text was revisited in all the chapter	Harry Saunders	Carnegie Institution for Science	United States of America
1073	85	1	93	1	This section is very thorough. But it seems to assume that rebound effects must always be minimized via various instruments. However, rebound effects are generally economic welfare-creating so there is a tradeoff. Especially for developing countries. References below:	the rebound effect text was revisited in all the chapter	Harry Saunders	Carnegie Institution for Science	United States of America
1075	85	1	93	1	References for the claim that rebound is generally seen to be welfare-creating: *Saunders H D. 1992. The Khazzoom–Brookes postulate and neoclassical growth. Energy J. 13(4):131–48 *Hanley N, McGregor PG, Swales J, Kim J, Turner K. 2009. Do increases in energy efficiency. improve environmental quality and sustainability? Ecol. Econ. 68(3):692–09 *Gillingham K, Kotchen MJ, Rapson DS, Wagner G. 2013. Energy policy: The rebound effect is overplayed. Nature. 36(493):475–76 *Gillingham, K., D. Rapson, and G. Wagner, 2016: The rebound effect and energy efficiency policy. Review of Environmental Economics and Policy, 10(1), 68–88, doi:10.1093/rep/rev017 *Liu Y, Wei T, Park D. 2019. Macroeconomic impacts of energy productivity: a general equilibrium perspective. Energy Effic. 1-16	the rebound effect text was revisited in all the chapter	Harry Saunders	Carnegie Institution for Science	United States of America
1077	85	1	93	1	Further, this tradeoff is emphasized in the 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)."	the rebound effect text was revisited in all the chapter	Harry Saunders	Carnegie Institution for Science	United States of America

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
45485	85	1			About section 9.9.2: see recent estimates by Aydin et al. (2017, DOI: 10.1111/1756-2171.12190) and Cozza et al. (2020, DOI: 10.1016/j.enpol.2019.111085)	the rebound effect text was revisited in all the chapter	Louis-Gaëtan Giraudet	CIREDD, Ecole des Ponts ParisTech	France
39879	86	7	86	7	Regarding co-benefits of rebound effects : the energy expenses linked with the rebound effects could be seen as the willingness to pay of buildings occupants for the extra comfort and thus seen as the economic value of the post-retrofit extra comfort. Is is assessed to be around 200 euros/household/year in Nösperger, Stanislas, Dominique Osso, and Maxime Raynaud. 2017. "A Proposal to Go beyond the Rebound Effect: How to Evaluate the Financial Value of Comfort after Retrofitting?" In ECEE conference proceedings, 1759–67. peer-reviewed paper.	Accepted, text revised	Bianka SHOAI-TEHRANI	RTE, CentraleSupélec	France
1083	86	10	86	11	"Considering rebound effects as a problem, appropriate policies could be implemented for their mitigation." Again, this points to the caution above against seeming to imply that mitigating rebound is always desirable.	the rebound effect text was revisited in all the chapter	Harry Saunders	Carnegie Institution for Science	United States of America
4535	86	13	86	13	9.9.3. only mentions energy efficiency policies for buildings and not polciies for renewable energy in buildings.	Accepted , RES in buildings are mention in the EPBD and building codes in particular in relation to NZEBs, plus there is an equivalent section on policies fro RES with focus on decentralised on-site installations	Leonardo Barreto	Austrian Energy Agency	Austria
39415	86	13	86	13	The reference in the title to energy efficient and low carbon buildings does not match with the previous sections which refer to decarbonised buildings. Consistency is needed in the terminology used across the whole chapter	Accepted title will be changed to decarbonisation.	Emmanuel RAUZIER	NGO Association negaWatt	France
43081	86	13	86	13	Chapter 13 presents a set of assessment criteria for evaluating policy instruments. Using the full set of assessment criteria to evaluate policies such as building codes would add richness to the analysis and ensure that policies are comprehensively assessed. In particular, one of the innovations in chapter 13 is the addition of new criteria such as transformative potential and policy package specific criteria (comprehensiveness, consistency and coherence). Please refer table 13.3 for the further details.	Partly accepted, unfortunately it is not always possible to have an assessment according to the full set of criteria as in Ch.13 because lack of literature.	Parth Bhatia	Centre for Policy Research, New Delhi	India
43083	86	13	86	13	This section very comprehensively assesses various policy instruments across geographies. However, it does not touch upon the interactions between policy instruments except in brief (pg 92, lines 22-33). For the SOD, it would be helpful to seek out and include literature on the synergies and trade-offs between policy instruments or within packages.	paragraph on policy mixes added	Parth Bhatia	Centre for Policy Research, New Delhi	India
43085	86	13	86	13	This section would greatly benefit from a case study of a building related program that shows a real world package of policy instruments along with processual steps taken to overcome governance and finance barriers. Such a case could also shed light on how policymakers are designing packages to achieve both technical and non-technical goals. The chapter could aslo think of including two boxes, one for a contemporaneous high profile large-scale program (eg. EU EPBD) and one success story with ex post analysis of key success factors.	Accepted: EU Building Policy Box + success story	Parth Bhatia	Centre for Policy Research, New Delhi	India

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
26119	86	14	86	18	The importance of policy packages is also stressed in Chapter 13 (section 13.6 Policy mixes and governance). It would be very helpful to have examples of such climate mitigation policy packages targeting buildings sector in Chapter 9. They could be referenced in Chapter 13 (e.g. Table 13.5 Enablers and barriers for policy led sector transitions)	Accepted: Box on EU building policies added	Mykola Shlapak	N/A	Ukraine
10021	86	16	86	18	These policy packages should also feature diversification to promote robustness against risks and uncertainties jeopardising the success of the measures included, in both short- and long-term planning, and from both quantitative and stakeholder perspective: - Forouli, A., Gkonis, N., Nikas, A., Siskos, E., Doukas, H., & Tourkolias, C. (2019). Energy efficiency promotion in Greece in light of risk: Evaluating policies as portfolio assets. <i>Energy</i> , 170, 818-831. - Nikas, A., Ntanos, E., & Doukas, H. (2019). A semi-quantitative modelling application for assessing energy efficiency strategies. <i>Applied Soft Computing</i> , 76, 140-155. - Doukas, H., & Nikas, A. (2020). Decision support models in climate policy. <i>European Journal of Operational Research</i> , 280(1), 1-24.	Accepted: citation added and suggested text added	Haris Doukas	School of Electrical and Computer Engineering, National Technical University of Athens	Greece
26121	86	19	86	27	Categorization of energy efficiency policies could be better aligned with the taxonomy used in Chapter 13, sub-section 13.5.1 (i.e. economic or market-based instruments, regulatory instruments, and other policies) to strengthen consistency	Accepted here different classification system for EE policy are presneted and then we propose the same as in chapter 13	Mykola Shlapak	N/A	Ukraine
43079	86	19	86	39	It might be worth mentioning the policy taxonomy recommended by the policy chapter (section 13.5.1) along with the other taxonomies recommended in the buildings specific literature.	Accepted here different classification system for EE policy are presneted and then we propose the same as in chapter 13	Parth Bhatia	Centre for Policy Research, New Delhi	India
13405	86	34	86	34	Some references are named in the text but nowhere to be seen in the sources section - e.g. Bertoldi 2020, Bertoldi 2018 or Rosenow et al. 2017 and Rosenow et al. 2019 - there may be others	Accepted references will be added in the reference list.	Thibaud Voita	IFRI	Germany
13025	86	36	86	39	When describing the IEA energy efficiency policies and measures database please do cite the IEA directly: https://www.iea.org/policies ; and please check for the latest classification of policy types.	Accepted IEA database website added	Mafalda Leite de Faria Coe	International Energy Agency	France
8491	86	1	93	32	This paragraph refers to policies for enegy-efficiency and low/zero carbon building, and needs to be classified.	Accepted: the title has been changed to "policies for the deacrbinsation of buildings"	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
39419	86	13	93	1	Suggestion: the sub-sections based on the categorisation provided in table 9.24 will make the section easier to read. It will also help the authors in identifying repetitions and inconsistencies within the section and with other sections.	Accepted, the table moved at the beginning of the section and used to classify the different policies, repetitions have been deleted	Emmanuel RAUZIER	NGO Association negaWatt	France

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
39421	86	13	93	1	On innovative policies, the ES makes it hard to identify what are these innovative policies in the policy section. Furthermore, reference to EU policies is too frequent. The same authors are also listed several times. Policies for renovating buildings are not sufficiently discussed and addressed. In developed countries the main challenge is to renovate their existing building stock.	Accepted, a new box on EU policies has been inserted where the topic of renovation of existing building is key. Please also note that the section of financing is mainly geared to the renovation of existing buildings, this will be clearly indicated in that section. Several non EU policies have been added in the text.	Emmanuel RAUZIER	NGO Association negaWatt	France
19733	86	13	93	2	<p>Currently the text mentions the energy efficiency gap, but does not address the specific way this problem is manifested in commercial buildings, commonly known as the the "performance gap". It arises because regulatory and market support regimes tend to focus on building codes aimed at the fabric of the building and regulated services such as HVAC using predictive models and general assumptions about building types and the way they might be used. However real-world experience shows that these predictions can significantly underestimate how much energy is actually used when the building is occupied.</p> <p>Suggested text follows (that also covers other issues identified in other comments below).</p> <p>Energy efficiency policy principles for non-energy intensive organisations</p> <p>Energy efficiency policy for commercial and public buildings face three problems. First, the sector is highly heterogeneous, with many different building types, sizes and operational uses. Second, rented property faces principal/agent problems where the tenant benefits from the energy efficiency investment of the landlord. Thirdly regulatory regimes such as building codes tend to focus on predicting energy performance at the design stage. These factors combine to produce a "performance gap" with in-use energy performance significantly higher than the regulated intent (Cohen & Bordass 2016).</p> <p>There are two sets of recent studies that are relevant to solving this dilemma. The first takes an organisational, bottom up approach looking in detail at how companies and individuals make decisions about energy efficiency investments and how policy might influence these decisions to reduce demand for energy.</p>	Comment accepted, suggested text added (not in full as there are some space limitations)	Peter Mallaburn	University 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
25179	86	13	93	2	Section 9.9.3 to also consider policy packages which are more suitable and effective for developing countries	Accepted, the following test is added: most of the policy packages suggested in the section 9.9.3 are also effective for developing countries, in particular on regulatory and incentives (grants), while the carbon tax could be more problematic unless there is a strong recycling of the revenues	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
13409	86	13	93	3	This part is very EU-focused and would need to be more structured (e.g. adding titles...) as it reads like a long list of measures. Some elements could be added: these include the fact that the public sector should play the role of the first mover and initiate policies within public buildings, the role of utilities (for ex. in the US - their policies are barely mentioned). It would also be interesting to link these to the concept of sufficiency, e.g. what type of policies can actually promote sufficiency?	Accepted, subheadings are added, with titles of policies. New section on the role of the public sector is added. Link to sufficiency is added. Additional non-EU policies will have been added.	Thibaud Voita	IFRI	Germany
39427	86	13	97	37	Industrial policies could also contribute to decarbonise the building stock	Partly accepted. Industrial policies are discussed in details in the Industry chapter. If the comment is related to the decarbonisation of the building materials (cement, glass, steel, etc.) this is already addressed in the short section on LCA, where we have included the link to industrial policies. If the comment is referring to the industrial buildings, these are already covered by the building policies in this chapter.	Emmanuel RAUZIER	NGO Association negaWatt	France
4533	87	3	87	5	It should be mentioned that building codes can also include minimum requirements for renewable energy in new and existing buildings	Accepted, text added as suggested.	Leonardo Barreto	Austrian Energy Agency	Austria
8493	87	22	87	22	In the part "however some limitation", "some limitation" needs more explanation and doesn't fit the context. Need to explain which is limited for better understanding.	Accepted, more explanation has been added	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8495	87	26	87	29	References to the definition of NZEB have been presented and discussed and only studies discussed are presented, not how defined. It needs more examples about defining NZEB through studies.	Accepted, several studies have been added, and a common definition.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13651	87	27	87	27	Willians' should be 'Williams' (?)	Accepted. Thank you, the name has been corrected	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian 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
4537	87	31	87	33	In EU context, besides the Energy Performance of Buildings Directive and the Energy Efficiency Directive, the EU Renewable Energy Directive 2018/2001 (Art. 15, 23, 21, 22, 24), which includes provisions for renewable energy in buildings, renewable heating and cooling and renewable district heating, also has an impact on decarbonisation of buildings. A coordinated implementation of the 3 directives is necessary to achieve decarbonisation targets in the buildings sector. Generally, it is necessary to exploit synergies between renewable energy policies, energy efficiency policies and policies specifically directed towards buildings as well as consider linkages with CO2 policies such as carbon pricing to achieve decarbonisation. Developing a unified set of rules for energy efficiency and the use of renewables in the buildings sector is important to achieve decarbonisation.	Comment accepted, reference to the RED will be done and also mentioned the coordination of the 3 EU policy.	Leonardo Barreto	Austrian Energy Agency	Austria
8497	87	36	87	36	The specific objective for "Several other jurisdictions" needs to be explained.	Accepted, "jurisdictions" has been changed to countries, and the list of countries could be seen in the reference Feng et al.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
19741	87	46	88	6	Energy Performance Certificates are useful in their own right and as a benchmark for policy but only when properly designed and implemented. There is evidence from the UK that as currently designed EPCs are not reflecting the true energy performance of households. Crawley, J., Biddulph, P., Northrop, P., Wingfield, J, Oreszczyn, T. and Elwell, C. (2019). Quantifying the measurement error on England and Wales EPC ratings. <i>Energies</i> 12, 3523-3542. doi.org/10.3390/en12183523	Comment accepted, the article will be cited and the point raised by the reviewer added to the text.	Peter Mallaburn	University College London	United Kingdom (of Great Britain and Northern Ireland)
19735	88	7	88	10	ontrok Authority, are showing clear and significant commercial building market transformation using this approach. BCA (2019). Singapore Building Control Authority (BCA) Building Energy Benchmarking Report (statistics and figures) 2019. Better Buildings Partnership. (2019). Design For Performance. A new approach to delivering energy efficient offices in the UK. June 2019. Cohen, R. & Bordass, B. (2015). Mandating transparency about building energy performance in use. <i>Building Research & Information</i> 43, 534-552. doi:10.1080/09613218.2015.1017416 Mallaburn, P. (2018b). Principles of successful non-residential energy efficiency policy. Proceedings of the European Council for an Energy Efficient Economy (ECEEE). Summer Study 2018, 15-22.	Comment accepted suggested references cited	Peter Mallaburn	University 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
22363	88	11	88	26	Generally there are different perspectives of energy and climate policy for the building sector: the object-related technological approach, the perspectives of the economic actors (owners, users and producers) as well as a macroeconomic environmental assessment. As far as I know there is not much scientific literature on suitable control indicators that cover all perspectives. The indicator "Reduction of greenhouse gas emissions" is missing for the building sector. See Nikolas D. Müller, Andreas Pfnür (2017): Conceptual approaches to implementing the energy transition in the building sector - systematization and discussion of alternative control indicators for energy and climate policy in the building sector. In: Andreas Pfnür (ed.), Working papers on real estate research and practice, volume no. 34. In German: https://www.real-estate.bwl.tu-darmstadt.de/media/bwl9/dateien/arbeitspapiere/Arbeitspapier_34.pdf	Accepted text and references added	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
1573	88	35	88	38	In terms of energy savings achieved, the Ecodesign Directive is an example of very effective EU policy, which provides evidence for the benefits of mandatory policies.	Accepted	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
8499	88	40	88	40	[Recommended] 'by a factor two → by a factor of two	Accepted	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13653	89	5	89	5	Kore should be Korea	Accepted	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
48215	89	16	89	18	The Canadian province of Nova Scotia has an energy efficiency utility who are contracted to invest in energy efficiency savings. https://www.energycyns.ca	Accepted	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
13655	89	19	89	19	Tax should be taxation	Accepted	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
25175	89	19	89	48	Paragraph to be revised, as national circumstances need to be considered. As stated in lines 45-47, resource-rich countries are expected to be negatively affected	Partly accepted, national circumstance shall be considered, however all energy efficiency policies may affect resources rich countries.	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
1085	89	20	89	20	"...and avoid the rebound effect.." Again, caution as above. Suggest language more like "...and manage the rebound effect where its effects are clearly more negative than positive."	Text changed as suggested	Harry Saunders	Carnegie Institution for Science	United States of America

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
13657	89	30	89	31	See comments on earlier sections. Our evidence leads us strongly to the view that energy poverty is best addressed by 'folk first' approaches, so these revenues would be better invested in frontline services that can provide a range of support - including advising householders on how to improve their homes, but also helping them understand and manage household finances, negotiating with energy suppliers, signposting to other social services, etc.	Accepted, suggested text added	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
45487	89	30	89	31	Bourgeois et al. (2019, https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2019/7-make-buildings-policies-great-again/social-environmental-economic-trade-offs-associated-with-carbon-tax-revenue-recycling/) show that using carbon tax revenue to finance energy efficiency investment reduces fuel poverty and increases cost-effectiveness	Accepted, suggested article and sentence added	Louis-Gaëtan Giraudet	CIREC, Ecole des Ponts ParisTech	France
25173	89	35	89	35	Replace "double divided" with "double dividend"	Accepted, correction done	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
45489	89	4			Review paper on energy efficiency obligations: Giraudet and Finon (2015, http://www.iaee.org/en/publications/eeeparticle.aspx?id=83)	Accepted references added in the reference list.	Louis-Gaëtan Giraudet	CIREC, Ecole des Ponts ParisTech	France
43671	89	19			Urban aspects are relevant here. A higher carbon price/ fuel tax translates into incentives to live closer to the city center which in turn means less floor space and thus reduced emissions. That is explored in urban economic papers: Borck, Rainald, and Jan K. Brueckner. "Optimal energy taxation in cities." Journal of the association of environmental and resource economists 5, no. 2 (2018): 481-516. Creutzig, Felix. "How fuel prices determine public transport infrastructure, modal shares and urban form." Urban climate 10 (2014): 63-76.	Accepted, text and references added	Felix Creutzig	MCC Berlin	Germany
25177	90	1	90	4	Taxes that penalise inefficient behavior should be considered in the context of sustainable development, justice and equity	Accepted, suggested text added	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
13659	90	15	90	15	Re-word to: Information is more successful when it inspires and engages people	Accepted, suggested text replaces existing text	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
5039	90	15	90	17	The sentence starting on line 15 has a grammatical mistake, it should say "Information is more successful when it inspires and engages people:"	Accepted, suggested text replaces existing text	Alexander Maki	AAAS Science Policy Fellow	United States of America
5041	90	21	90	24	The Karlin meta-analysis on feedback interventions should be cited along with Zangheri et al., 2019 and Buchanan et al., 2018; Karlin, Zinger, and Ford (2015) The effects of feedback on energy conservation: A meta-analysis, Psychological Bulletin, 141, 6, 1205-1227	Accepted, reference added	Alexander Maki	AAAS Science Policy Fellow	United States of America

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
39417	90	39	91	22	Here the concept of sufficiency is defined while it has previously been introduced and defined. Definitions should be merged and included in the section on sufficiency. This paragraph should introduce the policies linked to sufficiency	Rejected, it is important to introduce a policy oriented definition of sufficiency	Emmanuel RAUZIER	NGO Association negaWatt	France
13661	91	40	91	40	Delete the 'be' near the end of the line	Accepted, correction done	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
8501	91	48	92	8	Recommend to add Korean case that the building sector is included in the national emission trading scheme, which is allocated by the government. And energy saving and greenhouse gas reduction in buildings are being carried out to secure emission reductions (ERs).	Accepted suggested text and added some supporting references	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
13663	92	2	92	2	Provides' should be 'provided'. 'Prosumers' doesn't make sense in this context. 'Pier to pier' should be 'peer to peer'.	ATTENTION THIS IS AT PAGE 96. Accepted, proposed changes implemented.	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
48217	92	7	92	7	Reference to the UK CRC Energy Efficiency Scheme - This scheme is now closed as of April 2019. https://www.gov.uk/government/collections/crc-energy-efficiency-scheme	Accepted, text added as suggested.	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
4539	92	25	92	27	Policy packages should also include minimum requirements for the use of renewable energy in buildings. Policy packages must also combine renewable energy and energy efficiency instruments for buildings and not only rely on energy efficiency instruments. This should be acknowledged in the text	Accepted, we mention that there is a section on RES policies, but also to prescribe mandatory RES in buildings	Leonardo Barreto	Austrian Energy Agency	Austria
40087	92	34	92	34	Table 9.24: Please insert "international carbon markets (CDM / Article 6)" in the line "Market based".	The table has been deleted in SOD	Axel Michaelowa	University of Zurich	Switzerland
4541	92	34	93	1	The table 9.24 should include instruments for renewable energy in buildings (e.g. heating and cooling)	Accepted, added in the table what requested	Leonardo Barreto	Austrian Energy Agency	Austria
39423	93	3	93	39	Financial instruments included in this section should be merged with those included in the policy section. This would facilitate the analysis of the financial instruments used by policy makers	PARTLY Accepted. An introduction has been added stating that most financial instruments are part of the policies in the previous section, when financing is provided by public authorities	Emmanuel RAUZIER	NGO Association negaWatt	France
2023	93	17	93	22	Current projects are underway in the area of energy efficient mortgage - e.g. see https://www.energyefficientmortgages.eu/ (and at the end of line 22 some text seems to be missing.)	ACCEPTED, initiative mentioned	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
25181	93	21	93	22	Sentence "The success depends ..." is incomplete	Accepted, text corrected	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8505	93	22	93	22	[Omission] Word/sentence after "in the" is omitted.	Accepted, text corrected	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
825	93		93		For section 9.9.4 and 9.9.5 it should be notes that finance and professional training to finance for changing climatic conditions is not common let alone sufficiency . See Maxwell, K., S. Julius, A. Grambsch, A. Kosmal, L. Larson, and N. Sonti, 2018: Built Environment, Urban Systems, and Cities. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 438–478. doi: 10.7930/NCA4.2018.CH11	Accepted sentence added, but reference not relevant for mitigation	Ann Kosmal	U.S. General Services Administration	United States of America
25183	93	3	94	32	Elaborate on which financial mechanisms presented in section 9.9.4 could be suitable and effective for developing countries, and which one are associated with risks owing to matter related to justice and equity	Accepted, sentence added as suggested	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8503	93	4	94	32	Need more detailed explanation about applied cases and effects about each mechanism and business model.	Partly accepted, due to space limitations it is not possible to add case studies and business models. Some additional information and more references with case studies have been added	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
45491	93	12			On energy efficiency loans, there is empirical evidence by Giraudet et al. (2019, https://publications.banque-france.fr/sites/default/files/medias/documents/wp716.pdf) that banks make large profits on personal loans for renovation purposes. This may explain their low willingness to offer government-sponsored zero-interest loans	Accepted: suggested reference and text added	Louis-Gaëtan Giraudet	CIREN, Ecole des Ponts ParisTech	France
40089	94	10	94	14	Check the terminology regarding carbon finance (refer to review article Michaelowa et al. 2019). Michaelowa, Axel; Shishlov, Igor; Brescia, Dario 2019 Evolution of international carbon markets: lessons for the Paris Agreement, in: WIREs Climate Change, 10, e613, DOI: 10.1002/wcc.613	Accepted	Axel Michaelowa	University of Zurich	Switzerland
8507	94	16	94	16	[Typo] or zero interest loans → or zero interest loans.	Accepted correction made	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
2025	94	32	94	32	The presentation of funding options is expressly welcomed, especially energy performance contracting. Here, it could also be discussed whether, when and how the avoidance of greenhouse gas emissions could be taken into account in an EPC. Overall, it is suggested to consider the following topics: a) Effects of the energy performance or carbon footprint of buildings on (1) the amount of the rent level, (2) the building value, (3) the financing conditions. The reviewer can offer here support.	Accepted, suggested text added	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
35693	94	35	94	39	This narrative on the incorporation of RES into buildings reads as being out of date. It does not take into account the considerable fall in the costs of RES (especially PV, but also wind) and the advances in policies that require a link between EE and RES such as the EU-wide requirement that all new buildings are nearly zero energy buildings from 1st January 2021 and that the entire EU building stock must be decarbonised (in the operational phase at least) by 2050. It should be revised along these lines.	Accepted, text has been modified accordingly	Adrian Joyce	Catholic University of Louvain-le-Neuve	Belgium
39425	94	35	94	39	The affordability of Photovoltaic is now proven. The language on the barriers to Renewable Energy should be adjusted to this new economic reality	Accepted, text has been modified accordingly	Emmanuel RAUZIER	NGO Association negaWatt	France
8509	94	36	94	36	[Omission] ' Between "efficiency technologies" and "on-site renewable technologies" conjunction or ", " is omitted.	Accepted, text has been modified accordingly	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
4543	94	28	95	34	Aggregation of energy efficiency projects may facilitate finding financing from large investors, but it re	Rejected, aggregation discussed in another place in the section	Leonardo Barreto	Austrian Energy Agency	Austria
4545	94	35	95	44	9.9.5 only discusses policy instruments for renewable electricity and not for heating and cooling (e.g. investment grants, soft loans, RES heat obligations, RES heat tariffs, use obligations etc.). This description should be complemented (see e.g. Peter Connora, Veit Bürger, Luuk Beurskens, Karin Ericsson, Christiane Egger Devising Renewable Heat Policy: Overview of Support Options. Energy Policy 59. 3-16. 2013.	Accepted suggested text and reference added	Leonardo Barreto	Austrian Energy Agency	Austria
25185	94	34	96	7	Section 9.9.5 to also consider the effectiveness/suitability of the presented policies/financing for on site RE energy generation in developing countries	Accepted, a new paragraph on renewable support schemes in developing countries has been added	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
39545	94	34	96	7	RE100 is started to disseminate in building owner companies and it should be mentioned in here or somewhere.	rejected, not based on peer literatures	Shunsuke Kawagishi	Mitsubishi Research Institute	Japan
45493	94	28			According to Giraudet et al. (2018, https://www.journals.uchicago.edu/doi/abs/10.1086/698446), energy performance contracting is effective at reducing information problems between contractors and investors. It can however encourage unintended behaviour by building users, especially in the residential sector (hence its lack of appeal in this sector).	accepted,suggested text and reference added	Louis-Gaëtan Giraudet	CIREN, Ecole des Ponts ParisTech	France
8511	95	1	95	5	About FIT and RPS, in Korea, Choi et al have analyzed economic efficiency. But there is no result of this analysis.	Accepted, analysis added	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8513	95	7	95	7	[Typo] Germany and Japan are repeated twice.	Accepted, text corrected	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8515	95	25	95	30	There is relatively little information on institutions such as RPS that reflect market-based mechanisms. Some countries only mention that they have adopted RPS and only mention negative effects. Need to mention advantages and detailed explanations of market based mechanism.	Accepted text added on RPS and on comparison of RPS	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
8517	95	31	95	37	Need more explanation about the sentence "tenders are a fast spreading instrument to attract and procure new generation capacity from renewable energy sources."	More literature added to support the statement	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8519	95	38	95	38	[Omission] Subject is omitted.(in the sentence, (Gracia-Alvarez et al., 2018) ~	OK corrected	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8521	95	38	95	42	Needs more explanation for better understading that FIT installation affects solar energy capacity. (using table or graph)	Partly accepted,text iadded to highlight the impornatnce of Fit for PV as stated by the cited authors	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8541	95	38	95	42	Also, need more explanation that 30 OECD member countries' evaluation concluded that there is a "positive effect of the presence of a FIT".(using table or graph)	Partly rejected, data is found in the cited reference. Unfortunately we do not have the speace to add data and graphs. in any case now the section offer a more balanced description and comparison on RPS and FIT	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
48219	95	1			I think it is worth mentioning the UK's Renewable Heat Incentive (RHI). This is different than the FIT as it is focused on thermal energy. https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi	Accepted RHI has been added with some relevant references	Ian Hamilton	University College London	United Kingdom (of Great Britain and Northern Ireland)
4547	96	3	96	5	The renewable energy directive (Art. 2) defines renewable energy communities entitled to produce, consume, store,sell and share renewable energy. Communities can access suitable energy markets directly or through aggregation DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 on the promotion of the use of energy from renewable sources (recast), https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L2001&from=EN). Art. 16 of the Directive on the Internal Market for Electricity Directive defines "Citizen Energy Communities"., which have as primary purpose to provide environmental, economic or social community benefits may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders. DIRECTIVE (EU) 2019/944 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast), https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019L0944&from=EN	Accepted, very good suggestion, proposed text added	Leonardo Barreto	Austrian Energy Agency	Austria
4549	96	3	96	5	Renewable or local energy communities can increase pubic acceptance, mobilise private funding and provide flexibility to electricity markets	Accepted, very good suggestion, proposed text added	Leonardo Barreto	Austrian Energy Agency	Austria

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
4551	96	11	96	13	Renewable energy and energy efficiency policies in buildings must be combined and implemented in coordination with each other and with climate policies. For example, through the inclusion of renewable energy in building codes or the implementation of minimum renewable levels in Nearly-Zero Energy Buildings standards. In addition, financing instruments targetting both renewables and energy efficiency are necessary.	Accepted proposed text added in the sentence.	Leonardo Barreto	Austrian Energy Agency	Austria
8523	96	14	96	27	The international convention plays important role in establishing national and regional energy-efficient and renewable energy development policies, and only EU cases are provided. More cases other than EU is needed for better explanation that international convention affects national and regional policy makings.	Accepted proposed text added in the sentence. Difficulties to indentify suitable cases studies, this will be added in the final draft.	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
40091	96	28	96	28	Insert after "... international level": "For example, international carbon markets like the Clean Development Mechanism under the Kyoto Protocol can provide revenues from the sale of emissions credits (Michaelowa et al. 2019)." Michaelowa, Axel; Shishlov, Igor; Brescia, Dario 2019 Evolution of international carbon markets: lessons for the Paris Agreement, in: WIREs Climate Change, 10, e613, DOI: 10.1002/wcc.613	Rejected, the comment does not fit in the specific sentence.	Axel Michaelowa	University of Zurich	Switzerland
25187	96	28	96	39	"Some policies are best implemented at international level" only when specific enabling conditions prevail - particularly in regard to technology transfer and financial support to be provided to developing countries. Further elaboration on this matter is needed	Accepted, sentence suggested has been added	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
32527	96	28	96	39	Inefficient cooling equipment dumped into developing, economy-in-transition, and even other developed countries undermines national and local efforts to manage energy, environment, health, and climate goals. For example, developing countries would see energy savings of over 60% by replacing old refrigerators with more efficient equipment. Specific regulations can be put in place to avoid such environmental dumping, beginning with the simplest one: i.e. "prior informed consent" as seen in the Rotterdam Convention. Andersen, S.O., R. Ferris, R. Piccolotti, D. Zaelke, S. Carvalho, M. Gonzalez (2018) Defining the Legal and Policy Framework to Stop the Dumping of Environmentally Harmful Products, Duke Environmental Law & Policy Forum [Vol. XXIX:1]; United Nations Environment Programme (UNEP), 2017, Accelerating the Global Adoption of Climate-Friendly And Energy-Efficient Refrigerators, Un Environment – Global Environment Facility United For Efficiency (U4E), U4E Policy Guide Series, Paris, France 2017 (p. 7: "Developing countries with unregulated markets dominated by old technology refrigerators can attain energy savings of more than 60 per cent.").	Accepted, sentence suggested has been added with the references	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32529	96	28	96	39	For MEPs, see UNEP's United for Efficiency (U4E), Model Regulation Guidelines for Energy-Efficient and Climate Friendly Air Conditioners (20 September 2019). Additional governance approaches are described in Ch 4 of Dreyfus, G., Borgford-Parnell, N., Christensen, J., Fahey, D.W., Motherway, B., Peters, T., Piccolotti, R., Shah, N., and Xu, Y. (2020) Assessment of climate and development benefits of efficient and climate-friendly cooling. Molina, M., and Zaelke, D., Steering Committee Co-Chairs.	Accepted, sentence suggested has been added with the references	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
32531	96	28	96	39	Another governance approach is the use of bulk purchasing both through government procurement and through private “buyers’ clubs” to improve efficiency of cooling equipment, ensure low GWP refrigerants, and drive down price. See UNEP and IGSD, Buyers Club Handbook (updated January 2020); Energy Efficiency Services Limited (EESL), Super-Efficient Air Conditioning programme; and TERI, Bulk Procurement in Room Air Conditioning- A Critical Analysis of the EESL Programme (January 2019). See also India, Press Information Bureau, Ministry of Power, Super-Efficient Air Conditioning programme launched by EESL (2019).	Accepted, sentence suggested has been added	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32533	96	28	96	39	Another important governance initiative is coming from heads of state and government who are promoting improvements in energy efficiency of cooling equipment in parallel with the phasedown of HFC refrigerants. See Biarritz Pledge for Fast Action on Efficient Cooling (22 August 2019). See also the bilateral pledges between President Macron and President Xi (26 March 2019); and between President Macron and Prime Minister Modi (22 August 2019).	Accepted, sentence suggested has been added.	Durwood Zaelke	Institute for Governance & Sustainable Development	United States of America
32829	96	28	96	39	Inefficient cooling equipment dumped into developing, economy-in-transition, and even other developed countries undermines national and local efforts to manage energy, environment, health, and climate goals. For example, developing countries would see energy savings of over 60% by replacing old refrigerators with more efficient equipment. Specific regulations can be put in place to avoid such environmental dumping, beginning with the simplest one: i.e. “prior informed consent” as seen in the Rotterdam Convention. Andersen, S.O., R. Ferris, R. Picolotti, D. Zaelke, S. Carvalho, M. Gonzalez (2018) Defining the Legal and Policy Framework to Stop the Dumping of Environmentally Harmful Products, Duke Environmental Law & Policy Forum [Vol. XXIX:1]; United Nations Environment Programme (UNEP), 2017, Accelerating the Global Adoption of Climate-Friendly And Energy-Efficient Refrigerators, Un Environment – Global Environment Facility United For Efficiency (U4E), U4E Policy Guide Series, Paris, France 2017 (p. 7: “Developing countries with unregulated markets dominated by old technology refrigerators can attain energy savings of more than 60 per cent.”).	Accepted, sentence suggested has been added with the references	Kristin Campbell	Institute for Governance & Sustainable Development	United States of America
13665	96	31	96	31	damping' should be 'dumping'	Accepted, text corrected	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian 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
8525	96	40	97	4	Although "Net-Zero" is suggested as regional building policy stronger than national measurement, "Net-zero" is not the policy on behalf of building energy consumption policy. It would rather be better to suggest eco-friendly building certification system which controls from the beginning of building energy use. For example, in Korea, there is a green architecture certification system operated by the government. However based on this, Seoul has enacted Seoul's eco-friendly building standard and suggests stronger building standard.	Accepted the suggested text has been included	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
42055	96	6			Following the citation of (Zancanella et al 2016) add "and to group energy sales from prosumers to obtain a better price". Cybersecurity is also an important matter in this context and could be mentioned here	Accepted sentence added	Francisco Javier Hurtado A	European Patent Office	Germany
8527	97	4	97	4	[Typo] mobility → mobility.	Rejected, here e-mobility should be kept	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8529	97	7	97	7	Although the importance of stakeholder consultation and active participation is emphasized, it is necessary to cite thesis for better credibility. So additional explanation citing thesis which refers to the importance of stakeholder consultation and active participation is needed.	Accepted, articles on stakeholder consultation have been cited	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8531	97	19	97	20	[Recommended] No verb	Accepted text corrected	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8533	97	19	97	20	The role of government, regulatory organisation, financial institutions, standardisation body, test laboratory is omitted	Accepted text corrected	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8535	97	21	97	37	Although the title is institutional capacity, it doesn't provide the importance and role of the institutional capacity.	Accepted text added with definition of institutional capacity	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8543	97	21	97	37	This paragraph lists up the planning phase, policy implementation, assessment and international support to introduce energy-efficiency and renewable energy development policy, but the contents is slightly abstract.	OK the section is based on evidence collected from literature, but not possible to identify case studies in literature	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
8545	97	21	97	37	This paragraph refers to developing countries' capacity lackage. So, the specific plan to deal with this issue should be included.	OK Accepted	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
1087	97	32	97	33	"The role of energy efficiency policy evaluation needs to be expanded, including the assessment of the rebound effect." Completely agree.	OK accepted	Harry Saunders	Carnegie Institution for Science	United States of America
13667	97	34	97	34	(capacity buildings)' should be '(capacity building)'	Accepted text corrected	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian 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
22367	97	41	97	41	Clarification: "resulting from buildings energy demand, including direct and indirect emissions as well as embodied emissions, delivering...." Note: emissions from the building sector (scope 1) are shown here together with emissions from the energy and industrial (construction) sectors.	The conclusions section was completely rewritten	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
12869	97	1		3	e-mobility is mentioned here, but reference to the consequences for buildings in term of embedded carbon or the role of local electricity production to ease the pressure on the electricity system.	The conclusions section was completely rewritten	Arnulf JÄGER-WALDAU	European Commission, JRC	Italy
25189	98	40	98	42	Sentence "Existing technologies ... (medium evidence, high agreement)." is incomplete. Revise accordingly	The conclusions section was completely rewritten	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
1575	98	42	98	42	Incomplete sentence? "relatively low GHGs emissions.. [in developing countries]" ?	The conclusions section was completely rewritten	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
22365	98	42	98	44	Supplement: "This however requires an acceleration ... high agreement) by elimination the barriers to it."	The conclusions section was completely rewritten	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
4555	99	20	99	29	Please correct "Police shave"	The conclusions section was completely rewritten	Leonardo Barreto	Austrian Energy Agency	Austria
25191	99	20	99	29	Refer to the special needs and circumstances of developing countries	The conclusions section was completely rewritten	Eleni Kaditi	Organization of the Petroleum Exporting Countries (OPEC)	Austria
8537	99	22	99	22	[Typo] Police shave also fostered → Policy shave also fostered	The conclusions section was completely rewritten	Chungkook LEE	Korea Research Institute on Climate Change	Republic of Korea
4557	99	23	99	26	Policies to increase the qualification of construction workers and system installers on energy efficient buildings and on-site renewable system are also necessary to ensure compliance with minimum energy performance standards	The conclusions section was completely rewritten	Leonardo Barreto	Austrian Energy Agency	Austria
4553	99	28	99	29	Financing instruments combining renewable energy and energy efficiency may be necessary	The conclusions section was completely rewritten	Leonardo Barreto	Austrian Energy Agency	Austria
1577	99	32	99	32	Two additions for 9.10.2, insights: There is a lack of data on actual measured consumption, compared to theoretical consumption (as measured by the energy label).	The conclusions section was completely rewritten	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands
1579	99	32	99	32	And there is a lack of data on the technical state of buildings, like the energy installations used and level of insulation for example.	The conclusions section was completely rewritten	Paul Vethman	PBL Netherlands Environmental Assessment Agency	Netherlands

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
4559	99	32	99	43	Please add the following to Research needs: Benefits of renewable energy communities for decarbonisation, benefits of integrated district approaches for building renovation/new buildings to achieve decarbonisation and increase flexibility of the energy system at the neighbourhood level, how EE and RES measures can be combined and / or coordinated to achieve zero energy districts (ZEDs)	The conclusions section was completely rewritten	Leonardo Barreto	Austrian Energy Agency	Austria
13669	99	37	99	39	I would point you to work by Prof Sue Roaf and others, perhaps missed by not covering much literature from architects - e.g. https://www.irbnet.de/daten/iconda/CIB14196.pdf	The conclusions section was completely rewritten	Keith Baker	Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University	United Kingdom (of Great Britain and Northern Ireland)
36995	99	37	100	39	Also you mentioned about lack of research about indigenous knowledge. This is true; however there is no where prior to this in the manuscript that anything about indigenous knowledge has featured. Thus this research gaps appear to be from no where. I suggest, a few lines should be considered about indigenous knowledge somewhere in the manuscript prior to here.	considered when drafting the SOD of the chapter	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
36993	99		100		While I agree that there is limited publication about developing countries, there have been significant improvement over the years. Based on my experience in this field, there are a lot of publications about sections 9.7 to 9.9.1 from developing countries especially sub-Saharan Africa perspectives. I do not think this has been reflected in this report. However, there is paucity of research about developing countries especially sub-Saharan Africa about sections 9.9.3 to 9.9.6. I suggest that: 1.Sections 9.7 to 9.9.1 should be re-written to reflect voices from developing countries especially sub-Saharan Africa. Other sections such as 9.4.5 should also be revised accordingly. 2.An additional point on research gap or even an opening statement acknowledging the disparity made by developing countries in terms research should be considered.	considered when drafting the SOD of the chapter	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
2213	100	1	100	1	Please, add a new bullet with the following paragraph: "Literature on climate change impacts on buildings does not consider the potential carbon dioxide uptake by concrete. The cement and concrete industries have much to offer in terms of circular economy goals. There is need for further consideration of cement-based materials as carbon dioxide sinks (CEMBUREAU 2020)." CEMBUREAU 2020. https://lowcarboneconomy.cembureau.eu/5-years-on/the-5c-approach/recarbonation/	Rejected. Evaluated by the chapter authors, but not considered pertinent	Miguel Angel Sanjuán	Technical University of Madrid	Spain
4567	100	1	100	14	Please add the following to Research needs: the role of smart buildings and related issues such as user acceptance, interoperability and Monitoring and Evaluation of the impacts of Smart buildings	Rejected. Evaluated by the chapter authors, but not considered pertinent	Leonardo Barreto	Austrian Energy Agency	Austria
4565	100	8	100	12	Please add the following to Research needs: Tropical architecture, hurricane-proof buildings and technologies, buildings that are robust to extreme climate events (e.g. extreme cold spells), technologies that combine energy efficiency and water conservation/water harvesting for vulnerable regions (e.g. the Caribbean), Integration of energy efficiency into climate change adaptation strategies	Rejected. Evaluated by the chapter authors, but not considered pertinent	Leonardo Barreto	Austrian Energy Agency	Austria

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
4561	100	14	100	22	Please add the following to Research needs: Coupling policies on renewable energy and energy efficiency domains for the heat sector and combining them with climate policies, business models for prosumers	Rejected. Evaluated by the chapter authors, but not considered pertinent	Leonardo Barreto	Austrian Energy Agency	Austria
4563	100	14	100	22	Please add the following to Research needs: Implications of Sector integration for decarbonisation of buildings	Rejected. Evaluated by the chapter authors, but not considered pertinent	Leonardo Barreto	Austrian Energy Agency	Austria
2027	101	1	101	2	It is not true that the literature on embodied energy/carbon/emissions is still limited. Corresponding work began after 1970, with initial considerations around 1920. The reviewer can offer here support.	Accepted, text revised	Thomas Lützkendorf	Karlsruhe Institute of Technology (KIT) - Research University of Helmholtz Association	Germany
12533	101	3	101	3	Please, add: " Literature on climate change impacts on buildings does not consider the potential carbon dioxide uptake by concrete. The cement and concrete industries have much to offer in terms of circular economy goals. There is need for further consideration of cement-based materials as carbon dioxide sinks (CEMBUREAU 2020; Sanjuán et al 2020; Xi et al 2016)." CEMBUREAU 2020. https://lowcarboneyconomy.cembureau.eu/5-years-on/the-5c-approach/recarbonation/ Sanjuán, M.Á.; Andrade, C.; Mora, P.; Zaragoza, A. Carbon Dioxide Uptake by Cement-Based Materials: A Spanish Case Study. Appl. Sci. 2020, 10, 339. https://doi.org/10.3390/app10010339 Xi, F.; Davis, S.J.; Ciais, P.; Crawford-Brown, D.; Guan, D.; Pade, C.; Shi, T.; Syddall, M.; Lv, J.; Ji, L.; et al. Substantial global carbon uptake by cement carbonation. Nat. Geosci. 2016, 9, 880–883. https://doi.org/10.1038/NGEO2840	Rejected. Evaluated by the chapter authors, but not considered pertinent	MORA PERIS PEDRO	Profesor Titular de Universidad de la ETSI Minas y Energía de la Universidad Politécnica de Madrid	Spain
819	102		131		Based on the comments above , I was not able to discern the inclusion criteria authors were using to guide their literature review	The authors used a strict systematic review method	Ann Kosmal	U.S. General Services Administration	United States of America
22369	131	31	131	34	Regional specification: The active and networked prosumer with a preference for regional electricity products becomes the model for energy suppliers. Citizens and politicians prefer regional and decentralized solutions. This applies to an electricity system including political regulation that is characterized by a historically grown network of central and decentralized elements - but together they do not produce a consistent picture. The regulation of decentralization has been a big chaos so far. See: Agora Energy Transition (2017): Energy Transition and Decentralization. To the basics of a politicized debate. In German: https://www.agora-energiawende.de/fileadmin2/Projekte/2016/Dezentralitaet/Agora_Dezentralitaet_WEB.pdf	Updated now in the text, since data was available	Ingrid Vogler	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e.V.	Germany
793					Suggest including Living Building Challenge example in low energy examples.	Rejected, found not pertinent	Ann Kosmal	U.S. General Services Administration	United States of America
833					is decarbonized defined as it relates to this scope?	Accepted, text revised	Ann Kosmal	U.S. General Services Administration	United States of America

Comment ID	From Page	From Line	To Page	To Line	Comment	Response	Reviewer Name	Reviewer Affiliation	Reviewer Country
9403					fig 9.1 is not well motivated, since the central position of buildings may be justified or not, but please better argue this	not pertinent any more	ANNA LAURA PISELLO	DEPARTMENT OF ENGINEERING - UNIVERSITY OF PERUGIA, ITALY	Italy
9405					table 9.1 about Kindergarten: they should be divided into daycare (for <3y) and kindergarden as school 3-6 y. The first one is more like a hospital or aid building	Found too detailed to be added	ANNA LAURA PISELLO	DEPARTMENT OF ENGINEERING - UNIVERSITY OF PERUGIA, ITALY	Italy
9407					fig 9.4: lightweight walls is not a proper definition for internal partitions. They may also be heavy. That description is too much simplistic	not pertinent any more	ANNA LAURA PISELLO	DEPARTMENT OF ENGINEERING - UNIVERSITY OF PERUGIA, ITALY	Italy
9409					fig 9.5 is not clear in terms of message to deliver	not pertinent any more	ANNA LAURA PISELLO	DEPARTMENT OF ENGINEERING - UNIVERSITY OF PERUGIA, ITALY	Italy
9417					fig 9.18 is not visible	not pertinent any more	ANNA LAURA PISELLO	DEPARTMENT OF ENGINEERING - UNIVERSITY OF PERUGIA, ITALY	Italy
12863					Detailed impact of passive solar and daylighting technologies on the energy demand of buildings is missing.	Accepted, added in the text	Arnulf JÄGER-WALDAU	European Commission, JRC	Italy
20463					entire chapter; on prosumers. Full confirmation on the beneficial contribution of prosumers for energy demand coverage in buildings. An article of Keiner et al. (https://www.sciencedirect.com/science/article/pii/S0038092X19304281) analyses that for all countries globally in high level of detail and conclude very high potential for prosumers.	Accepted, text revised	Christian Breyer	LUT University	Finland
25529					Please take care not to use value-judgement terms such as 'important', 'significant' and also prescriptive terms such as 'need' and 'must'. Some readers will interpret these statements as policy prescriptive.	Accepted, text revised	Sarah Connors	IPCC WGI TSU	France
25563					As a reader who isn't familiar with all the topics being discussed in your chapter, it might help many Executive Summaries to include subheadings to cluster the statements by topic or overarching chapter themes.	The executive summary was completely rewritten	Sarah Connors	IPCC WGI TSU	France
33107					This is an excellent report but I would like to suggest to include how local government/other organisations can play a role effectively in promoting climate resilient building. It should also include junior school level curriculum for teaching climate resilient building and its usages for next generation	Found not pertinent	Edris Alam	Rabdan Academy	United Arab Emirates
36827					Authors should ensure, full meaning of abbreviations are provided on first use. Some examples in the Executive summary are: CO2, LED, RES, etc. These and many others in the draft should be fixed.	Accepted, text revised	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes 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
36829					The executive summary is well-written and covered most aspects. I like the embodied energy aspect that has strongly been reflected in the executive summary. However, the role of indigenous people and knowledge has not been covered. Despite representing only four per cent of the worlds population (between 250 to 300 million people), they utilize 22 per cent of the world's land surface thereby 80 per cent of the planet's biodiversity in, or adjacent to, 85 per cent of the world's protected areas (https://unu.edu/publications/articles/why-traditional-knowledge-holds-the-key-to-climate-change.html). I really of indigenous knowledge/people in mitigation options should be considered. This should be reflected in the various sections of this chapter.	The executive summary was completely rewritten	Henry Abanda FONBEYIN	Oxford Institute for Sustainable development, Oxford Brookes University	United Kingdom (of Great Britain and Northern Ireland)
39645					Active cooling / heating (HVAC) technologies need to be included in a more comprehensive manner	Accepted, text revised	SANJEEV JAIN	IIT DELHI	India
42831					The issue of maximum building parking standards is key to reducing car use and promoting less car-ownership based lifestyles. This is missing from this Chapter.	Found not pertinent, this is about transport, not buildings	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
42833					The provision of convenient bicycle parking and storage in buildings is key to promoting cycling and is missing from this Chapter.	Found not pertinent, this is about transport, not buildings	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
42835					The provision of electric vehicle charging facilities (for bikes and cars) in existing (offices, homes....) and new buildings is essential to support the transformation of transport.	Found not pertinent, this is about transport, not buildings	Mark MAJOR	Partnership on Sustainable Low Carbon Transport	Spain
48051					Comment on ES : integration of a changing climate in the assessment is indeed relevant as flagged in the paragraph starting by "climate factors". Please coordinate with WGI, especially our chapters 10 (methods), 11 (extremes) and 12 (climate impact drivers - sectoral and regional) so that there is coherency and in order to facilitate integration towards the synthesis.	The executive summary was completely rewritten	Valérie Masson-Delmotte	CEA, IPSL/LSCE	France
48053					The ES reads as very optimistic. What about barriers, costs, challenges and limitations (eg. current pace of retrofitting of the existing built infrastructure, challenge / return on investment etc). Examples of conditions to accelerate this would be very welcome.	The executive summary was completely rewritten	Valérie Masson-Delmotte	CEA, IPSL/LSCE	France