

IPCC AR6 WGIII First Order Draft Government and Expert Review Comments Responses (Annex III - Scenarios and modelling methods)								
If any fields are not readable, please ensure to expand relevant cells. If reading this in PDF format, please refer to the Excel format version of this document available on: https://www.ipcc.ch/report/ar6/wg3/downloads/drafts-and-reviews Please note, "Annex III - Scenarios and modelling methods" was previously titled "Annex C - Scenarios and modelling methods", and comments and responses below may refer to Annex C.								
Comment ID	From Page	From Line	To Page	To Line	Comment	Reviewer	Reviewer Country	Response
1587	0	0	0	0	Annex C could elaborate more on the benefits and difficulties of modelling human behaviour and decision making. This is a research field grown significantly over the last decade, for example from scientific disciplines such as behavioural economics. But compared to technical and economic models, there are probably only few examples of quantitative models that integrate assumptions on behaviour. Examples of relevant behavioural modelling literature: Beckage et al. (2018). Linking models of human behaviour and climate alters projected climate change. Nature Climate Change 8, 79–84 (2018). Article: https://www.nature.com/articles/s41558-017-0031-7 . Bury et al. (2019). Charting pathways to climate change mitigation in a coupled socio-climate model. Computational Biology, June 2019. Article: https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1007000 . News item: https://www.nationalobserver.com/2019/06/10/news/study-tries-bring-human-behaviour-climate-change-projections .	Paul Vethman	Netherlands	Accepted. The section on economic modelling was expanded to include the latest trend of behavioural modelling.
1589	0	0	0	0	Available financing for sustainable investments, e.g. climate change mitigation and adaption projects, is fundamental. One way to realise these, besides government policies, are private or independent science-based think tanks and network organisations. An example from the Netherlands is the Sustainable Finance Lab from the University of Utrecht. https://sustainablefinancelab.nl/en/rubriek/news/sustainability/ .	Paul Vethman	Netherlands	Noted. Although relevant, this goes beyond the annex C scope. This could be relevant to a sectoral chapter or chapter on financing.
9943	0	0	0	0	As with ENGAGE, the PARIS REINFORCE project (2019-2021) should be included in the SOD. It is based on equally as many models, which have already been transparently documented here: http://paris-reinforce.epu.ntua.gr/main The results of the first model inter-comparisons at the global level will be published in the <u>summer time 2020 and before the finalisation of the AR6 SOD</u>	Haris Doukas	Greece	Noted. The project results will be included in SOD if the publications are available before the cutoff date.
36079	0	0	0	0	according to Remark n°2 for Chapter 3, socioeconomic or socio-economic	Sandrine Selosse	France	Noted
36111	0	0	0	0	in a general manner, make reference to Annex C-supplementary material. the latter gives more information than the models, but some key assumptions such as costs and potentials remain opaque. To be seen according to what will be added in sections II.9 and II.10	Sandrine Selosse	France	Noted. References to SM were added.
36119	0	0	0	0	verify the voluntary (or not) use of land-use or land use alternatively	Sandrine Selosse	France	Noted
11755	0				Please consider to include a Chapter Box in Ch 3 or 4 with text from this supplementary about scenario framework.	Maria Malene Kvalevåg	Norway	Noted. A x-chapter box between Ch3/4 is being developed for SOD.
33351	0				Uncertainty and bias need to be better addressed by providing, e.g., proper definitions and methodologies suitable for their quantification.	Domenico Vitale	Italy	Noted. Literature review was expanded to include uncertainty and sensibility of modelling methods.
14111	1		30		The structure of the Annex is a bit confusing and even misleading. Describing scenarios before models brings some problems to the reader (see next comment), moreover the IPCC has traditionally relied on results from IAMs, so what is the objective of separating between IAMs and Economic modelling (section II.2), Energy (II.3), Buildings, Transport, etc.? Is it because in each of the dedicated chapters results from sectoral models are also reported? IF so please indicate clearly. Also, it does not make sense to include IAMs together with a classification with separates between simulation/optimization; general/partial equilibrium, etc. since IAMs can be of all of these types. It would be maybe more practical to separate scenarios and modelling approaches in 2 different sections/annexes. Also, it would be better for the reader to have a full chapter 3 about "modelling approaches" because now there is an abrupt jump from "emission drivers" to "long-term mitigation pathways". It is not transparent where the results reported in Chapters 3,4 and so on come from.	Iñigo Capellán-Pérez	Spain	Noted. The Annex C has been explicitly requested by the IPCC in the Scoping Meeting Report approval. Its structure follows the expert request in the Scenario/Modelling meeting held in April/May 2017.
40193	4	6	4	6	Suggested replace: " transparency of model assumptions" with " transparency of model assumptions and validity"	Mihaela Caiian	Romania	Noted

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41591	5	3	5	3	Depite widespread use, it is unclear what is meant by "internally consistent descriptions of the future". It would be good to explain this.	Ida Andrea Braathen Sognaes	Norway	Accepted. This "jargon" was clarified.
11759	5	10	5	11	Please consider to include a paragraph that describe the difference between a scenario and a pathway and how to use these terms correctly. For instance, wording as in page 6 line 7 - 10 creates confusion when the terms pathways/scenarios are used interchangeably	Maria Malene Kvalevåg	Norway	Noted. The definitions of scenario/pathway concepts was clarified. Also note that the WG III AR6 has na extensive glossary with a full list of definitions used in the report.
14113	5	12	5	43	These paragraphs are very confusing. Although it is stated that "[scenarios] are constructed to explore possible climate change futures covering the causal chain from (i) socio-economic developments [...] (vii) impacts on socio-economic developments, thus closing the loop", in fact, most models do not close this loop since they the socio-economic drivers are exogenous and the climate impacts are either absent (such as in the cost-effective IAMs) or representing very limited climate change impacts (typically in cost-benefit IAMs, cf. Moore & Diaz 2017; Dietz&Stern 2015). Hence it is of no importance if theoretically the scenarios describe one thing and then the models do a different thing. A similar argument can be given for the sentence "the integrative power of climate change scenarios". Diaz, D., Moore, F., 2017. Quantifying the economic risks of climate change. Nature Climate Change 7, 774–782. Dietz, S., Stern, N., 2015. Endogenous Growth, Convexity of Damage and Climate Risk: How Nordhaus' Framework Supports Deep Cuts in Carbon Emissions. The Economic Journal 125, 574–620.	Iñigo Capellán-Pérez	Spain	Noted. Rewritten
11761	5	13	5	17	Please consider to include a figure showing the causal chain (i) - (vii) to better illustrate the closing loop.	Maria Malene Kvalevåg	Norway	Noted.
40195	5	16	5	16	Suggested replace: "(vi) bio-physical impacts" with (vi) bio-physical and hydrological impacts"	Mihaela Caian	Romania	Noted
33305	5	22	5	22	transition / transformation (double space)	Domenico Vitale	Italy	Noted.
36081	5	24	5	24	different courses of actions? Or different courses of action?	Sandrine Selosse	France	Noted. Thanks
40197	5	26	5	26	Suggested: add: after "...adaptation pathway", "...adaptation pathway as well as for finding deterministic indicators towards an optimal pathway."	Mihaela Caian	Romania	Noted. Thanks
36083	5	11	6	3	Possibly, as an additional or second point, further highlight the fact that scenarios can also be used to test the potential and (associated) impact of different solutions to be deployed to achieve climate objectives, depending on the different contexts that are posed.	Sandrine Selosse	France	Accepted. This point has been included in SOD.

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18819	5	2	30	38	(same text as the comment on chapter 1, p. 35, section 1.5.1) When putting this Section 1.5.1 in relation with the two main sections of Annex C: Scenarios and modelling methods, this reviewer has difficulty in seeing clearly the respective roles of each one of them. More precisely, it is not stated in the text the extent to which scenarios are built and computed, using models, and which ones (if any) are built otherwise. From the last three lines of the Table of contents of Annex C, however, there is a clue from which it seems that scenarios (all of them?) are built from models. While the so announced tables are not currently available, it is recommended that the text be really explicit on the role of models in the construction of scenarios. On that point, as a social scientist, I would insist that the distinction between optimization models (in fact scenarios) and other simulation models be much more emphasized, because the optimization feature expresses in its mathematics, a human choice among alternatives. Such a choice is even an interpersonal one when the objective function involves several individuals. The choice, here is, for instance, between alternative forms of cooperation: none, partial, or full -- which are of course alternative possible "scenarios" of social organization (Tulkens 2019 using CWS), i.e. of international governance! Other examples of cooperation or non cooperation can be quoted, such as Lindahl equilibria or Nash Bargaining solution (Yang 2008, using RICE). The neglect of multi-agent scenarios and modelling in both this Section 1.5.1 and in Annex C is reflected in the absence, in the references lists of either chapter, of at least one reference to the pioneer paper (Nordhaus and Yang 1996) on multi-agent Integrated Assessment Model. Most, if not all, subsequent scientific work uses it. This multi-agent optimization, an essential tool for a social science, away from single agent models, is also the tool whereby cooperative game theory concepts can be introduced in economic reasoning. The IPCC cannot ignore that in its reporting of what social science has to offer on climate science.	Henry Tulkens	Belgium	Noted. SOD will include the reference card tables were the role of models in explicitly detailed.	
14115	6	5	6	19	Scenarios are used in many environmental scientific areas other than climate change, and for many decades, a more complete contextualization and link with other fields would be very useful (e.g. Millennium Ecosystem assessment, etc.). Include a citation to the paper Van Vuuren et al 2012. van Vuuren, D.P., Kok, M.T.J., Girod, B., Lucas, P.L., de Vries, B., 2012. Scenarios in Global Environmental Assessments: Key characteristics and lessons for future use. Global Environmental Change 22, 884–895. https://doi.org/10.1016/j.gloenvcha.2012.06.001	Iñigo Capellán-Pérez	Spain	Noted	
33307	6	13	6	14	Sort references by year	Domenico Vitale	Italy	Rejected.	
13453	6	20	6	34	The level of air pollutant control (week, medium, high) in SSP which drives the SLCF emissions (except CH4) directly results from the SSP narrative (Rao et al. 2017), could it be explained here?	Sophie Szopa	France	Rejected. This is a relevant comments but goes beyond the scope of this annex C. This could be embodied in sectorial chapters.	

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14117	6	25	6	34	It is extremely surprising that the variable which is identified as the most important driver of GHG emissions in Chapter 2 is considered as exogenous in climate scenarios. This requires an explanation since an obvious policy to reduce GHG emissions derived from this empirical fact would be to design societies which are not dependent on GDP growth (cf. Hickel and Kallis 2019; Parrique et al 2019; Demaria et al 2013). Hickel, J., Kallis, G., 2019. Is Green Growth Possible? New Political Economy 0, 1–18. https://doi.org/10.1080/13563467.2019.1598964 Parrique, T., Barth, J., Briens, F., Kerschner, C., Kraus-Polk, A., Kuokkanen, A., Spangenberg, J.H., 2019. Decoupling debunked - Evidence and arguments against green growth as a sole strategy for sustainability. European Environmental Bureau (EEB). Demaria, F., Schneider, F., Sekulova, F., Martinez-Alier, J., 2013. What is Degrowth? From an Activist Slogan to a Social Movement. Environmental Values 22, 191–215. https://doi.org/10.3197/096327113X13581561725194	Iñigo Capellán-Pérez	Spain	Noted. The literature review exercised has been expanded to include alternative societal models beyond GDP growth.
33309	6	40	6	40	1.9, 2.6, 3.4, ... the font is not the same	Domenico Vitale	Italy	Thank you for noting this. Accepted.
36085	6	42	6	43	Coupled Model Intercomparison Project Phase 5 (CMIP5) instead of Climate Model Intercomparison Project (CMIP5)?	Sandrine Selosse	France	Thank you for noting this. Accepted.
40199	6	44	6	44	"at around the same forcing level" maybe clarified	Mihaela Caian	Romania	Thank you for noting this. Accepted.
11753	6	11	7	10	Is it possible to include a schematic illustration/table/matrix showing the relationship between SSPs and RCPs? That would be helpful for clarification and ensuring that readers can digest this complex relationship.	Maria Malene Kvalevåg	Norway	Rejected. Thank you for your comment. This suggest will be addressed in chapter 3.
13455	7	11	7	11	title should specify "CLIMATE CHANGE mitigation" in contrast to air pollution mitigation for example. Idem in title II.10	Sophie Szopa	France	Noted.
40201	7	14	7	14	DC not defined	Mihaela Caian	Romania	Noted. Thanks
14119	7	19	7	19	Aparently (Because the article is not available for non-suscribers of NCC and I cannot read it fully), the reference Bertram et al 2018 does not refer to demand-side policies.	Iñigo Capellán-Pérez	Spain	Need to be confirmed
40203	7	34	7	34	" the scope " of "a separate..." (to add "of")	Mihaela Caian	Romania	Thank you for noting this. Accepted.
43359	8	1	8	1	"removal technologies and practices"	Matthias Honegger	Germany	Thank you for noting this. Accepted.
14121	8	4	8	4	"available to policymakerS for achieving mitigation goals". Please add available also for the society to fully encompass behavioral changes.	Iñigo Capellán-Pérez	Spain	Noted
36087	8	19	8	19	ScenarioMIP - Scenario Model Intercomparison Project	Sandrine Selosse	France	Noted
40205	8	34	8	34	Suggested add, after "the levels of confidence of the results" to add "the levels of confidence of the results linked to model uncertainty"	Mihaela Caian	Romania	Accepted.
36089	8	38	8	38	OpenSCM - Open Simple Climate Model	Sandrine Selosse	France	Noted.
40207	8	39	8	39	"For a given a scenario" to be replaced by "For a given scenario"	Mihaela Caian	Romania	Noted.
43811	9	3	9	4	please ensure the relationship of scenarios with WGII is fully developed for the SOD	Hans Poertner and Elvira Poloczanska	Germany	Noted. This point will be address in SOD.

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14123	9	8	9	24	<p>It is not clear why only mitigation scenarios are collated, and not also baseline scenarios as it was done in previous reports. Even in Chapter 3 it is acknowledged that "Thus, the baseline is critical to determine mitigation challenges and costs" (p12119). Moreover, since as shown in the AR5 there are also important divergences among BAU which are relevant. In the light of these facts, it is strongly suggested to include also in the database the baselines. The database should include baselines to allow for transparency, for example Pielke et al 2008 shown that there was a significant level of built-in of GHG mitigation already in baselines, or the BAU depicted by Capellán-Pérez et al 2020 is substantially different from most of the BAUs.</p> <p>Pielke, R., Wigley, T., Green, C., 2008. Dangerous assumptions. Nature 452, 531–532. https://doi.org/10.1038/452531a Capellán-Pérez, I., Blas, I. de, Nieto, J., Castro, C. de, Miguel, L.J., Carpintero, Ó., Mediavilla, M., Lobejón, L.F., Ferreras-Alonso, N., Rodrigo, P., Frechoso, F., Álvarez-Antelo, D., 2020. MEDEAS: a new modeling framework integrating global biophysical and socioeconomic constraints. Energy Environ. Sci. https://doi.org/10.1039/C9EE02627D</p>	Iñigo Capellán-Pérez	Spain	Noted.
36091	10	11	10	11	indicate that OS = overshoot	Sandrine Selosse	France	Noted
40209	10	11	10	11	"OS" (not defined in text)	Mihaela Caián	Romania	Noted
14125	10	11	10	12	What does the acronym "OS" mean?	Iñigo Capellán-Pérez	Spain	Noted
11749	10	14	11	3	Could you please explain why some pathways can not be evaluated in terms of their temperature outcomes. It is difficult to understand what other information these pathways can contribute with, if temperature outcome can not be evaluated. Over 20% of mitigation pathways in Table 1 falls into this category. Does this mean that these pathways are excluded from the assessment?	Maria Malene Kvalevåg	Norway	Noted.
14127	11	1	11	2	Table 1: does "no climate assessment" stands for baseline/no-policy scenarios? Clarify. If not, please add a new column collating information on baseline scenarios.	Iñigo Capellán-Pérez	Spain	Noted.
32317	11	4	11	7	It will be very useful to include an additional classification to show the dependance of each of the models on new/untested technologies so, it is easy to see what results (i.e. pathways) depend on operationalising those new technologies and innovation and how much the outcome of those pathways depend on them	Penny Apostolaki	United Kingdom (of Great Britain and Northern Ireland)	Noted.
40211	11	6	11	6	"CCS" (carbon capture and storage abbrev. not defined in text)	Mihaela Caián	Romania	Noted
11751	12	10	12	11	Please provide information in the text related to Table 2 about what kind of scenario type "other" refers to.	Maria Malene Kvalevåg	Norway	Noted.

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14129	12	14	12	24	<p>There are more biases operating: virtually all relevant models have been developed in rich/developed countries, the regular participation in intercomparison exercises has a tendency to homogenize practices and modellings approaches (cf. Chapter 3 "often based on harmonised assumptions on input data and a shared experimental design"); there is less methodological diversity in IAMs than usually stated (e.g. predominance of optimization/equilibrium approaches; see Scricciu et al 2013; Hardt & O'Neil 2017 and also Capellán-Pérez et al 2020 for the assumptions on the abundance of energy resources and underestimation or neglect of climate change impacts).</p> <p>Scricciu, S., Rezai, A., Mechler, R., 2013. On the economic foundations of green growth discourses: the case of climate change mitigation and macroeconomic dynamics in economic modeling. WENE 2, 251–268. https://doi.org/10.1002/wene.57</p> <p>Hardt, L., O'Neill, D.W., 2017. Ecological Macroeconomic Models: Assessing Current Developments. Ecological Economics 134, 198–211. https://doi.org/10.1016/j.ecolecon.2016.12.027</p> <p>Capellán-Pérez, I., Blas, I. de, Nieto, J., Castro, C. de, Miguel, L.J., Carpintero, Ó., Mediavilla, M., Lobejón, L.F., Ferreras-Alonso, N., Rodrigo, P., Frechoso, F., Álvarez-Antelo, D., 2020. MEDEAS: a new modeling framework integrating global biophysical and socioeconomic constraints. Energy Environ. Sci. https://doi.org/10.1039/C9EE02627D</p>	Iñigo Capellán-Pérez	Spain	Noted. A wide range of bias has been included in SOD.
33311	12	17	12	17	Please clarify the meaning of "full uncertainty space"	Domenico Vitale	Italy	Noted
33313	12	19	12	19	Please clarify the meaning of "biases in the ensemble"	Domenico Vitale	Italy	Noted
40213	12	26	12	26	[variance scaling of ensemble members to estimate probabilities; ensemble weighting]	Mihaela Caian	Romania	Noted
36093	13	1	13	1	(Ho et al. 2019) - delete the comma	Sandrine Selosse	France	Noted
14131	13	1	13	5	<p>There is a rich literature about the pros and cons of assigning scenario likelihood, the topic is too important to resume it in 5 lines (e.g., works from Schneider). Moreover, despite assigning probabilities may in fact be very challenging some work has shown that biophysical constraint do provide some reasonable boundaries for the projections (e.g., Capellán-Pérez et al 2016).</p> <p>Schneider, S.H., 2002. Can we Estimate the Likelihood of Climatic Changes at 2100? Climatic Change 52, 441–451. https://doi.org/10.1023/A:1014276210717</p> <p>Mastrandrea, M.D., Schneider, S.H., 2004. Probabilistic Integrated Assessment of "Dangerous" Climate Change. Science 304, 571–575. https://doi.org/10.1126/science.1094147</p> <p>Capellán-Pérez, I., Arto, I., Polanco-Martínez, J.M., González-Eguino, M., Neumann, M.B., 2016. Likelihood of climate change pathways under uncertainty on fossil fuel resource availability. Energy Environ. Sci 9, 2482–2496. https://doi.org/10.1039/C6EE01008C</p>	Iñigo Capellán-Pérez	Spain	Noted. The section about likelihood has been expanded.
33317	13	6	13	6	The use of descriptive statistics is too vague and can be confusing. By considering the characteristics of the ensemble distribution one should use robust and proper statistics (e.g. by considering the parameters of a Uniform distribution, instead of a Normal, see https://www.bipm.org/utis/common/documents/jcgm/JCGM_100_2008_E.pdf).	Domenico Vitale	Italy	Noted.
33315	13	9	13	9	change "statistical" to "wrong"	Domenico Vitale	Italy	Noted.

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14133	13	14	13	31	There is a problem with the IPs described here, given that for example the BAU reference scenario from Capellán-Pérez et al 2020 would not fit in any of these categories. It is suggested to create a new category where a BAU is compatible with "relatively low" temperature increases by the end of the century due to the consideration of substantial climate change damages in a BAU scenario. Capellán-Pérez, I., Blas, I. de, Nieto, J., Castro, C. de, Miguel, L.J., Carpintero, Ó., Mediavilla, M., Lobejón, L.F., Ferreras-Alonso, N., Rodrigo, P., Frechoso, F., Álvarez-Antelo, D., 2020. MEDEAS: a new modeling framework integrating global biophysical and socioeconomic constraints. Energy Environ. Sci. https://doi.org/10.1039/C9EE02627D	Iñigo Capellán-Pérez	Spain	Noted.
32319	13	29	13	31	For the two pathways (IP3 & IP5) that depict alternative systems transformations towards 1.5C - The 1.5C report used 4 IPs and it would be very useful to use those here as well for continuity and to make comparisons easier	Penny Apostolaki	United Kingdom (of Great Britain and Northern Ireland)	Noted
14135	14	3	14	3	"Modelling frameworks vary vastly amongst themselves" is too generous as it has been showed by Scricciu et al 2013; Hardt & O'Neil 2017 and Capellán-Pérez et al 2020. In fact, several characteristics are repeatedly found in IAMs, which is a weakness of the field. Scricciu, S., Rezai, A., Mechler, R., 2013. On the economic foundations of green growth discourses: the case of climate change mitigation and macroeconomic dynamics in economic modeling. WENE 2, 251–268. https://doi.org/10.1002/wene.57 Hardt, L., O'Neill, D.W., 2017. Ecological Macroeconomic Models: Assessing Current Developments. Ecological Economics 134, 198–211. https://doi.org/10.1016/j.ecolecon.2016.12.027 Capellán-Pérez, I., Blas, I. de, Nieto, J., Castro, C. de, Miguel, L.J., Carpintero, Ó., Mediavilla, M., Lobejón, L.F., Ferreras-Alonso, N., Rodrigo, P., Frechoso, F., Álvarez-Antelo, D., 2020. MEDEAS: a new modeling framework integrating global biophysical and socioeconomic constraints. Energy Environ. Sci. https://doi.org/10.1039/C9EE02627D	Iñigo Capellán-Pérez	Spain	Noted. The literature review exercise has been expanded to include the wide range of modelling frameworks.
33321	14	15	14	16	Please check the sentence.	Domenico Vitale	Italy	Noted.
33319	14	2	16	11	I suggest to add some comment about the risk of bias and the level of uncertainty associated with each modelling framework.	Domenico Vitale	Italy	Noted.
36095	15	1	15	2	"partial equilibrium models have a particularly detailed representation of a specific sector, such as policies packages and technology portfolio": "particularly" or "very" reflects more the characteristic of this type of model and the difference with the general equilibrium models	Sandrine Seloisse	France	Accepted. This point has been clarified in SOD.
36097	15	18	15	18	a dot is missing at the end of the sentence/line.	Sandrine Seloisse	France	Noted
33323	15	27	15	29	GHG and AFOLU acronyms appear for the first time in the Annex C and need to be defined.	Domenico Vitale	Italy	Noted.
40217	15	29	15	29	"AFOLU" not defined in text	Mihaela Caian	Romania	Noted
12961	15	34	15	34	Would be useful to expand on the exogenous and endogenous methods for modeling technological change	Robin White	Canada	Need to be discussed
33325	15	40	15	40	double ..	Domenico Vitale	Italy	Noted
34705	15	40	15	40	"Finally,," one comma should be deleted	Jordi Solé-Ollé	Spain	Noted
36099	15	40	15	40	double comma	Sandrine Seloisse	France	Noted
33327	16	1	16	8	Check brackets	Domenico Vitale	Italy	Noted
34707	16	1	16	8	It is important to mention the review work on ecological economics and the different modelling approaches (using IAMs) for transitions to a post-growth zero emissions socio-economies. Hardt & O'Neil 2017. Ecol Ec. http://dx.doi.org/10.1016/j.ecolecon.2016.12.027	Jordi Solé-Ollé	Spain	Accepted.

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Comment ID	From Page	From Line	To Page	To Line	Comment	Reviewer	Reviewer Country	Response	
46115	16	9	16	11	IAMS unable to model influence of flexibility options on integration of VRES resulting in overuse of CDR.	Neven Duic	Croatia	Noted. In fact, most IAMs do not assessed VRE endogenously. However, some IAMs are soft-linked with dispatch models to identify VRE constrains in input variables.	
33329	17	19	17	19	change un-biased to unbiased	Domenico Vitale	Italy	Noted	
33331	17	21	17	29	GDP, R and D acronyms appear for the first time in Annex C. They should to be defined.	Domenico Vitale	Italy	Noted.	
33333	17	30	17	38	Redundant. Such classification has been already provided on page C-14.	Domenico Vitale	Italy	Accepted.	
36101	18	1	18	1	multi-region	Sandrine Seloisse	France	Noted	
40215	18	18	18	18	"vary" instead of "very" ?	Mihaela Caian	Romania	Noted	
36103	18	31	18	31	macro-finance: "macro" also in bold?	Sandrine Seloisse	France	Noted	
34709	18	45	18	45	It could be interesting to consider the open energy modelling initiative (http://openmod-initiative.org/manifesto.html) due to the importance of opening the energy modelling data and models (Pfenninger, Stefan; DeCarolis, Joseph; Hirth, Lion; Quoilin, Sylvain; Staffell, Iain (February 2017). "The importance of open data and software: is energy research lagging behind?". Energy Policy. 101: 211–215. doi:10.1016/j.enpol.2016.11.046. ISSN 0301-4215.)	Jordi Solé-Ollé	Spain	Accepted. The literature review exercise was expanded to include open sourced softwares published in peer-reviewed literature.	
46117	18	45	18	46	IAMS unable to model influence of flexibility options on integration of VRES resulting in overuse of CDR.	Neven Duic	Croatia	Noted. In fact, most IAMs do not assessed VRE endogenously. However, some IAMs are soft-linked with dispatch models to identify VRE constrains in input variables.	
36105	19	6	19	7	"the techno-economic potential" of what?	Sandrine Seloisse	France	Accepted. This sentence was been clarified.	
1583	19	18	19	20	In this section or elsewhere in the chapter, examples from scientific literature could be added on the potential benefits and current results of applying machine learning in climate change scientific research. Article: Huntingford et al. (2019). Machine learning and artificial intelligence to aid climate change research and preparedness. Environmental research letters, 2019. (https://iopscience.iop.org/article/10.1088/1748-9326/ab4e55) News item: https://towardsdatascience.com/tackling-climate-change-with-machine-learning-78d1e185b3ec	Paul Vethman	Netherlands	Rejected. While relevant, this topic goes beyond the scope of the Annex.	
33337	19	18	19	20	I suggest to improve description.	Domenico Vitale	Italy	Accepted. Description has been expanded and clarified.	
1581	19	19	19	19	Incomplete sentence	Paul Vethman	Netherlands	Noted	
12963	19	19	19	19	The sentence is not complete	Robin White	Canada	Accepted. Sentence has been expanded and clarified.	
33339	19	21	19	29	The definition of hybrid models is confusing. Are they build by combining data driven and physically-based models or by combining top-down and bottom-up approaches?	Domenico Vitale	Italy	Noted. Description of "hybrid" models has been expanded.	
12965	19	28	19	29	The sentence is not complete	Robin White	Canada	Accepted. Sentence has been expanded and clarified.	
33335	19	1	20	33	Do the three approaches differs in terms of uncertainty and/or bias sensitivity. Please, add more references.	Domenico Vitale	Italy	Noted. Description of TD, BU and "hybrid" models has been expanded.	
1585	20	3	20	3	Wrong phrase? "hardly linked" should be "directly linked" or "hard-linked"?	Paul Vethman	Netherlands	Accepted. Sentence has been expanded and clarified.	
12967	20	3	20	3	hardly linked' should probably be 'hard-linked'	Robin White	Canada	Noted	
12969	20	5	20	5	comprise should be compromise	Robin White	Canada	Noted	
46119	21	2	21	3	IAMS unable to model influence of flexibility options on integration of VRES resulting in overuse of CDR.	Neven Duic	Croatia	Noted. In fact, most IAMs do not assessed VRE endogenously. However, some IAMs are soft-linked with dispatch models to identify VRE constrains in input variables.	
20257	21		23		There is only one sub-section II.6.1 under Section II.6 . Should it be another sub-section under II.6?	Thi Lan Huong Huynh	Vietnam	Noted	
36107	22	9	22	9	add one or more references on the TIMES paradigm or link to the documentation page of the ETSAP website: https://iea-etsap.org/index.php/documentation	Sandrine Seloisse	France	Accepted. Links to TIME model has been included.	
36109	22	44	22	44	add one or more references on the FORECAST model, as https://ec.europa.eu/clima/sites/clima/files/docs/pages/com_2018_733_analysis_in_support_en_0.pdf	Sandrine Seloisse	France	Accepted. Links to FORECAST model has been included.	

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Comment ID	From Page	From Line	To Page	To Line	Comment	Reviewer	Reviewer Country	Response
29491	23		8		The discussion on IAMs could also highlight some criticism in the literature. Suggested papers:	Alaa Al Khourdajie	United Kingdom (of Great Britain and Northern Ireland)	Accepted. This section was expanded to include literature on IAM criticisms.
29493	23		8		oJ. Doyne Farmer, Cameron Hepburn, Penny Mealy, Alexander Teytelboym (2015), A Third Wave in the Economics of Climate Change. Environmental and Resource Economics	Alaa Al Khourdajie	United Kingdom (of Great Britain and Northern Ireland)	Accepted. This section was expanded to include literature on IAM criticisms.
29495	23		8		oLamperti et al. 2018: Faraway, So Close: https://www.sciencedirect.com/science/article/pii/S0921800917314623	Alaa Al Khourdajie	United Kingdom (of Great Britain and Northern Ireland)	Accepted. This section was expanded to include literature on IAM criticisms.
29497	23		8		oDietz and Venmans, 2019: In search of general principles: https://www.sciencedirect.com/science/article/pii/S0095069618302122#fig2	Alaa Al Khourdajie	United Kingdom (of Great Britain and Northern Ireland)	Accepted. This section was expanded to include literature on IAM criticisms.
29499	23		8		oTowards agent-based integrated assessment models: examples, challenges, and future developments. Francesco Lamperti, Antoine Mandel, Mauro Napoletano, Alessandro Sapio, Andrea Roventini, Tomas Balint & Igor Khorenzhenko. Regional Environmental Change volume 19, pages 747–762(2019)	Alaa Al Khourdajie	United Kingdom (of Great Britain and Northern Ireland)	Accepted. This section was expanded to include literature on IAM criticisms.
29501	23		8		oEnergy and Complexity. Volume 2017 Article ID 1967645 23 pages https://doi.org/10.1155/2017/1967645 Creating Agent-Based Energy Transition Management Models That Can Uncover Profitable Pathways to Climate Change Mitigation. Auke Hoekstra ,1 Maarten Steinbuch,1 and Geert Verbong1	Alaa Al Khourdajie	United Kingdom (of Great Britain and Northern Ireland)	Accepted. This section was expanded to include literature on IAM criticisms.
29503	23		8		oModelling the Evolution of Economic Structure and Climate Change: A Review☆ Tommaso Ciarli, Maria Savona. Ecological Economics. Volume 158, April 2019, Pages 51-64	Alaa Al Khourdajie	United Kingdom (of Great Britain and Northern Ireland)	Accepted. This section was expanded to include literature on IAM criticisms.
36113	23	16	23	16	Indicate TRL= Technology Readiness Level	Sandrine Seloisse	France	Noted
11757	23	30	24	2	This section will be very important and since this is not provided in this draft, it will only be possible to comment on this in the Second Order Draft. We therefor look forward to a draft text in SOD that is thoroughly prepared, especially the section on treatment of land-based mitigation options.	Maria Malene Kvalevåg	Norway	Noted. The land use section will be included in SOD.
33341	24	11	24	11	Check the footnote position	Domenico Vitale	Italy	Noted
36115	24	11	24	11	space incorrectly located for the footnote	Sandrine Seloisse	France	Noted
36117	24	15	24	15	"e.g., land use and...": delete the comma	Sandrine Seloisse	France	Noted
26325	24	30	24	30	I wonder where models like ACC2 (Tanaka and O'Neill, 2018, Nature Climate Change), a simplified IAM based on a cost-effective approach, would fall into. ACC2 is a simple climate and carbon cycle model coupled with a set of global marginal abatement cost functions. Conceptually, it fits better in the second class because of its cost-effective approach. On the other hand, it fits better in the first class in terms of its level of complexity. I further note the MiMiC model (Johansson, 2012, Climatic Change), a model of comparable features developed by my collaborator. There are probably some other examples like ACC2.	Tanaka Katsumasa	France	Noted. Annex C refers only to models and scenarios submitted in the international call of national and global scenarios managed by Chapter 3 and 4 CLAs.
36121	25	14	25	14	"such as the energy-water-land nexus": water aspects are much less developed	Sandrine Seloisse	France	Noted.
46121	25	28	25	46	IAMS unable to model influence of flexibility options on integration of VRES resulting in overuse of CDR.	Neven Duic	Croatia	Noted. In fact, most IAMs do not assessed VRE endogenously. However, some IAMs are soft-linked with dispatch models to identify VRE constrains in input variables.
43361	25	33	25	33	"carbon dioxide removals" to be consistent across chapters and the glossary	Matthias Honegger	Germany	Noted
36123	26	1	26	20	what about the interaction between the potential of EnR (as PV) and land use, interplay with agricultural land use, for example	Sandrine Seloisse	France	Noted. This issue will be further developed in sectorial chapters (6 and 7)
43363	26	9	26	12	"carbon dioxide removals" to be consistent across chapters and the glossary	Matthias Honegger	Germany	Noted
40219	26	11	26	11	suggested. add: "...albedo" to be replaced with "... albedo and water cycle"	Mihaela Caian	Romania	Accepted.
33343	26	15	26	16	Sort references by year	Domenico Vitale	Italy	Noted

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Comment ID	From Page	From Line	To Page	To Line	Comment	Reviewer	Reviewer Country	Response
33345	26	22	26	35	Please clarify if results based on climate system component are not more biased and/or more uncertain than others.	Domenico Vitale	Italy	Noted. A discussion on uncertainty and model sensitivity will be added in SOD.
33347	27	13	27	13	Please provide the meaning of SDG	Domenico Vitale	Italy	Accepted.
33349	28	1	28	7	Improve clearness of symbols. Figure caption: remove brackets at the end.	Domenico Vitale	Italy	Accepted.
14137	28		30		<p>Please separate "policy analysis" from "limitations of IAMs" clearly in a separate section. The limitations of IAMs should be stated more clearly so the reader can understand the results reported through the paper. Check for example Screciu et al 2013; Hardt & O'Neil 2017 and Capellán-Pérez et al 2020:</p> <p>"Despite great advances achieved in the field over the years,8,10 most IAMs (and especially those more policy-influential), share a core set of common assumptions whose validity is being disputed in the scientific discussion. First, IAMs are generally characterized by a rather sequential structure with limited feedbacks among the represented subsystems. The interconnectivity of modules has likely being constrained by the historical development of most IAMs through linkage of existing modules which were not originally designed for being interlinked.15 For example, natural science models must respect the laws of thermodynamics, while economic models often do not. Also, the discrepancy between the natural scientists' understanding of ecological feedbacks and the representations of environmental damage found in IAMs (if any) is especially relevant for the case of climate change impacts. Most IAMs fail to capture the "potentially irreversible threat to human societies and the planet" stated, for example, in the Paris Agreement.4,9,16–21 Second, a lack of plurality in the methods to represent the economic dimension has been detected in the literature, dominated by assumptions of conventional general or partial equilibrium through optimization methods, perfect factor substitutability, as well as the widespread use of prices as indicators of scarcity. These simplifications fail to capture the relevance of sector complementarities within the economic structure, the socioeconomic system dynamics and the role of macroeconomic policies for sustainability governance.22–28 Third, the abundance of both fossil fuels and renewable energy sources is a default assumption in most of the prominent IAMs used for climate policy analysis; hence, future energy transitions are thus largely modeled as demand-driven transformations only constrained by available monetary investments.8,29,30 However, this assumption is disputed by studies in the literature showing that fossil fuels' extraction might face significant constraints in the next few decades related with increasing geological restrictions as the quality of the resource decreases.30–32 Furthermore, a branch of literature is also showing that the replacement of fossil fuels in the current socioeconomic system by the large scale deployment of RES faces serious challenges in relation to biophysical factors such as intermittency or mineral and land requirements.33–41 Fourth, most IAMs disregard the</p>	Iñigo Capellán-Pérez	Spain	Noted. This section will be improved in SOD.
39051	29	28	29	36	In this section it states clearly that IAM's lack the possibility to model properly CDR, but thus also CCU options, so that all possible mitigation options can technically not be taken into account in the scenarios.). This recognized failure of the IAM's to represent specific technologies should not prevent the integration of updated scientific discussions on all existing important technologies to mitigate climate change. It should also be noted that Energy System Models (EMS) are able to simulate the major CCU routes and other specific technologies and therefore a discussion on EMS and on their key results should be added in the report (e.g.Ram et al., 2019, Krey et al., 2019). (REFERENCES: • Ram et al., 2019 EWG&LUT, 2019: Global Energy System Based On 100% Renewable Energy, Energy Watch Group & LUT University./• Krey et al., 2019, Energy, 172, 1254-1267.)	Célia Sapart	Belgium	Noted. The different dimensions of "feasibility" and chapter 1 approach will be included in SOD

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Comment ID	From Page	From Line	To Page	To Line	Comment	Reviewer	Reviewer Country	Response
14139	29	31	29	31	The reference Wilson et al 2012 after "demand-side responses" is not appropriate and outdated, please include other references which have already been listed in the chapter (Grubler et al, Van Vuuren et al.; van den Berg et al 2019 etc.). van den Berg, N.J., Hof, A.F., Akenji, L., Edelenbosch, O.Y., van Sluisveld, M.A.E., Timmer, V.J., van Vuuren, D.P., 2019. Improved modelling of lifestyle changes in Integrated Assessment Models: Cross-disciplinary insights from methodologies and theories. Energy Strategy Reviews 26, 100420. https://doi.org/10.1016/j.esr.2019.100420	Iñigo Capellán-Pérez	Spain	Noted
14141	30	17	30	23	This paragraph in fact is more related with scenarios than with modelling tools. Among the futures which are not typically tested with IAMs are non-growth dependent economies such as the ones depicted by the Degrowth proposal (e.g., Demaria et al 2013 or Capellán-Pérez et al 2015) Demaria, F., Schneider, F., Sekulova, F., Martinez-Alier, J., 2013. What is Degrowth? From an Activist Slogan to a Social Movement. Environmental Values 22, 191–215. https://doi.org/10.3197/096327113X13581561725194 Capellán-Pérez, I., Mediavilla, M., Castro, C. de, Carpintero, Ó., Miguel, L.J., 2015. More growth? An unfeasible option to overcome critical energy constraints and climate change. Sustain Sci 10, 397–411. https://doi.org/10.1007/s11625-015-0299-3	Iñigo Capellán-Pérez	Spain	Noted.
25925	31	1	38	27	Nordhaus, W. and Yang, Z. 1996, "A Regional Dynamic General-Equilibrium Model of Alternative Climate-change Strategies", American Economic Review 86, 741-763. Tulkens, H. 2019, Economics, Game Theory and International Environmental Agreements, World Scientific Publishing Co., Singapore. Yang, Z. 2008, Strategic bargaining and cooperation in greenhouse gas mitigations: an integrated assessment modeling approach, The MIT Press, Cambridge, MA.	Henry Tulkens	Belgium	Noted.
14143	38		38		This comment is for the Supplementary Material but I cannot insert correctly the number of the page. I would suggest to expand a bit the categories reported for each model: - type of licence? Open-access? - add 5 key recent papers obtained with the simulation of each of the models - specify the representation of climate change impacts and adaptation	Iñigo Capellán-Pérez	Spain	Accepted. Requested informations will be added in SOD.
9437					ok	ANNA LAURA	Italy	Noted
13457					To better inform policy makers the hypothesis underlying air pollution control in the SSps and their robustness per regions should be discussed in this annex.	Sophie Szopa	France	Noted.
42683					Chapter is well-written, clear	ABHA CHHABRA	India	Thank you for your constructive comment. Noted.