Expert and Government Review Comments on the IPCC WGIII AR5 Second Order Draft – Chapter 5

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
34472	5					This figure is comprehensive but difficult to read because it covers too many things at once. Please explore options to make it more accessible.	Accepted. See the response to line #278
23357	5					We are missing in this chapter a mention of the complexities of attributing emissions to sectors, as discussed in past lead-author meetings (insertion of double-counting box drafted by chapter 10, including Sankey-like diagram). Section 5.8 at the end would seem like an appropriate place for this, but it would also need to be highlighted in the Executive Summary.	Considered. The issue is briefly discussed in 5.2. in connection to uncertainty. Each sector has unique challenge in linking emissions to them, and this chapter is not able to give a detailed account to this issue.
27300	5					Figure presents data related to a very limited timeframe (1970-2010). This figure must be replaced by another one presenting data from 1850-2010, by region, in a similar methodology as adopted to other sectors. The limitation of the timeframe is misleading, since it suggests only developing countries (which started they AFOLU emmissions much later) are responsible for this source of emmisions, while most developed countries had cleared they primary forests long before 1970.	Accepted. We have included in the Final Draft cumulative emissions starting at 1750.
23861	5					It would make sense if this was less vague and linked to Chapter 6	Accepted, done
23878	5					It is interesting to search "carbon leakage" in the whole WGIII report, as many cases use "" around "carbon leakage". It is important that the Box and Glossary has a quite robust defition of carbon leakge. This box is not very specific. Defining quite clearly as in, e.g., section 3.1 in Bohringer et al 2012 (Energy Economices, EMF study), or in Peters 2010, etc. Particularly specifing the difference between "weak" and "strong" (or consumption-induced and policy-induced). Also, describing the avenues for strong (relocation, fossil fuel channel, etc), see EMF study.	Accepted
23855	5					What is the middle set of numbers (38.3)? Is this the 1990 values or the cumulative values?	Noted - seems to us that it is clear form looking at the y-axis that these are total emissions at each of these years.
23856	5					The caption should probably be in the main text, and the caption explain the figure.	Accepted - text moved.
23858	5					Explain the peak in Asian emissions around 1997.	Noted - this is a pulse of fire-related emissions for that year. Caption in figure has been updated to note that figure includes LUC emissions.
23864	5					Are these figures constructed to be additive? For example, if I add all the values in 2010 will I get to the net? It seems not.	Editorial: a clarification will be made: they are multiplicative (a product of all numbers will result in the net figure).
23865	5					In the "world" population seems to have a similar growth to emissions, while in all the regions population is somewhat lower. Is that correct?	Noted: it is correct. The reason is that there are significant differences in abosolute volume of GHG emissions between the regions. Therefore one has to weigh regional figures differently. In sum, the global GHG emission trend is more closely related to OECD90 trend, while global population trend follows more closely that of Asia.
23875	5					The LUC figure is rather noisy. What is the reason for that? It only seems to be Asia. Comment.	The figure has been redrawn and put as one figure for all the sectors
23876	5					The LUC figure has a relatively small share for LAM. Is this correct?	Accepted

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23877	5					How do the LUC results compare with the data presented in WGI?	Our LUC resutls are based on EDGAR data, which gives relatively lower estimates of emissions. The results of other studies have been referred to in Chapter 11.
23868	5					Can you explain more clearly which lines are consumption and which are production?	Accepted. More explanation will be given within the page limit.
23871	5					It is a little confusing to have some countries mentioned twice with PPP and MER. I would select one and stick to it (if one only has data in a different format, then just mark that instead of showing all datasets for ecah country, as it just makes the plot more confusing then needed)	Rejected: purpose of the figure is to reinforce the limitations of using energy intensity as an indicator, as it depends on various factors other than energy efficiency, for example, reporting of GDP as either in MER or PPP
23872	5					Confusing to have different time periods. Perhaps mark the area where the time periods are the same.	Rejected: The time periods indicate the data used to illustrate the long-term historical trends in energy intensities. What is more interesting is to compare energy intensity and per-capita intensity levels, rather than differences in intensities of a particular year. The figure is already very crowded. Adding time periods will not help clarity.

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34076	5					Overall, the chapter could be improved by providing more balance in the discussions. At the moment, some data is analysed more strongly than others, with the emphasis appearing to suggest that the emissions reduction responsibility has shifted to developing countries or Asian countries as per the country differentiation here, given their overall growth rates in absolute and per capita emissions from 1970. The fact that OECD countries have stayed at very high ends of both these measures for a long time, and continue to emit significantly more per capita at certain GDP/capita levels is not as strongly emphasised, neither is the implication that the emissions cut would still be most effective at this level as it is associated with excessive consumption and wastage. If so, emission reduction therefore would arguably not involve a reduction of quality of life or imited access to neccesities. While the negative effects of materialism, especially in rich countries, short termism have been mentioned in the report and here too, they require to be tied into the analysis here and repeated several times (as is done with the data on rate of emissions increase) to make the impression that they are important drivers. Infact, they could be considered to be the root cause of excessive release of GHGs. Hence more emphasis is required, as this would also be an important consideration for developing countries with high growth rates and who are about to achieve their development goals. Such countries should also recognise that the thinking and model of growth and continuous growth in a resource constrained world cannot continue indefinitely and start preparing to make a shift towards maintaining well being without economic growth. (eg: Jackson, 2011 and other literature referred to in chap 4, chap 10). The trade part leaves the impression that trade liberalisation has been more good overall than not despite the rise in embedded emissions. It even suggests one of the benefits as the production of higher quality goods and promotion of innovation. In terms of the former, the evidence appears to be a greater quantity rather than quality of goods as borne out by the increase in per capita consumption and spending. Literature on trade liberalisation and its negative impacts on the environment need to be included as expounded by authors like Daly where he states “Global competitiveness” (frequently a thought substituting slogan) usually reflects not so much a real increase in resource productivity as a standards-lowering competition to reduce wages, externalize environmental and social costs, and export natural capital at low prices while calling it income" (Daly, H.E., 1993. The perils of free trade. Sci. Am., 269: 24-29.; Daly, H.E. 1994. Fostering environmentally sustainable development: four parting suggestions for the World Bank. Ecological Economics 10 (1994) 183-187). JM Keynes himself has stated the following vis-a-vis trade: "I sympathize therefore, with those who would minimize, rather than those who would maximize, economic entanglement between nations. Ideas, knowledge, art, hospitality, travel - these are the things which should of their nature be international. But let goods be homespun whenever it is reasonably and conveniently possible; and, above all, let finance be primarily national" (from Daly 1994). The liberalisation of finance should also be mentioned in the context of trade, as one of the conditions upon which comparative advantage works is when factors like capital movement is curtailed. With regard to innovation, this can also be promoted through other means (eg: open access means). Finally, there are alot of statements that require more adequate support and explanation. Captions of figures too need to be improved in some instances.	Taken into account. The points brought up by the reviewer have been thorougly discussed in the chapter team. The team pursues to maintain a good balance between two robust findings: (i) that per capita emissions are higher in OECD countries compared to lower and middle-income countries, and (ii) that the emerging economies contribute the most to the increase in emissions. Chapter 4 and other chapters identify the issues that are raised by the reviewer: whether reductions are more or less costly, in social and monetary terms, in richer or poorer countries, and what type of burden sharing is desirable. CH5 focuses on a description of trends and drivers. We have revised the chapter to improve the representation of differences between countries, and to improve the captions of the figures.
34077	5					JRC 2012 which is the "Emission Database for Global Atmospheric Research (EDGAR). Available at: 19 http://edgar.jrc.ec.europa.eu/index.php" as shown in the bibliography has been used in generating many of the figures relied upon in this chapter. A section should be prepared as to what this database contains, why this database has been chosen over other databases, and why it is deemed to be appropriate. Any shortcomings of the database should also be stated.	Accepted: The EDGAR database was chosen to allow the use of consistent data across all chapters of the report. Other data sources does not provide a breakdown of emissions by activities or industrial sectors. More information on the data sources will be included in an Annex.

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34044	5					What does the table with numbers at the bottom right of the figure (next to the key) connote? The units for this table are missing and the caption does not describe it either.	Accepted - all graphs are redrafted
34058	5					Incorrect caption. The left shows decomposition of both territorial and consumption emissions for Asia whilst the right shows the decomposition of both types for OECD countries. Caption should describe how territorial and consumption emission decompositions are shown in the 2 parts of the figure.	Editorial: caption will be corrected.
34066	5					The caption should describe and explain the figure including the scale used which is magnitudanal rather than linear. Additonally, it is unclear if the figure shows average per capita energy use at rising per capita income levels over the 40 years (ie the 1970 income being the start of the line and the 2010 income being the end) OR the energy use associated with different per capita incomes in the different regions.	Accepted - the revised caption mentions the use of logarithmic scales, and the figure includes the start and end years, which clarifies the potential confusion whether the lines indicate a trend over time or the spread across countries within each region.
34050	5					Source reference is incomplete.	Accepted: source will be added. Reference is Grubler et al., 2012.
34062	5					While the size of the circles in the figure denote the population size, what is the significance of the different colours for the circles in the figure? This should be described in the caption.	Accepted - caption will be modified.
34436	5					A box highlighting key issues for LDCs as included in almost all other chapters should be added to the chapter.	Accepted: The box was included in the next version of Chapter 5
34046	5		5		7	The data in the figure provided shows a 80% increase from 27.9(1970) to 50.1 Gt (2010) CO2e/yr. This appears to differ slightly from the information taken from IEA, 2011 that states 75%. Why the discrepancy and which is more accurate?	Accepted - This is a different data source from IDEA, estimates are uncertain (now discussed in the text), so it is to be expected that numbers would be somewhat different. There is a full discussion of ucnertainty and databases in the final draft
30100	5					There has been considerable advancement in the understanding of EU ETS imapcts, particularly using firm level data, also on the price impacts. Unfortunately there is no time to go into this, but these recent review may be useful. Calel (2013) Carbon markets: a historical overview. Wiley Interdisciplinary Reviews: Climate Change, 4(2), 107–119. Available from: http://wires.wiley.com/WileyCDA/WiresArticle/ wisId- WCC208.html.; Laing, T., Sato, M., Grubb, M., and Combert, C. Assessing the effectiveness of the EU Emissions Trading System. February 2013. Working Paper, Grantham Research Institute, London, UK.http://www2.lse.ac.uk/GranthamInstitute/publications/WorkingPapers/Papers/100-109/WP106-effectiveness-eu-emissions-trading-system.pdf; Martin, R., Muûls, M., & Wagner, U. (2012). An Evidence Review of the EU Emissions Trading System, Focusing on Effectiveness of the System in Driving Industrial Abatement. Technical report, Department of Energy and Climate Change. Available from: https://www.decc.gov.uk/assets/decc/ 11/cutting- emissions/eu- ets/5725- an- evidence- review- of- the- eu- emissions- trading- sys.pdf.	Noted. Thanks for the literature. The topic is discussed in Chapter 15, Section 15.5.
30098	5					This section can be more up to date - this recent review may be useful. Calel (2013) Carbon markets: a historica overview. Wiley Interdisciplinary Reviews: Climate Change, 4(2), 107–119. Available from: http://wires.wiley.com/WileyCDA/WiresArticle/ wisId- WCC208.html.	Noted. The comment is forwarded to CH15

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34460	5					Please extend and sharpen your assessment. Currently, emission trends are dealt with only for a very limited period (1970-2010). This analysis needs to be extended. Moreover, it need to be communicated more clearly what changes occured since the AR4. There are a series of significant changes (e.g. growth rate of emissions etc.) as highlighted in SPM/TS.	Taken into account - Trends are considered before 1970 for CO2, but data limitations preclude analysis of longer periods for other GHGs. Final draft will be edited to be consistent with the SPM/TS conclusions relating to this section.
34463	5					How does the use of different GHG emission metrics alter the representation of regional and sectoral emission trends? Please provide evidence that answers this question and coordinate with chapter 3 (section 3.8.5) to clarify conceptual issues.	Taken into account - Have refered to Chapter 3 on this point and have noted in the text how much difference a change in metric makes.
23854	5					Important to note that the figures only have well-mixed GHGs, and not other species that cause a forcing. As you discuss in 5.2.2 these other species are rather important	Taken into account - Rreference here to the later section noting that these forcing agents are considered there.
23862	5					At the start you mentioned "factors" and "underlying drivers". Make sure the language is consistent.	Accepted. Will use terms consistently.
23869	5					Minx et al 2011 look into both urbanisation and household size in the case of China (see, e.g., Figure 4), and is a useful reference for this section http://pubs.acs.org/doi/abs/10.1021/es201497m	Accepted - Conclusions and citation included.
34461	5					Section 5.3.4 overlaps with the “emission trends and driver” section of the sector chapters (7-11). This section could either be removed or reduced to a short synthesis of the material discussed in the sector chapters. This might free-up space for new material elsewhere in your chapter. Consistency with chapter 12 material on urbanization needs to be ensured.	Noted. We have coordinated with the sector chapters and reduced their length in CH5.
30253	5					I suggest having cross-chapter references within this section, guiding the reader to further details about each sector (e.g. Link within 5.3.4.3 to chapter 10, and 5.3.4.5 to waste excursus within chapter 10)	Agreed.
27299	5					Data and figures related to agriculture, forestry, other land use (AFOLU) refers only to a very limited timeframe (1970-2010). In order to enable comprehensive and historical assessment of AFOLU contribution by regions, emissions figures must refer to the same timeframe used in other sectors, that is 1850-2010. The limitation of the timeframe is misleading, since it suggests only developing countries (which started they AFOLU emmissions much later) are responsible for this source of emmisions, while developed countries had cleared they primary forests long before 1970.	In all the key sectors, we have data from 1970 to 2010.
19844	5					Needs more concrete (quantified) examples or I suggest cutting this section.	Accepted. We have revised the section thoroughly and believe it is much more precise now, even though quantifyable results are hard to get.
30255	5					I suggest cross-linking this behaviour part with Box 10.1 in chapter 10	Noted.

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35409	5					This section should include a paragraph showing the co-benefits of material efficiency strategies, as this is presented as an important strategy throghout the report and it is unjustifiedly missing here. Such paragraph should make mention of those strategies aiming at reducing, reusing, and recycling municipal waste as these are effective and high-impact means of reducing greenhouse gas (GHG) emissions. Reference: US EPA, Solid Waste Management And Greenhouse Gases: A Life-Cycle Assessment Of Emissions And Sinks, 3rd Edition. 2006. When discarded materials (waste) are recycled, they provide industry with an alternate source of raw materials. This results in less demand for virgin materials whose extraction, transport and processing are a major source of GHG emissions. Recycling thus reduces emissions in virtually all extractive industries: mining, forestry, agriculture, and petroleum extraction. Additional energy (and associated emissions) are saved in the manufacturing process itself, as recycled materials generally require less energy to be turned back into products. Reference: IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Waste Generation, Composition, and Management Data, Ch. 2, 2006. In this way, recycling can save three to five times as much energy as incineration captures by burning. Ref: J. Morris, “Comparative LCAs for Curbside Recycling, Versus Either Landfilling or Incineration With Energy Recovery.” International Journal of Life Cycle Assessment, 2005. This is particularly notable in products such as aluminium, where the direct energy required to recycle is 88% less than that required to produce primary aluminium. Ref: M. Schlesinger, Aluminum Recycling, CRC Press, 2006. LIkewise, it should be noted that for every kg of plastic recycled, around 1.5 – 2 kg CO2-e is saved. Reference: UNEP, 2010. Waste and climate change. Global trends and strategy framework. Recycling of paper and wood products has a notable double impact. Not only does it reduce the demand for virgin wood fibre, thus reducing emissions from deforestation, but it also preserves forests’ ability to continue to act as carbon sinks (removing carbon from the atmosphere).	Noted. Efficiency improvements return in CH5 at various places. As part of productrivity improvement and economic growth (5.3.3.1), and as part of the rebound effect (5.6.2)

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35463	5					This section should include a paragraph showing the co-benefits of material efficiency strategies, as this is presented as an important strategy throghout the report and it is unjustifiedly missing here. Such paragraph should make mention of those strategies aiming at reducing, reusing, and recycling municipal waste as these are effective and high-impact means of reducing greenhouse gas (GHG) emissions. Reference: US EPA, Solid Waste Management And Greenhouse Gases: A Life-Cycle Assessment Of Emissions And Sinks, 3rd Edition. 2006. When discarded materials (waste) are recycled, they provide industry with an alternate source of raw materials. This results in less demand for virgin materials whose extraction, transport and processing are a major source of GHG emissions. Recycling thus reduces emissions in virtually all extractive industries: mining, forestry, agriculture, and petroleum extraction. Additional energy (and associated emissions) are saved in the manufacturing process itself, as recycled materials generally require less energy to be turned back into products. Reference: IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Waste Generation, Composition, and Management Data, Ch. 2, 2006. In this way, recycling can save three to five times as much energy as incineration captures by burning. Ref: J. Morris, “Comparative LCAs for Curbside Recycling, Versus Either Landfilling or Incineration With Energy Recovery.” International Journal of Life Cycle Assessment, 2005. This is particularly notable in products such as aluminium, where the direct energy required to recycle is 88% less than that required to produce primary aluminium. Ref: M. Schlesinger, Aluminum Recycling, CRC Press, 2006. LIkewise, it should be noted that for every kg of plastic recycled, around 1.5 – 2 kg CO2-e is saved. Reference: UNEP, 2010. Waste and climate change. Global trends and strategy framework. Recycling of paper and wood products has a notable double impact. Not only does it reduce the demand for virgin wood fibre, thus reducing emissions from deforestation, but it also preserves forests’ ability to continue to act as carbon sinks (removing carbon from the atmosphere).	Noted. Efficiency improvements return in CH5 at various places. As part of productrivity improvement and economic growth (5.3.3.1), and as part of the rebound effect (5.6.2)
29556	5					This section should include a paragraph showing the co-benefits of material efficiency strategies, as this is presented as an important strategy throghout the report and it is unjustifiedly missing here. Such paragraph should make mention of those strategies aiming at reducing, reusing, and recycling municipal waste as these are effective and high-impact means of reducing greenhouse gas (GHG) emissions. Reference: US EPA, Solid Waste Management And Greenhouse Gases: A Life-Cycle Assessment Of Emissions And Sinks, 3rd Edition. 2006. When discarded materials (waste) are recycled, they provide industry with an alternate source of raw materials. This results in less demand for virgin materials whose extraction, transport and processing are a major source of GHG emissions. Recycling thus reduces emissions in virtually all extractive industries: mining, forestry, agriculture, and petroleum extraction. Additional energy (and associated emissions) are saved in the manufacturing process itself, as recycled materials generally require less energy to be turned back into products. Reference: IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Waste Generation, Composition, and Management Data, Ch. 2, 2006. In this way, recycling can save three to five times as much energy as incineration captures by burning. Ref: J. Morris, “Comparative LCAs for Curbside Recycling, Versus Either Landfilling or Incineration With Energy Recovery.” International Journal of Life Cycle Assessment, 2005. This is particularly notable in products such as aluminium, where the direct energy required to recycle is 88% less than that required to produce primary aluminium. Ref: M. Schlesinger, Aluminum Recycling, CRC Press, 2006. LIkewise, it should be noted that for every kg of plastic recycled, around 1.5 – 2 kg CO2-e is saved. Reference: UNEP, 2010. Waste and climate change. Global trends and strategy framework.	Noted. Efficiency improvements return in CH5 at various places. As part of productrivity improvement and economic growth (5.3.3.1), and as part of the rebound effect (5.6.2)

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26971	5					This section should include a paragraph showing the co-benefits of material efficiency strategies, as this is presented as an important strategy throghout the report and it is unjustifiedly missing here. Such paragraph should make mention of those strategies aiming at reducing, reusing, and recycling municipal waste as these are effective and high-impact means of reducing greenhouse gas (GHG) emissions. Reference: US EPA, Solid Waste Management And Greenhouse Gases: A Life-Cycle Assessment Of Emissions And Sinks, 3rd Edition. 2006. When discarded materials (waste) are recycled, they provide industry with an alternate source of raw materials. This results in less demand for virgin materials whose extraction, transport and processing are a major source of GHG emissions. Recycling thus reduces emissions in virtually all extractive industries: mining, forestry, agriculture, and petroleum extraction. Additional energy (and associated emissions) are saved in the manufacturing process itself, as recycled materials generally require less energy to be turned back into products. Reference: IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Waste Generation, Composition, and Management Data, Ch. 2, 2006. In this way, recycling can save three to five times as much energy as incineration captures by burning. Ref: J. Morris, “Comparative LCAs for Curbside Recycling, Versus Either Landfilling or Incineration With Energy Recovery.” International Journal of Life Cycle Assessment, 2005. This is particularly notable in products such as aluminium, where the direct energy required to recycle is 88% less than that required to produce primary aluminium. Ref: M. Schlesinger, Aluminum Recycling, CRC Press, 2006. LIkewise, it should be noted that for every kg of plastic recycled, around 1.5 – 2 kg CO2-e is saved. Reference: UNEP, 2010. Waste and climate change. Global trends and strategy framework. Recycling of paper and wood products has a notable double impact. Not only does it reduce the demand for virgin wood fibre, thus reducing emissions from deforestation, but it also preserves forests’ ability to continue to act as carbon sinks (removing carbon from the atmosphere).	Noted. Efficiency improvements return in CH5 at various places. As part of productrivity improvement and economic growth (5.3.3.1), and as part of the rebound effect (5.6.2)
34459	5					Please assess uncertainty ranges in data sources (as agreed upon in previous lead author meetings). One way of doing this is to compare estimates (GDP, population, emissions) across different data sources. How do estimates vary at a global, regional or sectoral level? What are the uncertainties associated with different GHGs? It should also be explored to what degree uncertainties are reported for individual data sets (contact Jos Olivier). In the literature a variety of articles have been published comparing estimates across data sets and studies including consumption-based emissions: http://www.biogeosciences.net/special_issue107.html	Accepted: We have added information about uncertainty in emissions and differences between data sources in the chapter.
34462	5					Overall, more efforts could be devoted to synthesize the evidence you find in the literature. If there are large uncertainty ranges in estimates, the text should explain why they exist. In most parts of the current text, you cite individual studies one after the other without providing a synthesis. Important synthetic studies like Copeland and Taylor (2004) on growth and the environment are not even referenced. http://www.jstor.org/stable/3217036?origin=JSTOR-pdf&	Taken into account: We refer to the original EKC study by Grossman and Krueger and the recent paper by Brock and Taylor.
34471	5					Thanks for (almost) staying within your page limit. Well done! Please keep it in mind when preparing your final draft.	Noted
34476	5					At the beginning of each section (or in another prominent place), please tell the reader if, where and how the evidence you assess in this section has been treated in previous Assessment Reports, in particular in the AR4. Moreover, for key findings please state how the state of knowledge evolved in comparison to the equivalent AR4 finding.	Accepted. The changes since AR4 has been strengthened throughout the chapter.
34479	5					Overall, your draft improved a lot when compared to the first order draft. Thank you for your efforts. Well done!	Noted
34490	5					Please make sure that your Final Draft complies with the outline that governments had approved for your chapter.	Noted

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34451	5					Your 'Executive' Summary includes much data but offers few insights. What do these numbers mean? How big are they? Please sharpen your messages. When presenting evidence, please put your numbers always into context and tell the 'Executive' reader in what respect this is relevant information for policymaking. For instance, you do not mention once that the growth rate of emissions was higher in the period 2000-2010 than in previous decades (see SPM). Moreover, please provide information on the uncertainty ranges of data. Your account of GHG emissions differs substantially from the AR4. Why is that?	Accepted: The ES was revised accordingly.
34483	5					If you feel that there is a trade-off between providing details for key findings and respecting space constraints in your Summary, please focus on a small set of key findings and their details rather than provinding a paragraph on every topic that is covered in your chapter. The latter approach tends to produce assertions that are so 'comprehensive' and general that they are almost meaningless. Hence, selection seems warranted.	Accepted: The ES was revised accordingly.
34491	5					Please sharpen your key messages. Every paragraph in your Summary should state one key finding in the first sentence, qualified with an uncertainty statement, and substantiated/qualified with relevant evidence in the paragraph body and referenced to sections where more detail can be found.	Accepted. Summary has been rewriten.
35238	5	0				The source of the GHG emissions data since 1970 used in this report is mainly the EDGAR database. However, the EDGAR database has systematic deviations for developing countries. The data of China is usually 10% higher compared to other databases (see figure 1 in the attached WORD file). It is recommended to: (1) conduct a systematic review of the existing databases and examine the methodology and original data sources of different databases; (2) add a paragraph to address data disparity and uncertainties of different databases, especially the systematic data deviation of China, and the reason why EDGAR database is chosen; (3) replace the EDGAR database with the CDIAC database for data consistency in CO2 emissions, given that CO2 emission data before 1970 in this report is from the CDIAC database.	Rejected: We have added information about uncertainty in emissions and differences between data sources in the chapter. The EDGAR database was chosen to allow the use of consistent data across all chapters of the report. The CDIAC data does not provide a breakdown of emissions by activities or industrial sectors. This is why we adopted the EDGAR database as a common data source for the Report.
35239	5	0				Time spans chosen in this chapter are mostly between 1970 to 2010 and 1990 to 2010. The choice of these time spans only emphasizes the recent incremental emissions and the emission flow, but ignores the emission stock. Meanwhile, it neglects the industrialization and urbanization processes of industrialized countries when their emissions increased dramatically (usually before 1970). These may lead to misunderstanding. To fully reflect the emission stock, historical responsibility and corresponding economic development, it is recommended to use the time span of 1850 – 2010, or at least 1950 – 2010.	Taken into account: The new version of chapter 5 adds a new figure and a discussion about emission stocks. Regarding the time span, several figures in the chapter, including emission flows and stocks started all the back to 1750. The emphases on the last decade is to cover new data and information created after IPCC AR4.

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35240	5	0				This chapter fails to present the balance between aggregate and per capita emissions, and between emission flow, increase and stock. It is recommended to consider absolute value when referring to growth rate, to consider per capita data when referring to aggregate emissions, and to consider emission stock when referring to emission flow. For example, Page 4, lines 10-12, “Industrial GHG emissions have increased from 6.3 GtCO2eq/yr in 1970 to 10.5 GtCO2eq /yr in 2010, with an increased growth rate after 2002 attributed to a 66% growth in China’s industry (high confidence).” It is inappropriate to single out China here without addressing the fact that OECD countries contributed most of the emissions in transportation and building sectors. It is suggested to either delete “with an increased growth rate after 2002 attributed to a 66% growth in China’s industry” or list all other major factors that contribute to emission increase. It is also suggested to revise accordingly in the underlying report. For another example, Page 28, lines 26-27, “The highest growth rate of transport emissions was in the Asia region, where emissions registered more than 7-fold growth between 1970 and 2010”. This argument ignored the huge differences in emission levels in 1970 between developed countries and Asian countries, and the fact that the per capita transport emissions in OECD countries were and are still much higher than that of Asian countries. In addition, many figures in this chapter use logarithmic coordinates, as shown in Figure 5.3.3, 5.3.8 and 5.4.1, which omit the huge differences in actual value of per capita data between developed and developing countries. It is proposed to either use ordinary coordinates to substitute logarithmic coordinates, or illustrate every specific data when using logarithmic coordinates.	Taken into account: The chapter was revised to improve the balance mentioned in the comment. The revised version has new figures showing emissions stocks (Fig. 5.2.2) as well as figures including per capita emissions in relation to different parameters (Fig. 5.2.1, 5.3.3.1, 5.4.2, 5.5.1, 5.3.4.1, 5.3.4.2, 5.3.4.4, 5.3.5.2). Regarding references to individual countries, the revised version includes references and make comparisons among all regions, or when needed, several countries within a region.
24243	5	0				First and foremost, a great chapter! Very informative about drivers and useful for policy and strategy making. However, the text repeatedly refers to "low carbon renewable energy and nuclear electricty". As these options are primarily a matter for policy and economic viability, i.e. not specifically related to scientific findings, it would be great if the IPCC could refrain from prescribing technology and simply refer to "low carbon electricity" or "low carbon energy" in these writings. Furthermore, the chapter lack a dedicated section for addressing financing and investments as a specific and very potent driver.	Accepted and noted. We have rephrased the 'low carbon electricity' in Section 5.3.2.2 as suggested. We acknowledge that we do not address financing and investments in a dedicated section. We touch on the subject in 5.6 and 5.6.3 where we discuss infrastructure and lock in.
33512	5	0				I find it a major omission that the chapter does not outline the huge differences in per capita contributions to climate change WITHIIN countries, which are far greater than averaged per capita emissions BETWEEN countries. This is an underlying problem of all sectoral studies mentioned, i.e. that drivers are embedded in differences in per capita consumption, and that a small share of high-energy consumers accounts for a very large share of overall emissions. In my opinion, if this issue is not taken up, there is very little chance to reduce emissions, because individual high contributors appear to be the most reluctant to change lifestyles. For example, see Chakravarty et al. 2009. Sharing global CO2 emission reductions among one billion high emitters. PNAS.	Taken into account: The revised version of Chapter 5 mentions the differences in per capita emissions within regions and within countries in a particular region, although not extensive analysis is included on this particular issue in Chapter 5. Please refer to Chapter 4 for a more comphensive discussion on this issue.
33514	5	0				Tourism is one of the most rapidly growing emissions sectors, mostly as a result of growth in aviation. It might be worth to outline this, as tourism is a very powerful driver of emission growth, with limited options to influence behaviour. As for transport and specifically aviation/car references, I find that these are mentioned in a very generic way throughout the chapter.	Correct but do not have literature that provides evidence in contribution to transport emissions
23842	5	0				GWP100 is mentioned in a few places, but it does not state which values are used. Are they from AR4? I guess the best solution is to use the must updated values from AR5 WGI.	Taken into account - Text added to clarify SAR GWPs are used, following UNFCCC procedures.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
23843	5	0				At a few places, particularly at the start, it is not state the source of the emission statistics. I gather it is EDGAR. What was the reason for this choice? What do other data sets say (even if just for CO2)? How does EDGAR compare with the data used in WGI?	Taken into account: We have added information about uncertainty in emissions and differences between data sources in the chapter. The EDGAR database was chosen to allow the use of consistent data across all chapters of the report. The CDIAC data does not provide a breakdown of emissions by activities or industrial sectors. This is why we adopted the EDGAR database as a common data source for the Report.
23870	5	0				Throughout the chapter, MER and PPP data are used. I suspect not many will know the significance of the difference. Perhaps a FAQ on PPP versus MER and associated issues of each dataset is warranted?	Taken into account: The glossary defines these terms.
19693	5	0				Excellently illustrative and very interesting graphs - well done!	Noted and thanks.
36323	5	0				Behavior changes to rising energy prices are not addressed very well. We suggest building on the discussion on the bottom of page 22 to include more evidence that so long as energy prices are rising more quickly than per capita GDP you will see reductions in energy use.	Reject - not enough evidence
36324	5	0				Overall, there is a very heavy emphasis on CO2 emissions from energy in this chapter. While that is the largest source of emissions, there may be substantial opportunities for mitigation from other sources of GHG.	Noted. Most attention is given to CO2 emissions from energy, but we have considerable expanded the space given to other contributors. Section 5.2 and 5.3.5 now discuss in detail the relative importance of substances and sectors.
36325	5	0				The tone of this chapter often seems to indicate that we have little understanding of the factors and drivers of emissions (e.g., page 17 FAQ 5.2). While they are complex, there have been numerous studies examining these factors and drivers and, as described in detail in Chapter 6 of this report, there are multiple simulation models that are being used to assess future policy scenarios that are attempting to capture many of these factors within forward-looking models. There are many places where the text in Chapter 5 would benefit from additional information on economic (and other social science) theory and findings regarding behavioral response that are more specific than the many vague statements and qualifying clauses that indicate impacts of drivers, trends, policies, etc. are not well understood and quantitative influence unclear.	Taken into account: The revised version of Chapter 5 tries to improve the explanation of the influences of the different drivers identified in past emissions trends. The literature often describes the drivers and their influence on emissions in a qualitative fashion. This fact, together with the interlinkages among drivers, makes diffcult to single out the influence on past emissions of the each of the drivers (see Section 5.1 and 5.8). For forward looking analysis of the drivers in future trends, please refer to Chapter 6.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36326	5	0				The document needs to be reviewed for logicial flow. It starts with the thorough yet complex Kaya and other analyses and then goes into the qualitiative discussions, including definitions of the terms used in the beginning of the chapter. This makes for difficult reading and, more importantly, difficulty in derived the key points this chapter seeks to make.	Noted. The issue has been largely addressed by the restructuring the chapter structure.
36327	5	0				There is little to no mention of Mitigation in this chapter (only brought up in terms of refering to other chapters or in a FAQ, mentioned 12x overall), yet the title implies that it is a key component. This either needs to be removed from the title or significantly bolstered.	Noted. We cannot change the title. This has been plenary approved. We include mitigation in the chapter at various places. We include it in the findings on co-benefits in the ES. A word count shows we use the word 'mitigation' 35 times in text. Indeed, there is not much empirical work on the effects of past mitigation on emissions.
36328	5	0				This chapter seems to only discuss emissions - presumably gross though that it never stated. What is the role of sequestration? How can you discuss (or add in discussion as none is currently here) mitigation without discussion of sequestration or other methods to mitigate emissions.	Rejected. We have net emissions for the AFOLU sector and sequestration through trees and reforestation is covered. As CH5 only considers past trends and drivers, CCS does not figure prominently in the chapter, indeed.
36329	5	0				Many sentences are too lengthy and, as a result, the subject and main points are lost.	Taken into account: The revised version has an improved language that will contribute to solve this issue.
36330	5	0				Lots of acronyms are introduced but not used again in the chapter (eg AFOLUFA). This is not necessary.	Accepted. We try to make the final draft reader friendly.
36331	5	0				The chapter is called "Drivers Trends and Mitigation" but to us it seems to be almost all discussion about trends, with some mention of drivers and very little discussion of mitigation. A better chapter title would be "Trends and Drivers". Alternatively, the authors could revise the chapter to reflect the original title.	Taken into account: The title was fixed by the IPCC plenary. It was agreed within WGIII that Chapter 5 focuses mainly on trends and drivers, leaving mitigation to the sectoral chapters (Chapters 7 to 12). WGIII will request to the IPCC plenary to change the title of Chapter 5 to "Trends and Drivers".
40567	5	0				As described in section 5.4.1., (especially P38, L7-L12), emerging countries can be regarded in a transition status from developing countries to developed ones, and show characteristic behavior. The behavior is different from both developed and developing countries. Therefore, it would be reasonable to divide into three categories, developed, emergent, and developing countries. Especially the trend of Asian countries (especially developing countries in G20) is very characteristic, and it would be academically valuable to analyze and summarize their movements, and surely helpful to make a strategy for GHG emission reduction. Therefore, this chapter should focus more on those emerging countries.	Noted. Though, it is not the task of AR5 to do new academic research, in the Final Draft, we differentiate between Least Developed, OECD90, Economies in Transition, and other countries.
29163	5	0				Chapter feels quite disjointed, and could be improved by better linking between the different elements.	Accepted. The chapter has been restructured.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
29164	5	0				Many historical comparisons are against 1970. While historical comparisons are useful more info on more recent trends would be interesting.	Accepted. In the Final Draft we give more attention to the last decade 2000-2010.
33651	5	1	48	2	3	The words territorial, production, consumption are unclear. Does 'terrorial' mean (standard) IPCC/UNFCCC accounting of actual emissions from the activities within a country/region? Does production/consumption mean of energy or of all goods within the country/region? Same remark for main text; pls. define these terms upfront or when they are first introduced in the chapter. But since the standard form of accounting GHG emissions of countries is cf. the UNFCCC/IPCC, I would recommend to only explicitly mention it when 'other' accounting methods are used. E.g. in fig. 5.2.1 and 5.22 "territorial" can be removed.	Accepted. A box has been created.
29357	5	1	48	2	3	The words territorial, production, consumption are unclear. Does 'terrorial' mean (standard) IPCC/UNFCCC accounting of actual emissions from the activities within a country/region? Does production/consumption mean of energy or of all goods within the country/region? Same remark for main text; pls. define these terms upfront or when they are first introduced in the chapter. But since the standard form of accounting GHG emissions of countries is cf. the UNFCCC/IPCC, I would recommend to only explicitly mention it when 'other' accounting methods are used. E.g. in fig. 5.2.1 and 5.22 "territorial" can be removed.	Accepted. A box has been created.
19885	5	1	1			Overall comment: it is not clear whether the discussion in this chapter can cover "all GHGs" or "CO2 only". The emission patterns and sources of non-CO2 GHGs are uncertain and dependent on regional and economic conditions. However, the sections after 5.4 seem to focus on CO2 emission only. The authors should touch upon the factors of non-CO2 GHG drivers.	Taken into account: The revised version includes a thorough analysis of the trends of non-CO2 GHG, including an uncertainty analysis (see Section 5.2.3). The Chapter gives a better explanation why only CO2 are used for certain analysis and why all GHG are used for others (see Sections 5.2, 5.3.4, and 5.3.5).
27511	5	10		10		Meaning of inserted table at the right bottom with headings "Sector, 70s, 80s, 90s" is unclear; there is no reference in the text; propose to delete it.	Accepted - all graphs are redrafted
27512	5	10		10		Meaning of inserted table at the right bottom with headings "Sector, 70s, 80s, 90s" is unclear; there is fairly no reference in the text; propose to delete it.	Accepted - all graphs are redrafted
36354	5	10	1			In Fig 5.2.3 (a), what are the CO2 Processes including? Please make explicit/define.	This figure was moved elsewhere, TSU will add sector and region definitions in an appendix.
36355	5	10	1			What is the small gray box conveying? There is no discussion/explanation about it. Is it percentage increases? Please explain or delete.	Accepted - all graphs are redrafted
36353	5	10	1	10	1	This figure should not be presented and mentioned here until it is discussed in the text. We think it should be moved.	Accepted. Figure is moved to Chapter 1.
36356	5	10	3	10	4	However, past societal choices are not indicative of future societal choices. There is greater attention paid to reducing GHG emissions now than 20 years ago.	Noted. Not sure where the comment precisely referred to. We have revised texts that connect past policies to future expecations.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
33660	5	10	5			a: Strange order of gases. Suggest to use the usual order used in national GHG inventories and move CH4 up, between CO2 and N2O. b: I recommend to split AFOLU into Agriculture and FOLU, since these are very different, also in their uncertainty	Accepted - Figure was moved to CH1. Sometimes the order of a series is also based on other considerations e.g. showing changes in trends.
29351	5	10	5			a: Strange order of gases. Suggest to use the usual order used in national GHG inventories and move CH4 up, between CO2 and N2O. b: I recommend to split AFOLU into Agriculture and FOLU, since these are very different, also in their uncertainty	Accepted - Figure was moved to CH1. Sometimes the order of a series is also based on other considerations e.g. showing changes in trends.
36358	5	10	5	10	5	It is not clear what the inset tables are; they should be described in the caption.	Accepted - all graphs are redrafted
36357	5	10	5	11		The data are presented with three significant figures, no uncertainty analysis, including land use. Please revise with uncertainty analysis and appropriate number of significant figures.	Accepted. We are more careful with number of digits and include full discussion of uncertainty.
26315	5	10		10		the title of the little box, at the bottom right, is "sector". It should be better as "gas".	Accepted - all graphs are redrafted
33661	5	11	1	11	24	I miss a discussion on the uncertainty in emissions estimates, e.g. with reference to Andres et al. (2012) for fossil-fuel CO2 and Houghton et al. (2012) for CO2 from LULUCF (see refs in Ch. 1). Moreover, for non-CO2 GHG uncertainties, reference could be made to: UNEP (2012) The Emissions Gap Report 2012. United Nations Environment Programme (UNEP), Nairobi. In Appendix 1 of this report, the uncertainties in global total emissions of CH4 and N2O and F-gases from EDGAR are discussed and global emissions 1970-2010 and for specifically for 2010 are compared to global emissions infereed from atmospheric concentration measurements.	Taken into account - discussion of uncertainty integrated into the text throughout, including some of the references noted here.
29352	5	11	1	11	24	I miss a discussion on the uncertainty in emissions estimates, e.g. with reference to Andres et al. (2012) for fossil-fuel CO2 and Houghton et al. (2012) for CO2 from LULUCF (see refs in Ch. 1). Moreover, for non-CO2 GHG uncertainties, reference could be made to: UNEP (2012) The Emissions Gap Report 2012. United Nations Environment Programme (UNEP), Nairobi. In Appendix 1 of this report, the uncertainties in global total emissions of CH4 and N2O and F-gases from EDGAR are discussed and global emissions 1970-2010 and for specifically for 2010 are compared to global emissions infereed from atmospheric concentration measurements.	Taken into account - discussion of uncertainty integrated into the text throughout, including some of the references noted here.
23860	5	11	1	11	26	This is all using the WGI results, but it should also be in the EDGAR data. Are EDGAR and WGI consistent?	Notes - Yes, WG I results quoted here and EDGAR are consistent (e.g., results are not identical, but are within uncertainties.)
36359	5	11	1	11	5	Why were units changed from reporting values in GtCO2e to GtC? Seems preferable to be consistent throughout for the sake of consistency and to avoid confusing the reader.	Accepted - Units changed to be consistent (GtCO2).
27513	5	11	1	11	26	Emissions from CH4 and N2O are represented inadequately. Recent research findings for example present roughly three times higher total N2O levels then formerly expected. This research niche is a global academic voic and should be considered to include in more detail.	Rejected - No literature reference supplied for the claim that N2O emissions are this high. This would be well outside of the currently understood uncertainty range (e.g. WG I report), so some reference would need to be supplied for this claim.
36364	5	11	14	11	16	The only citation given here is from ' Ciais et al 2014'. Please add a citation from recent history to be the basis of this important information.	Editorial - We reference the WG I assessment.
33662	5	11	15			… be larger than for fossil CO2, …	Accepted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
26622	5	11	17			Emissions of banked CFCs, HCFCs are significant problem.Ref. UNEP/WMO Scientific Assessment of Ozone Depletion 2010	Noted - CFCs are not dealt with in this chapter (since these are controlled under Montreal Protocol), but we have added a reference to WG I where CFCs are reviewed.
29353	5	11	2			Missing is space and water heating in buildings	Noted - To save space, individual sectors were deleted in this sentence
36365	5	11	25	11	26	Please change to "In addition to greenhouse"	Rejected - We could not figure out what portion of the text this applies to.
20301	5	11	28			What is BaU, what uncertainties apply: how confident can we be about future GDP growth paths, or energy prices? Can we assume that GDP elasticities of CO2 intensity will follow similar paths as in past?	Taken into account - Section re-written to be clearer. BAU wording removed.
36366	5	11	30	11	40	What is the citation for stating emissions increase from just over 25 Gt GHG in 1970 to over 45 Gt in 2008? Figure 5.2.3b shows 27.9 Gt in 1970 increasing to 50.1 Gt by 2010 (though as noted elsewhere, it appears that this total does not include emissions from waste management). Also, what is the reason to expect that the human population will increase at approximately the same rate of recent decades? Many projections show declining rates of growth in population and then flattening out of global population levels. Please review this text and the corresponding literature and revise as necessary.	Taken into account - Section re-written to be clearer. (Numerical figures here, and elsewhere in this chapter, updated to match final emissions data sets.)
31395	5	11	37	11	40	This formulation is not very clear as population and economic growth will increase regardless. Suggested revision: "..but past societal choices indicate that with projected economic and population growth emissions will continue to grow."	Accepted. Revision made exactly as suggested. However, we note this runs counter to requests from some other reviews to be more quantitative in these FAQs.
36367	5	11	37	11	40	What is meant by "net negative, but uncertain"? Would it be best to simply give the uncertainty?	Accepted The phrase is removed in revision to address other comments.
29354	5	11	4	11	5	Missing here is which Confidence Interval is used here (1 or 2 sigma; 66% or 95% CI, 2 SD convention of GHG inventory reporting or 1 SD as used by WG I) and mentioning that land use related CO2 emissions are very uncertain, globally and even more at country level, compared to fossil-fuel CO2 emissions.	Accepted -- Added "(90% confidence interval) " to text.
23859	5	11	4	11	5	Is this the EDGAR estimate or another? Why not use the EDGAR data for this.	Noted - This is WG I results, as referenced. WG I has already performed this assessment, including uncertainty (which needs to be done consistenly between fossil and LUC emissions), so we use those results.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36360	5	11	4	11	5	The only citation given here is from ' Ciais et al 2014'. Please add a citation from recent history to be the basis of this important information.	Rejected - WG I has extensive references on this topic and has performed the relevant calculations and balancing between fossil and LU emissions uncertanties. We do not repeat their work here, as there is little additional informationthat has accumulative over the past 6 months that would change their conclusions.
32161	5	11	41	11	43	Add aviation contrail and contrail-induced cirrus (see below)	Noted - See response below. We have added a note to the chapter that the WG I report provides an assessment of this topic.
40572	5	11	41	11	46	Please indicate rough proportion of Aerosol and Tropospheric Ozone onto the global worming.	Rejected - Unfortunately this is a complex topic that cannot be dealt with in this chapter due to space constraints, but is assessed in the WG I report. What we have done in this chapter is provide radiative forcing from aerosols and ozone precursors.
36368	5	11	42	11	42	Is there a reason why CO2 is not included in the chart on the left.	Noted - The reason CO2 is not included is that this figure and section focuses on aerosols and ozone (and their precursors).
36369	5	11	44	11	44	The only citation given here is from ' Myhre et al 2014'. Please add a citation from recent history to be the basis of this important information.	Rejected - These are WG I references who have throughouly assessed this topic. There is no need to re-do their work here so soon after their assessment.
40571	5	11	5	11	5	Is it OK to cite the publishment 2014? The dead line of acceptance for IPCC WG3 is 2013.10.3	Editorial -- These are references to the WG I report. The appropriate date is unclear, but will be updated as soon as this information becomes available.
36362	5	11	6	11	11	This discussion should mention that CH4 is the 2nd largest contributor (since the authors list CO2 as largest and N2O as 3rd in next paragraph).	Taken into account - Text was moved, but this point added to revised text.
36361	5	11	6	11	24	This section seems to indicate that there is great uncertainty regarding sources of methane, nitrous oxide, and F-gases and values for global emissions of these GHGs are not provided. Sources like EPA (2013) and others summarize global anthropogenic emissions of these GHGs by sector and country and should be added here.	Taken into account - This is correct, there is substantial uncertainty for these emissions. Information on this added.
36363	5	11	9	11	16	The only citation given here is from ' Myhre et al 2014'. Please add a citation from recent history to be the basis of this important information.	This is a reference to the WG I report which accessed this topic. We do not have space to repeat the assessment here.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
24600	5	11	1	11	16	This section gives estimates of what share of methane and N2O emissions are anthropogenic (in the land sector) but does not give an estimate as to the percentage of CO2 emissions from the land sector that are anthropogenic. Suggest that the estimated anthropogenic attribution of CO2 in the land sector is clarified in the sentence on lines 3-4	Noted -All LUC emissions, are by definition, anthropogenic, however uncertainty is so large, in part, because of these difficult definitional issue, that we cannot make a definitive statement on this point. This uncertainty is now explicitly discussed.
32409	5	11	4	11	5	Please provide correct reference here and in the following paragraphs, i.e., Ciais et al. (2013).	Editorial - These are correct WG I references and are correct, although the appropriate year is still unclear.
32410	5	11	43	11	44	Please provide correct reference here and in the following paragraphs, i.e., Myrhe et al. (2013).	Editorial - These are correct WG I references and are correct, although the appropriate year is still unclear.
26317	5	11	44	11	44	Same as above for the study of Myhre et al., 2014, and in page 12, lines 1, 16 and 29.	Editorial - These are correct WG I references and are correct, although the appropriate year is still unclear.
26316	5	11	5	11	5	It is quoted the study of Ciais et al. 2014. Is impossible. The same quotation in line 11 and 16.	Editorial - These are correct WG I references and are correct, although the appropriate year is still unclear.
27514	5	12		12		Font size to be enlarged, in particular in the right panel.	Editorial - All figures will be re-drafted by TSU before final report is published.
27515	5	12		12		Second last sentence of the figure description unclear.	Noted - although we are not sure what is unclear. This sentence describes the figure and provides the source for the figure and its data.
27516	5	12		12		Why not separated into panel a) and panel b), as it is done with other figures? And one below the other?	Editorial - Figure placement will be decided during final typesetting.
36370	5	12	1	12	1	This is a key point that perhaps should be clarified earlier in the chapter.	Editorial - while it is true that this is an important point, space constraints prohibit duplication of material.
36372	5	12	10			It seems appropriate to include N2O emissions in this figure. Please consider adding N2O emissions.	Accepted - N2O added to figure.
31396	5	12	11			Please consider to visualize which components that are ozone precursers, as well aas the total aerosole direct effects in the right hand panel of this Figure.	Noted - Unfortunately this is not easy to do because some emissions impact both ozone and aerosols and this would take up too much space in the chapter. The WG I assessment provides a much more detailed, breakdown of these distinctions.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36373	5	12	11	12	12	A better legend is needed for clarity.	Editorial - Not clear what is being requested here.
40573	5	12	21	12	22	It would be better to use Carbonaceous aerosol, instead of these. Furthermore, it was hard to understand what kind of uncertainty was indicated by "large uncertainty".	Rejected - We focus this comment on BC since Bond et al. (2013) conclude that black carbon emissions are underestimated. The evidence for OC emissions was ambiguous (the measurement data are not as clear, and there are multiple sources of organic aerosol from secondary organic aerosol (SOA), so even if there is an underestimate compared to measurements, it is unclear if emissions are also underestimated.)
40574	5	12	28	12	28	Indicate[?]concentration[?]of [?]what[?]	Accepted - "Ozone" inserted
32162	5	12	33	12	33	Add a small paragraph: Airplanes often make contrails, whch can induce formation of cirrus. They have a positive radiative forcing, equivalent to to up to four time that of emitted GHG.	Rejected - The WG I assessment concluded that the combined contrail and contrail-cirrus ERF from aviation is small (ERF of +0.05 W/m2). Due to space limitations in this chapter, we cannot devote space to all the small forcing components. We have added a note to the chapter that the WG I report provides an assessment of this topic.
24348	5	12	9	12	17	This figure should be consistency with the one in WGI report.	This figure is created using WG I data. (And will be updated from the preliminary version in the SOD.)
36371	5	12	9	12	10	It is not clear in the figure how this is a notable exception. It is not easy to ascertain which trend is REF.	We do not understand what this comment refers to. There is no REF in figure 5.2.4.
32411	5	12	1	12	1	Please provide the correct reference to WGI AR5 Ch08, i.e., Myhre et al. (2013).	Noted - Comment refers to the use of 2014 as opposed to 2013. We are told the date is unclear. Will be correct once this information is available.
32412	5	12	27	12	29	Please refer to WGI AR5 Ch08 properly , i.e. Myhre et al. (2013).	Noted - Comment refers to the use of 2014 as opposed to 2013. We are told the date is unclear. Will be correct once this information is available.
30560	5	13			1	The title could be written as Key drivers of global climate chnge " instead of "Key drivers of global change"	Rejected: we cannot change the title of the section, which was set by the plenary. We will however communicate this with TSU.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
24349	5	13	1	35	17	The selection of time spans for Kaya indentity analysis fails to be comprehensive and does not fully reveal the industialization process in developed countries .It is suggest to extend the time span to 1950-2010.	Rejected. Data limitation does not allow us to do so. Also our mandate is to focus on the period after the last AR.
36376	5	13	12	13	14	This point is not clear in the graph?	Noted. Sorry, we did not understand the comment. Which point, which graph?
36377	5	13	15	13	22	In this list of "drivers", it seems that "institutions" is notably missing. In particular there is a substantial literature that identifies capitalist economic structures and the role of governments to facilitate the accumulation of capital as key driver of GHG emissions (e.g., Michael Paterson, "Global Warming and Global Politics," 1996).	Accepted. We do not succeed to provide an in dentph discussion. There is some discussion in 5.3.3.1 "a wide variation in per capita emissions levels among countries at a common level of income per capita due to structural and institutional differences (Pellegrini and Gerlagh, 2006) (Matisoff, 2008) (Stern, 2012)". There is also some discussion in 5.6
30099	5	13	18	13	18	The Yunfeng and Laike 2010 ref is wrong - correct is Yan, Y. & Yang, L. (2009). China's foreign trade and climate change: A case study of CO2 emissions. Energy Policy, 38(1), 350–356.	Editorial: will be corrected.
36378	5	13	28	14	31	This subsection on drivers goes straight into the Kaya analysis rather than explaining clearly and qualitatively what the drivers are (including definitions), how they interrelate, magnitude, etc. Figure 5.8.1 and related introductory text should be moved to this section on drivers, prefacing the Kaya analysis and discussion (which should explain why E drops out and not other terms).	Accepted. We moved the figure that explains the drivers/factors to the front as introduction.
36379	5	13	36	13	36	Equation 1: same equation twice	Editorial: will be corrected.
23863	5	13	39			I am not sure everyong will know what PPP is?	Accepted: will be explained.
36374	5	13	7	13	8	This defines "proximate" and "ultimate" drivers but on page 14, the terms "root" , "key", and "zero-order" are used. This is confusing and does not add value. Please choose a specific term and use it consistently.	Accepted: will be corrected.
36375	5	13	9	13	12	Please correct the English in this sentence (including conflicting verb tenses and the neverless neither) and break it into 2 sentences.	Editorial: we will consult an English editor on this.
19881	5	13	4	13	4	The uncertainty of the non-CO2 emissions should be emphasized as well as in Figure5.2.4.	DECISION? Could add uncertainty bounds for some species.
19882	5	13	28	19	23	Chapter 5.3 should analyze the "GHG emissions" and 5.3.1.1 also talks about the method to analyze the "GHG emissions", while the analyzed results in 5.3.1.2 show the decompostion analysis on "CO2 emission" only. This chapter should explicitly show the reason why existing studies on IPAT and Kaya decomposition have dealt with CO2 only.	Accepted: The reason will be explained in the text.
36382	5	14	13	14	13	The expenditure version of the identity needs much more explanation.	Accpeted. More explanation will be given.
36383	5	14	18	14	18	Equation (5) and discussion of it makes more sense after equation (3).	Accepted.
19832	5	14	18			ditto	Accepted.
36380	5	14	3	14	4	Better explanation of the purpose and precedent for using the Kaya analysis and explanation of the steps are needed.	Accepted: more explanation will be given within the page limit.
36384	5	14	32	14	32	The term "key drivers" was used with the three factor disaggregation on page 14 line 5. Please clearly delineate what the key drivers are and use different distinct terms for other drivers or factors somewhere near the beginning.	Accepted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36385	5	14	32	14	42	Why is LULUCUF used here when AFOLU is used elsewhere in this chapter (and chapter 11)? And what is meant by "the rest of GHG emissions" on line 36?	Editorial. Will be corrected.
27517	5	14	32	14	32	The key drivers must be specified, otherwise the hole discussion in subsection 5.3.1 remains unclear and confusing; this includes the display in the figures 5.3.1., 5.3.2. and 5.3.3.	Taken into account: section 5.3 and 5.8 explaines the difficulties and the choice was justified.
29355	5	14	37	14	42	Recommend to use more rounded figures reflecting the uncertainty in the sources, in particular LULUCF.	Accepted.
21067	5	14	37	14	39	I would not rate an increase of 11% / decade "stable".	Rejected: it says "relatively" stable, and it is being compared with other items that display over 100% increase.
19831	5	14	4			Although this logarithmic form is true, it is not used subsequently. For instance Page 15 lines 1-3 deal with ratios instead of logarithms. I suggest for a change from time 0 to time 1, giving a formula like this: (F1/F0) = (P1/P0) * (g1/g0) * (e1/e0) * (f1/f0)	Editorial: after discussing with the chapter authors, these formula may be removed.
36387	5	14	41	14	41	Provide evidence in Fig. 5.3.1 for the claim of "+125%" increase.	Accpeted. Each planels will be marked with (a), (b), … and corresponding panel will be noted in the text.
29360	5	14	7	14	9	"based on territorial emission and production-based GHG accounting, is a consumption-based or life-cycle-based decomposition".	Editorial: the sentence will be fixed.
36381	5	14	8	14	8	Here and in earlier sentences "territorial" is used but it is not defined until page 45. A more concise definitions and discussion of territorial vs consumption emissions (including definitions) in the beginning of the chapter is needed (perhaps can use some text on these issues from the end of the chapter where it is explained partially).	Editorial: this will be defined.
36386	5	14	32	17		This section is an example of one that is very difficult to read and understand. The overall language and phrasing needs work. The graphs are hard to read and the section does not explain them well (it doesn't illuminate the most important points of the graphs in an efficient and clear way) and there are problems with logical flow.	Will consult the review editor. The current comments are not specific enough for particular action.
19833	5	15	10			Change "but" to "except" for readability.	Editorial: will change.
36389	5	15	12	15	15	We recommend chaing "growth rate" should be "growth" to improve clarity.	Editorial: accepted.
36390	5	15	12	15	15	What is interesting is not that population and GDP grew over these periods -- it is how GDP/POP grew vs POP that matters.	Noted. We have extensive assessment of GDP/cap in 5.3.3.1 and of Population in 5.3.2.
36391	5	15	15	15	15	Change GPD to GDP.	Editorial: will change.
40577	5	15	16	15	20	This is a good summary, please maintain it.	Noted with thanks.
34064	5	15	18	15	20	How is the statement that "Strong growth in GDP per capita in Asia combined with its population growth has been the largest contributor to the increase in GHG emissions" supported? Figure 5.2.2 for example shows that for historical territorial CO2 emissions per region, OECD countries are responsible for 54% of cumulative emissions from 1970-2010 while Asia is only responsible for 27.4%. (please see attached calculations). As noted in the caption for figure 5.2.3, CO2 accounts for more than 75% of GWP weighted emissions. As such, it appears that other factors such as the continuously high GDP per capita in OECD countries have contributed more to emissions rise despite the strong growth in GDP per capita and population in Asia. A relatively modest increase in GDP/capita in OECD countries could have a stronger impact as the level is already comparatively very high.	Accepted: the sentence will be accompanied with the time horizon considered. For the last two decades, the sentence is inevitable and will supported from the figure 5.3.1.
21068	5	15	5	15	5	Do you mean "decades", not "dates"?	Editorial: will be corrected.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36388	5	15	6	15	6	"Unusual synchronous behavior" is the result of the ppp adjustment. Its described on page 22 but not here. Please explain here as this discussion comes first without explanation.	Rejected. We are sorry but we don't fully understand the comment. If the synchronization is present in PPP and not in MER, that still does not explain why it would be present when using PPP. The description on p. 22 is not sufficient to explain this phenomenon.
33663	5	15	8	15	20	What is missing here is the observation from the small insets that for non-Annex I regions the LULUCF CO2 emissions are often comparable or larger than fossil-fuel related CO2 emissions compared to Annex I regions.	Accepted. This point will be strengthened.
29368	5	15	8	15	20	What is missing here is the observation from the small insets that for non-Annex I regions the LULUCF CO2 emissions are often comparable or larger than fossil-fuel related CO2 emissions compared to Annex I regions.	Accepted. This point will be strengthened.
40575	5	15	8	15	9	It is characteristic that the energy intensity is increasing only in Asia. Please put the fact at least in TS.	Rejected. Energy intensity has declined in Asia.
40576	5	15	8	15	9	Please discuss about the reason why energy intensity/GDP in the Middle East has been increasing.	An explanation added.
19688	5	15	12	15	12	The abbreviation REF does not fit logically with the label Economies in Transition; perhaps best to rephrase this to say "The Economies in Transition or to what we refer to as Reforming Economies (REF)…." or something similar along these lines	Editorial: definition will be corrected.
21069	5	16				Please explain what is meant by "CAP" and set "Therest" as "the rest" or only "rest".	Editorial: Cap is capita. The rest can be changed to rest.
27519	5	16				Enlarge the figure insets.	Accepted.
27520	5	16				Enlarge the figures: use 3 lines with 2 figures instead of 2 lines with 3 figures.	Accpeted.
19834	5	16				Needs legend for each of the 4 factors	Accepted.
36393	5	16	1			Define all the regions clearly (currently scattered through preceding and succeeding paragraphs).	Rejected. The regional definitinon is used throughout the report, and for the sake of efficiency in page use, we cannot repeat it each and every chapter. However, we will make a clearer reference to the chapter where the regional definitions appear for the first time.
36394	5	16	1			We think GDP/ Capita tracks Emissions/Energy because of the PPP adjustment. This is an assumption, not a finding. If an assumption, please state as such. If a finding, please have specific citations to support this.	Rejected: Not supported from the literature. Logically the opposite should be the case, if there is any relationship.
36395	5	16	1			Please make the legend for all these regional terms bigger and more apparent in the figure.	Accepted.
36392	5	16	1	16	4	Scale is especially difficult. Insets are too hard to read and the figure text should state what they represent more clearly and thoroughly.	Accepted. Insets will be taken out and presented separately. We will work on the presentation issue with TSU.
27518	5	16	1	16	1	Figure 5.3.1: The figures within the figures are too small to read.	Accepted. See the response to line #278

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
40579	5	16	11	16	14	Chapter 5 gives a strong impression that the CO2 emission grows especially in developing countories in G20s. Therefore, please discuss about the reason and how to suppress the emission increase especially in G20(DC)., and emerging economies which follow G20-DC. Especially, effects of R&D is very important.	Rejected. Out of scope.
29358	5	16	5			The words territorial, production, consumption, life-cycle are unclear: "production (territorial) and consumption (life-cycle) accounts, global CO2 emissions from fossil energy..". Please clarify	Accepted. The authors team will discuss strengthening the box that we already have for clarifying this issue.
30087	5	16	5	16	15	To my mind, this paragraph at least needs to include a mention of the methodology used to calculate the consmumption-based emissions, given the multitude of methods used in the literature to estimate these volumes. Better still, the methodology and data used should be separately docutemented and cited/ included in Annex.	Accepted.
40578	5	16	5	16	6	Please clearly define the territorial and lifecycle CO2 emission.	Accepted. See the response to line #282
36396	5	16	2	16	15	Y-axes need better labeling.	Editorial: accepted.
29359	5	17				As reference only JRC (2012) is mentioned, but this source does not provide "life cycle fossil energy CO2 emissions based on production".	Accepted: the calculation method will be presented.
21070	5	17				Please explain the abbreviations ("cap", "GNE"). Why do you show two different world regions and two different pespectives? This is misleading, please either use one region or one perspective in both panels or delete figure.	Accpeted.
21071	5	17				Please bear in mind that all figures in a paper should be legible on their own. Please give GNE in full (the term is also missing in the Glossary).	Accpeted.
25315	5	17	1	17	3	It would be very interesting to plot another graph in 5.3.2 for Asia and OECD of prior to 1990 dating back to 1970 or 1960 as it can show developmental challenges. This also would substantiate the claim in line 6-9 of page 8.	Rejected. No data available.
24350	5	17	15	17	19	This figure use logarithmic coordinates, which omit the huge differences in actual value of per capita data between developed and developing countries. It is proposed to either use ordinary coordinates to substitute logarithmic coordinates, or illustrate every specific data while adopting logarithmic coordinates.	Rejected. Due to the fact that the range is so wide, ordinary scale doesn't work here. No one figure can capture every thing, and that's why we have other figures shownig the differences in per capita GDP elsewhere.
19690	5	17	15			The label OECD90 2010 is missing from the figure	Editorial. Will be corrected.
36403	5	17	16			This graph appears to be in log scale. Please clarify.	Editorial. Will be clarified.
36404	5	17	16			This is not very helpful - hard to read and no explanation. Add more explanation and make this more legible and useful (perhaps another graph format?).	Accepted. More explanation will be given within the page limit.
36397	5	17	3	17	3	This figure seems mislabeled. "right" and " left" refer to Asia and OECD, not consumption and production? also, page 16 line 5 states "production (territorial) and consumption (life-cycle) accounts" and the legend refers to '(cons.)' and '(terr.)'yet in the figure description territorial and life-cycle are used, which is confusing. please insert consiumption here as this is the term used most often in the chapter for this concept. consistent use of terminology would vastly improve this chapter. Lastly, what are the Y axis units?	Accepted. Caption will be corrected.
23866	5	17	4	17	15	I suggest to more clearly explain the differences between GDP and GNE	Accepted.
36398	5	17	4	17	4	We recommend that the discussion of drivers (GDP, Population) be separated from and discussed before the Kaya analysis.	Rejected. The disucssion is a result of the Kaya identity analysis.
32163	5	17	5	17	5	What is GNE ?	Editorial. Will be clarified.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36399	5	17	5	17	5	Where is GNE defined? Is it the same as Y in equation 5?	Editorial. Will be clarified.
36400	5	17	5	17	6	"REF" does not appear to be an exception - didn't income go down between 1990 and 2000?	Editorial. Will be clarified.
36401	5	17	6	17	6	The authors should consider discussing the significance levels of the different trends. Per the referenced report, statistical significance is not the same for all groups.	Accepted. Such issues will be noted.
31397	5	17	7	17	8	This is an interesting statement and could be included in the executive summary.	Noted. This will need to be discussed with CLAs and Las.
23867	5	17	7	17	13	These elasticities are measured over time, while in Hertwich and Peters they are measured for a single year but between countries. One is a longitudinal measure, one is a cross-section. They elasticities also seem to be different. Any comments on this?	Noted. Extracting elasticity using cross-sectional data is a challendge as one has to control other factors carefully. The same applies to longitudal data but to a lesser extent.
36402	5	17	9	17	11	It appears that this figure is a 2 dimensional representation of 3 factors (time, energy use per capita, and GDP per capita). Can this be better represented? For example, it is not clear how one should interpret the REF line in the chart	Rejected. 3D representation will be even more complicated to read.
19689	5	17	4	17	15	Developments in REF are not in fact an exception in the sense that even for GDP still moves in the same direction as emissions as noticed in Figure 5.3.3 - the only difference is that both appear to move in the opposite direction (negative growth) compared to rest of the regions for most of the 1990s.	Noted.
36406	5	18	17	18	18	"Because these factors cannot be disentangled in the real world, it is not possible to disentangle their individual roles in the growth of carbon emissions either." The point of this chapter is to identify and discuss the drivers, yet this text says it is impossible. Please delete this sentence and replace it with more appropriate text, along the lines of "These factors are integrated, which makes it difficult to isolate their relevent contributions to carbon emissions growth or mitigation."	Accepted. Suggestlon incorporated in the FAQ as proposed.
36407	5	18	18	18	22	Please edit the sentence on 18-19. it is not solely because "Policies, culture and traditions, and external economic factors can intervene in every link" that policies "need to be coherent and robust" so this sentence overgeneralizes the issue. More specifically, policies should be crafted with consideration of those factors and how they interrelate. There are causes for optimism but also the opposite -- the situation is far more complex than the author allows. Delete this sentence as it adds nothing to the discussion.	Accepted. Sentence revised. The problematic part deleted and a more balanced prhasing added.
30844	5	18	19	18	22	Suggest deleting first part of sentence and simply stating: " There are many pathways to…"	Accepted. Revisions to address comment above addess this this comment as well.
36408	5	18	29	18	38	This is an unsupported but important assertion for a key driver, citations needed. Where is this steady-state in Fig 5.3.4?	Accepted. We have included the population growth rates in the chart to show that indeed growth rates level off. We refer to Section 4.3.1 where literature is discussed. We note that there is no reference to a 'steady state' in text. Possibly the reviewer refers to the 'more stable population size".
36409	5	18	39	18	43	Please move this sentence about the drivers of population size and age composition to the beginning of this section, line 29 after '1900' as it explains the trends much better than the current text starting on line 29.	Accepted. The text has been revised as suggested.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30843	5	18	6			The wording of this question (i.e., "attribute causation") is difficult to understand and should be simpler given that it is an FAQ. Is there a way to simplify? (e.g., "why is it hard to attribute the origin of GHGs?")	Accepted. This point will be further clarified.
36405	5	18	6			This is very light on analysis and some statements (like lines 17-18) state that separating these drivers and related emissions, yet this entire chapter attempts to do so. delete or bolster with citations. if included in the final text, it should be moved up prior to the Kaya analysis description.	Accepted. Authors team will discuss how to deal with this.
36410	5	18	45	18	46	Why is the terminal year not more current than 1999?	Accepted. The final year has been updated to 2010
36412	5	19	10	19	16	The caption for Fig. 5.3.5 provides a better explanation than what is in the main text.	Noted - Text and figure caption describe different things. The caption explains the content and technicalities of the figure while the text summarizes the most important message of the figure. No change.
40580	5	19	14	19	16	Fig. 5.3.5. (a) is a log-log plot. Therefore, the decline of the curve shows exponent. In this figure, for the countories other than aria, the decline was about 1 whereas that of the Asia was nearly 2. This might means there is some factors other than population at least for the case of Asia.	Accepted - the other most important factor is per capita income growth - text revised.
36413	5	19	17			We suggest making this bigger. Currently it is too hard to read and one cannont evaluate value added. Perhaps put vertically so you can enlarge. Please provide more explanation.	Editorial - Size will be larger in the final published version. No change.
40581	5	19	29	19	30	It does not appears to be reasonable to talk total CO2 emissions based on domestic transport activities. Therefore ,please delete at least this sentence.	Accepted - A higher elasticity for a specific country group is cited to illustrate the full range.
36411	5	19	3	19	3	Do not cite Fig. 5.3.5; it doesn't support the earlier part of the sentence.	Accepted - figure call-out deleted.
36414	5	19	35	19	35	The premise of Fig 5.3.3 seems to be that there is no difference between the marginal damage of growth in rich or poor countries. Is that correct?	Noted - No, there is no such conclusion. The message is that world regions and selected countries were following different pathways between 1971 and 2010 and are at different levels of total population and per capita GHG emissions. No change.
33652	5	2				The chapter uses throughout the 4 terms territorial, production, consumption, life-cycle. I recommend to define these terms explicitly upfront. And then in the follow texts use them in a more consistent way. E.g. instead of p.14, line 7: "based on territorial emission and production-based GHG accounting, is a consumption-based or life-cycle-based decomposition" write its as: "based on production-based (i.e. territorial) GHG accounting, is a consumption-based (i.e. life-cycle-based) decomposition". That is, if you want to recall the synonyms again, where applicable.	Accepted. A box has been created.
29346	5	2				Several figures refer to JRC (2012), which should be JRC/PBL (2012).	Editorial/Accepted.
29361	5	2				The chapter uses throughout the 4 terms territorial, production, consumption, life-cycle. I recommend to define these terms explicitly upfront. And then in the follow texts use them in a more consistent way. E.g. instead of p.14, line 7: "based on territorial emission and production-based GHG accounting, is a consumption-based or life-cycle-based decomposition" write its as: "based on production-based (i.e. territorial) GHG accounting, is a consumption-based (i.e. life-cycle-based) decomposition". That is, if you want to recall the synonyms again, where applicable.	Accepted. A box has been created.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36415	5	20	1	20	2	Check this and please elaborate on this point. What evidence/support do the respective literature have for these numbers (eg. Explain how the elasticity would be lower in high income countries)?	Rejected - Checked the sources and found them to be correct. Numbers based on statistical data analyzed by cited sources. Lower elasticity: that's what the authors find. No change.
36416	5	20	1	20	3	More information should be provided explaining why these studies found different results for the net effects of high-income vs. low-income people on GHG emissions. What are the differences in the studies that can help explain those findings? Are the differences in elasticities for high- and low-income groups statistically significant?	Rejected - reasons for differences are clearly explained in SOD p19, ll30-33. Yes, all cited elasticity numbers are statistically significant. No change.
36417	5	20	15	20	15	What are system boundary problems? Where is that term defined?	Accepted - Boundary and related problems explained.
36420	5	20	31	20	31	What is gateway status? Where is this term defined?	Accepted - Explained.
36423	5	20	39	20	39	What is a second-order effect? Where are these terms defined?	Accepted - Confusing term deleted.
36424	5	20	39	20	42	This finding seems to be contradictory to that attributed to Jorgenson, above.	Noted - Yes because results of different studies contradict each other.
36425	5	20	39	20	47	Is the section here indicating that emissions tend to increase in the early phase of urbanization and decrease with further urbanization consistent with the discussion two paragraphs above where urbanization reduces energy use in low-income households, but increases it in middle and high-income households? It would be helpful to have more synthesis of literature findings and conclusions.	Accepted - added more literature sources. Emissions do not decrease in later stages of urbanization; the growth of emissions is lower. Note: urbanization has many facets. It is important to distinguish between energy sources used by rural and urban households and the related GHG emissions and aggregated studies that estimate total energy use and emissions from urban areas. No change.
40582	5	20	44	20	47	This is very important findings for urbanization and CO2 consumption increase. Please maintain this sentence.	Noted - OK, we'll try. No change.
36418	5	20	20	20	22	Sovacool, Benjamin K. and Marilyn A. Brown. 2009. “Scaling the Policy Response to Climate Change,” Policy and Society 27: 317-328.	Noted - Not clear what is meant here. Read the paper but could not find any relevance to the indicated line. The paper is about mitigation hence out of scope for WGIII and Chapter 5. No change.
36419	5	20	29	20	29	After the reference to public transport systems, please add a reference to Brown, Southworth, and Sarzynski (2009), which finds a statistically significant negative correlation between the size of urban public transit systems and the US metropolitan area's carbon footprint. Brown, Marilyn A., Frank Southworth, and Andrea Sarzynski. 2009. “The Geography of Metropolitan Carbon Footprints,” Policy and Society 27: 285-304.	Rejected as per RE advice: "Too specific scope research for such broad problem."
36421	5	20	36	20	36	Please add a line to this figure showing the values for US-PPP.	Rejected - Not clear what is meant; no figure in p20, l36. No change.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36422	5	20	36	20	36	It is worth noting that energy consumption per capita is notably higher than otherwise expected in countries with large energy subsidies, such as Saudi Arabia, Iran, and Russia. IEA WEO stats show this, but we don't have a reference to a journal article on this.	Noted - Agree with the statement but it is totally unrelated to population or urbanization as drivers. No change.
36427	5	21	16	21	21	This is not clear in the figure.	Noted - Because the figure presents national averages, not broken down into age groups. No change.
36428	5	21	28	21	38	Please add citations as there are many unsupported assertions in this paragraph, or delete.	Rejected - This is the insight / conclusion paragaph based on the discussion in preceding paragraphs. No change.
36426	5	21	3	21	43	This section seems to ignore immigration. Please either add discussion on the role it plays here or at least qualify this text with a ceteris paribus.	Accepted - Qualification added.
36429	5	21	40	21	42	Add the word "some " before studies (ie Some studies tend to show). Add citations to these studies here. Also, was a complete evaluation of the literature completed (eg are there studies to the contrary)? Please add and cite these as well.	Accepted - Added: 'most' to qualify.
29375	5	21	43			I miss a small section on energy supply: sources (flaring, venting in oil and gas production, release during coal mining and gas transmission, recovered/flared fractions), relative amount of GHG compared to combustion CO2) And on distribution of main fossil fuel resources, important for explaining the present energy mix of countries and regions.	Rejected: Chapter 5 is on trends and drivers, and of course extends to broader energy issues, while Chapter 7 is on energy systems and includes a discussions of this issue.
29376	5	21	43			I miss a discussion of the structural trend of electrification of society and its consequences, which is important as it shifts GHG emissions from end-use sectors to the power sector, and therefore affects baseline GHG trends and GHG reduction potentials over time.	Rejected: Chapter 5 is on trends and drivers, and of course extends to broader energy issues, while Chapter 7 is on energy systems and includes a discussions of this issue.
36430	5	21	44	21	44	Energy Demand is not a driver, it is so closely identified with the emissions you are trying to explain that it has no explanatory power. Population and GDP are the real drivers. Making the drivers and related factors, such as energy, clearly in the beginning of this document, will significantly help this chapter. it current sends mixed messages about what the drivers are.	Accepted - we have revised the structure of the chapter and do better separate out factors and underlying drivers.
24351	5	21	45	22	2	This paragraph fails to present the balance between absolute value and growth rate. The fact that although the energy consumption in developing countries increase a lot, the energy consumption per capita in developed countries is still much higher than that in developing countries.	Taken into account - added a subsentence regarding the absolute level of emissions in developing and developed countries in response to comment 333.
27521	5	21	45	22	2	A short explanation about the sort of discussed energy demand (primary or final energy) should be inserted.	Accepted - the first sentence and the axis legend in the figure now clarify that we refer to primary energy demand.
36431	5	21	44	23	19	This section is a good example of one in need of better stuctural organization; the logical flow could be improved, increasing clarity. The last paragraph in this section would be better placed as a text box.	Accepted - various passages have been revised for clarity.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
34065	5	21	45	22	2	The statement at the end of the paragraph states "The figure shows trends in global and regional per capita primary energy consumption over the last four decades" - which figure? If it is figure 5.3.6 which appears directly below the paragraph, then a further sentence should be added to state that despite the phenomenal rise in per capita primary energy consumption in the Asia, Middle East and Africa and Latin America regions as highlighted earlier in the paragraph, per capita primary energy consumption at a particular income level is well below the world average for these 3 regions. Infact the figure even shows that per capita primary energy consumption today in these 3 regions is less than the global average 4 decades ago, meaning that OECD and REF have consumed a significantly and disproportionately large per capita primary energy share and continue to do so to this day. Despite the strong growth, per capita primary energy consumption in these 3 regions are no where close to those of OECD and REF countries 40 years ago, much less today. Energy is also being consumed more efficiently in these 3 regions.This point should definitely be made to provide balance to the section.	Accepted - indicated the relevant Figure is 5.3.6, and added a subsentence stating that per capita consumpton in these three regions is lower than consumption in OECD90 and REF 40 years ago.
34048	5	21	46	22	1	For balance, it should also be stated that the figure shows that despite these steep rates of increase, energy use per capita in all 3 regions remain below the global value with that for OECD and REF well above the global value. Line 21-22 in pg 22 should be moved here for better balance in data presentation.	Taken into account - the changes in response to comment 333 improve the balance in data representation.
19155	5	22				How accurate are the biomass energy statistics in this figure? Although this section should talk about energy supply, I cnnot find mention of it.	Noted: For energy-supply issues we now refer in text to CH7.
36434	5	22	14	22	14	Flexibility is not relevant here. For example, coal is probably more flexible than gas because it doesnt require a pipeline and it can more easily be substituted, even marginally through cofiring ,with other solid fuels.Uranium is a whole lot less flexible because it requires special handling.	Accepted - mention of flexibility removed.
36435	5	22	14	22	15	Does it make sense to include electricity with fossil here? Electricity is really just the delivery method. The fuels are either fossil, renewables, or nuclear material. Delete electrons.	Taken into account - relevant passage has been removed.
36436	5	22	16	22	24	This sentence is hard to follow. Please revise it for clarity.	Accepted - passage has been revised for clarity.
34049	5	22	18	22	22	What is the evidence of convergence of energy use per capita over time? There is still a marked difference with OECD and REF being well above the global figure and ASIA, LAM and MAF being below. It would be more appropriate to state that the reason for the high growth rates in the latter regions could be that they have been using comparatively far lower energy/capita to begin with as even the high growth rates have not brought them to the global enrgy use/capita amount. This would have implications for energy development pathways in the future and the related wisdom of transferring clean energy technology to meet what appears to be legitimate growing energy needs. Another interesting point that should be highlighted is that the energy use per capita at a certain income level remains lower in the latter 3 regions as compared to the OECD90 and REF regions.	Accepted - the revised passage mentions the remaining disparity in energy consumption per capita between OECD/REF and ASIA/LAM/MAF.
36432	5	22	2	22	3	It is difficult to interpret these conclusions based on Figure 5.3.6	Accepted - the discussion above the Figure now mentions that the figure shows 'regional time trends' and the Figure now includes the start and end years.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
29362	5	22	25	22	28	To which data is "the OECD data"(line 27) referring? I do not agree that "price shocks do not appear, however, to have had a long-term impact on the trend in per capita energy use in this [OECD] region". E.g. in Fig. 4-11 of IEA(2004)Oil Crises and Climate Challenges- 30 Years of Energy Use in IEA Countries, it shows that industry sub-sector energy intensities (in TJ/USD value added) have decreased more slowly in periods with low oil prices (e.g. after the high prices in 1979-1985). Also annual improvement was larger when prices grew higher than in lows of the 1986-2000 period (as shown in other more recent IEA reports. These changes, slower or faster have a long-term impact, since for most sectors and years there is only a continuous trend towards lower intensity values.	Accepted - 'OECD data' has been replaced by 'OECD trend' for clarity, and the sentence regarding the long-term trend has been revised to address the comment.
36437	5	22	25	22	29	Prices fell again following oil price shocks. Had prices remained at high levels on a more permanent basis, there would likely have been a larger effect on long-run per capita energy consumption. People are expected to behave differently in response to shocks they believe are short-term vs. those they expect to be long-term/permanent.	Taken into account - the revised passage notes that the price shocks did not reverse the upward trend in OECD per capita energy consumption. The passage does not preclude the possibility that this observation stems from the mechanism described in the comment.
36433	5	22	6	22	7	We suggest adding examples of these factors.	Rejected - we are sorry but we could not interpret this comment. We do not find factors in the line referred to.
20583	5	23	19	23	19	Please add "Econometric analysis of the Granger causality of China's economic development and primary energy demand reveals that only since the introduction of economic reforms in China in 1978, economic development has a significant expalantory power for energy consumption and related CO2-emissions (Oberheitmann and Frondel, 2006)." Please cite as: Oberheitmann, A. and Frondel, M. (2006). The Dark Side of China's Increasing Economic Prosperity: Will Energy Consumption and Global Emissions Rise Drastically? Bleischwitz, R. and Budzinski, O. (eds.): Environmental Economics – Institutions, Competition, Rationality. Berlin: VWF, 207-224.	Rejected: Thanks for the suggestion, but this material has now been removed from this section of the chapter. In section 5.3.3.1 where the issue of causality is now discussed the material has been shortened to only consider Stern's (2011) review paper.
33664	5	23	20			I miss a discussion that sector energy intensities have decreased over time, as shown for OECD countries in IEA(2004) Oil Crises and Climate Challenges- 30 Years of Energy Use in IEA Countries. E.g. Fig. 4-11 (industry sub-sector energy intensities in TJ/USD value added) shows that industry sub-sector energy intensities (in TJ/USD value added) more slowly in periods with low oil prices (e.g. after the high prices in 1979-1985). (see also comment on p. 22, lines 25-28)	Rejected: Exactly this information is shown in Figure 5.3.7. Originally we had more materials in the chapter on this important topic, yet these were removed for SOD to shorten the length.
29363	5	23	20			I miss a discussion that sector energy intensities have decreased over time, as shown for OECD countries in IEA(2004) Oil Crises and Climate Challenges- 30 Years of Energy Use in IEA Countries. E.g. Fig. 4-11 (industry sub-sector energy intensities in TJ/USD value added) shows that industry sub-sector energy intensities (in TJ/USD value added) more slowly in periods with low oil prices (e.g. after the high prices in 1979-1985). (see also comment on p. 22, lines 25-28)	Rejected: See identical comment (ID: 33664)
27522	5	23	21	23	42	The introducing sections could be deleted. A short description about the sort of energy (primary/final) in regard to efficiency and intensity should be inserted.	Reject: Why should they be deleted? How will the reader know what enery efficiency and energy intensity are?

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36439	5	23	32	23	42	The text here seems to be indicating that because there are conversion losses in converting primary energy sources to final energy forms, the theoretical potential for efficiency improvements is large. What technologies do the authors have in mind for more efficient conversion of primary energy sources to final use?	Reject: Discussion of specific technologies is outside the scope of this section. Furthermore, high efficiencies do not rely only on technologies, but also the fuel, the way fuel is supplied, surroudndings, infrastructures etc. The text refers to the theoretical potential, indepdent of specific technolologies, that can be calcualted by the second-law, however the second law sections have been deleted to shorten the text.
33665	5	23	35			…, about one half of gobal final …	Rejected: Should say two-thirds of primary energy does not end up as useful. This is the result of the product of the two efficiencies.
40583	5	23	40	23	42	Since rebound effect is classified in "limited evidence, low agreement", it is misleading to put the possibility of such an effect in the SPM.	Noted. The inclusion in the SPM depends on the strength of evidence and agreement, but also on the importance of the mechanism.
20302	5	23	20			When discussing "energy efficiency" one could mention "energy productivity" as an alternative term. This is appealing because it relates to the widely used term "labour productivity".	Partially accept: but not as an alternative term for energy efficiency. Instead we will say… “energy intensity, also known as, energy productivity”
36438	5	23	20	26	2	We suggest breaking this section into two, one on EE and one on EI.	NN: Rejected. Energy efficiency and energy intensity are intricately linked. Energy intensity is effectively a measure of the energy efficiency of a nation’s economy. Splitting into two sections would also substantially increase the length.
22566	5	24				Figure is confusing and the essential informations - the energy intensity improvements and per capita income are invisible. Please change layout of the graph - it might be better to seperate the 2 subjects in 2 different graphs. However the current graph does not make the subject clearer.	Rejected: Not clear what the reveiwer would like us to do. Energy itensity and per capita income are in the axis in log scale, clearly visible. Separating MER and PPP trends into two figures would render comparing them very difficult.
22313	5	24		24		The source for Figure 5.3.7 needs to be indicated.	Accepted: source will be added. Reference is Grubler et al., 2012.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36440	5	24	2	24	2	The decline in the green curve is not clear in the figure.	Rejected: Green curve shows general downward trend. And the thin green curve referring to commercial energy peaks and then declines.
27523	5	24	5	24	6	This is a confusing argumentation, including the footnote: the footnote refers to commercial energy, which is defined with a description about what commercial energy is "not".	Accepted. Footnote should describe "non-commercial energy". Text changed to reflect this.
31399	5	24	6	24	6	In the footnote it should say "Non-commerial energy" instead of "Commercial energy".	Accepted: Footnote corrected. Change made.
29364	5	24	7			The figure 5.3.7 shows more countries than the US.	Rejected: The sentence refers only to the U.S. commercial energy intensities in the thin green curve in figure 5.3.7. Other sentences refer to other countries
36441	5	24	7	24	19	This section discusses shift away from biomass and other traditional energy sources to fossil fuels. What about shift back towards biomass energy in recent years and looking forward?	Rejected: this deals with future pathways and is discussed in Chapter 6 of WGIII
36442	5	24	7	24	9	"Commercial energy intensity" would be more clearly described as "energy intensity of the commerical sector".	Rejected: commerical energy intensity refers to the intensity of commercial energy sources and not to the energy intensity of the commerical sector. Apologies for the ambiguous terminology (but it's not ours.) See footnote.
36443	5	24	7	24	9	Can a reference be provided for this that is more recent than 1998? If so, please add one.	Rejected. References in this section are from 2011, 2007 and 1990. Not sure what reference to 1998 reviewer is referring to.
19835	5	24	7			Rephrase so that it is clear where the sentence ends. "U.S. Commercial" looks like a single concept, not the end and start of a sentence.	Accepted: Changed. Rearranged sentence to avoid this problem.
36444	5	24	9	24	10	The y-axis does not have units. Please provide units on the y-axis.	Rejected: Units are clearly stated.
36445	5	24	9	24	9	"Commercial energy" would be more clearly described as "energy use by the commerical sector".	Rejected: commerical energy intensity refers to the intensity of commercial energy sources and not to the energy intensity of the commerical sector. Apologies for the ambiguous terminology (but it's not ours.) See footnote.
19836	5	24	footnote			Change "Commercial" to "Non-Commercial"	Accepted: Footnote corrected. Change made.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36446	5	24	19	24	19	Add a reference to the end of the sentence to (Hirst and Brown, 1990), which is the article that first coined this term. Hirst, E., & Brown, M. A. (1990). Closing the Efficiency Gap: Barriers to Improving Energy Efficiency. Resources, Conservation and Recycling, (3), 267–281. In this article, the authors estimated that only half of the economic potential for US energy efficiency was likely to be realized over the subsequent 20 years. The authors may also want to generalize the concept beyond appliances, since it also has been used to explain the shortfall in adoption of energy efficient equipment and processes in industry.	Rejected: The article coined the term "energy gap", which refers to the potential improvements in energy efficiency between the optimal and real energy use. The paper continues to discuss barriers to closing this gap and opportunities to do so. This section does not explicitly discuss these issues, nor does it use the term energy gap. The paper is also about the future possibilities, and this section is about historical trends. This deals with future pathways and is discussed in Chapter 6 of WGIII. This reference does discuss the rate of energy intensity improvements □
36449	5	25	30	25	31	The authors need to include citation for this statement "structural changes play a minor role in determining trends in energy use and CO2 30 emissions, though they can be important in individual countries."	Accepted: Reference added: de Cian et al., 2013.
33666	5	25	33			… causes for energy intensity trends are difficult …	Accepted: changed. "in" removed.
24352	5	25	35	25	36	The statement "Similar results have been found for Sweden (Kander, 2005) and China" is incomplete.There are literatures pointing out that strutural change instead of technological change is the most dominent factor in reducing energy intensity in China. See Liao H, Fan Y, Wei YM. What Induced China's Energy Intensity to Fluctuate: 1997-2006? Energy Policy, 2007, 35(9): 4640-4649. " In future, to save more energy, in addition to technical progress, China should attach more importance to optimizing its sectoral structure, and lowering its investment ratio."	Accepted: Sentence added " Similarly, Liao et al., (2007) conclude that structural change, instead of technological change, is the most dominant factor in reducing energy intensity in China."
27524	5	25	36	25	36	Reference "Wing, 2008 is missing in the reference list.	Accepted: Will add to reference list.
36447	5	25	4	25	4	Add "Chinese or Indian" before "consumer" in this sentence.	Accepted: changed.
20303	5	25	47	26	2	How are the effects of higher prices and the elasticities to be interpreted: Does this mean that lower energy services are consumed or is the same amount of energy services consumed with more efficient appliances? Two completely opposite results.	Response: the jury is still out on this important question. There is no doubt that in the long run, high prices will lead to high efficiencies which can lead to rebound effects, but in any case to increase efficiencies. In the short run, however, high prices will lead to lower electricity use and the provision of lower levels of service.
36448	5	25	9	25	26	This should come before the discussion on commerical energy intensity.	Rejected: We prefer the section as it is, as we envision the flow of the section to go as follows: Description of EE and EI -> Limitations of EI -> historical EI development -> Decomposition of EI.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
22567	5	25	9	25	18	Unclear if part of the effect is due to statistical improovements or real development. It is a well documented effect, that part of the GDP growth in developing countries appears, because for the first time, this economic activity has been documented - which hasn´t been done before. So the "grey economy" became part of the offical statistic. Please add information to capture this subject.	Accepted: the reviewer makes a very good and important point, grey economy in some ways is equivalent to non-commerical energy. As countires developed, only commerical activities are recorded, and therefore appear to be growing faster, than if we had information on non-commerical or grey economic activity. Unfortuneately the estimates of the grey economy are very sparse in theliterature and not available as time series to be included in the figure.
36450	5	25	47	25	49	Please add the following to the end of this sentence: "and within countries(Brown, Southworth, and Sarzynski, 2009)." Brown, Marilyn A., Frank Southworth, and Andrea Sarzynski. 2009. “The Geography of Metropolitan Carbon Footprints,” Policy and Society 27: 285-304.	Rejected: We cannot discern what the comment suggests we do. "and within countries" does not appear to make sense in this sentence.
22568	5	26				Please change the figure from Primary energy to Final Energy as the role of nculear, hydro and renewables is misleading in the figure. By using primary energy either Hydro and new renewable are under estimated or nuclear is over estimated	Rejected: unfortuneately not possible as there are no estimates of final energy for the world going back more than 50 years.
27525	5	26	10	26	10	Footnote 2: literature references IPCC 1995 and IPCC 2006 are missing in the reference list.	Accepted: references added to the list.
36453	5	26	13	26	14	It is not clear what this sentence means. Please revise it for clarity.	Accepted: we have tried an alternative formulation that point explicitly to the slow dynamics of primary energy change.
27526	5	26	13	26	13	Delete "substitution".	Accepted. Deleted.
36454	5	26	20	26	22	It is not clear what this sentence means. Please revise it for clarity.	Accepted: we have tried an alternative formulation that point explicitly to the slow dynamics of primary energy change.
27527	5	26	20	26	20	Insert "of primary energy" after "decarbonization".	Accepted. Changed
19157	5	26	22	26	25	"Historically, biomass emissions related to land-use changes (deforestation) have far exceeded carbon releases from energy-related biomass burning, which indicates that in the past, biomass, like fossil fuels, has also contributed significantly to increases in atmospheric concentrations of CO2 (Grübler et al., 2012)". What are the 'enertgy-related biomass burning'? Are you inferring that the biomass is not sustainable? If so this is wrong.	Accepted: traditional biomass is not sustainable as it leads to deforestation and net carbon release. While sustainable biomass is carbon neutral, because of the reabsorbtion thorugh new growth. This sentence refers to traditional biomass. "traditional" has been added to make this clearer.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36455	5	26	22	26	25	This sentence is unclear. It seems to compare biomass emissions from deforestation and biomass emissions from biomass used for energy. It is not clear if the deforestation was caused by biomass demand OR if if the author is counting the actual amount of biomass (ie tree fiber) lost during deforestation. Please refine this point or delete.	Accepted: sentence changed to make this point clearer.
36451	5	26	3	26	14	Supply and prices play a far bigger role in shifts (eg from coal to Natural gas in the U.S.). Please address this here.	Rejected: the section does not argue that the substitution and decarbnozation is the result of conversion alone, nor security or supply and prices as such. The statement is phenomological, based on the literature without implication of causaility.
31400	5	26	4	26	5	What about biogenic carbon in an intact carbon cycle? E.g. bioenergy from sustainable forest management? A more precise definition could be added to the glossary.	Accepted: The following text has been added: ", including sustainably managed biomass (biogenic carbon is reabsorbed through new growth),"
36452	5	26	4	26	14	This paragraph is unnecessarily complicated. Please revise it.	Accepted: Has been revised in response to many comments. However, its not clear that it is any less complicated.
32458	5	26	6	26	12	It should be deleted because the shiftmentioned here seems to be caused by the aspect of the energy security rather than the increase of energy conversion.	Rejected: the section does not argue that hte substitution and decarbnozation is the result of conversion alone, nor security as such. The statement is phenomological, based on the literature without implicatoin of causality.
19883	5	26	40	29	2	This section should touch upon the contributions of the progress of information technologies as pointed out by the "Digital Economy" provided by US Ministry of Commerce since 2001.	Accepted: We have added text on the potential role of ICT in decarbnoziation, and included the folliwing reference: Japanese Ministry of Internal Affairs and Communications, 2010: Information and Communications in Japan: Economic Research Office, ICT Strategy Policy Division, Global ICT Strategy Bureau, Ministry of Internal Affairs and Communications, Japan
21664	5	26	8	26	12	Note that decarbonisation of the energy systems may also affect the impacts of aerosol emissions which could influence the climate in different ways, and on shorter timescales, from GHGs.	Accepted: text added: "Decarbonization can also affect the emissions of other GHGs and radiatively active substances such as aerosols."

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
24244	5	27				The discussion about fossil fuel reserves would benefit from being linked to the interest and drivers of global financial markets, as they are assets in many stock-listed companies and pension funds, e.g. by referring to the 'carbon bubble' as described in "Unburnable coal" http://www.carbontracker.org/carbonbubble	Rejected: this is beyond the scope of chapter 5, as decided in the last round of revisions, the lengthier section, including tables of resource sand reserves have been moved to chatper 7. We will pass this comment to chapter 7.
22518	5	27				The two dashed lines in the figure are too similar to be clearly distinguished. Please, use different colors for the lines.	Accepted: will changed.
36457	5	27	1			Seems like there should be more explanation of the assumptions behind biomass having a higher emissions intensity than fossil fuels.	Rejected: see IPCC 2006 guidelines for GHG inventories.
36458	5	27	1			The dashed line hard to distinguish from dotted line. Please consider revising so that the reader can better distinguish between the dashed and the dotted lines.	Accepted: will change.
36456	5	27	1	27	7	Assuming all biomass emissions are balanced by 'sustainable harvesting" of feedstock is an oversimplification of a complex issue (recent studies are finding that this is indeed a rosy assumption). Please note that here. In the figure, in the legend for the dashed line should state w/o biomass emissions (but w/biomass PE). Also, please explicitly state whether or not the solid black line includes biomass CO2.	Rejected. We are not assuming that all biomass emissoins are blanaced by sustainble harvesting, or anything else for that matter. Instead, we are showing sensitivity analysis of how carbon intensity of energy looks if one excludes emissions of biomass and biomass primary energy. This is informative as we do not have precise infromation on which proportion of biomass was sustainable in the past, therefore all three extreme cases are shown.
36459	5	27	10	27	14	Mentions rising carbon intensities from increased use of coal. But does not mention large shift towards natural gas in recent years.	Accepted: sentence added to reflect this point.
27528	5	27	10	27	14	This section is seemingly redundant and could be deleted	Rejected: an important part of the kaya identity is the indicaiton that decarbonization is a global trend.
36460	5	27	13	27	14	The finding on rising carbon intensities since 2000 is not shown, and overturns the argument about decarbonization. This section would be stronger if it focused on relative prices and demands, and China's huge growth since WTO membership in 2000.	Rejected: this section is not about energy prices, rather about the decarbonization of energy. The recent carbonization trend is clearly shown as a slight increase. However, this does not neccesarily imply that decarbonization is over because, as the text argues, it is related to a recent increase in coal consumption that need not be permanent.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36461	5	27	15	27	19	This is very old data that does not reflect new gas supplies. WEO 2012 is a better source. Please update to this or other more recent source.	Rejected: This is about long-term scenarios, and the WEO2012 scenarios only go to 2035. In comparison, the 2007 reference is to the AR4 but as soon as the scenario papers for AR5 have been published, they will be included in the revised version of the text. A number of special issues are planned that document RCPs and SSPs.
36463	5	27	31	27	32	Should the proper word used here be "by".	Rejected. Not clear where the word "by" belongs in this sentence.
36462	5	27	31	27	33	Citations needed for these estimates.	Accepted: will add references.
27529	5	28	15	28	16	A sector "AFOLUFA" is introduced, incl. "fisheries and aquaculture". In the subsequent discussions only AFOLU is presented. Propose to substituted AFOLUFA with AFOLU.	The sector is AFOLU only. The difinition has been given at the end of the write up.
36464	5	28	2	28	2	Seems like too old a citation to use. Please provide an updated citation.	Accepted: Will also add Rogner et al., 2012
19837	5	28	2			Reference to 1998 is too old for discussion of trends in the energy industry. Much has happened since then.	Reference to 1998 is too old for discussion of trends in the energy industry. Much has happened since then.
36465	5	28	23	28	33	The trends are poorly explained in this paragraph. Pie charts showing shares for 1970 and 2010 would be much more efficient.	This wqould require more space that is not available. Figures depicts contrbutions of each region
40585	5	28	23	28	24	Regarding the shift in the proportion of GHG, table or graph which indicate transition would be very useful.	changes by region depicted in figure 5.3.5.1
31401	5	28	8	28	12	To further strengthen this statement a reference to the volume of reserves that need to remain unused could be added. IEA in its World Energy Outlook 2012 estimated that over 2/3 of the world's proven fossil fuel reserves cannot be commericalized if the world is to remain on a 2 degree C path.	Accepted: but the IEA is not a good reference becaause scenarios stop in 2030 and the climate stabilization refers to 2100. Instead we have added references that have the appropriate time horizon. □
40584	5	28	8	28	11	This point is very important! Please put it in SPM.	Noted. This is mainly a topic for CH7.
33667	5	28	9			… embedded in oil and gas reserves exceeds …	Accepted: Grammar has been corrected.
34067	5	28				Something is wrong in the formulation of footnote 3. It needs to be revised.	Revised

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
34068	5	28	23	28	33	Looking at Figure 5.3.10, it appears based on the gradients that the OECD and REF regions had the highest growth rates in this time, with a dip at certain times, the most recent being around the time of the latest financial crisis. However, the entire section is written focussed only on the factors affecting increase in transport emissions in non-OECD countries. Given the huge contribution in absolute terms from OECD countries as well as the high growth rate as shown in the figure in the last 4 decades, more focus should be given to factors in this region too. More balance is required in this section, otherwise, it leaves the impression that most mitigation opportunities lie in non-OECD countries only. For example, despite the statement that policy has led to "strong reductions of emissions in the developed world" with the EU and Japan being given as examples, the figure does not depict this. Is this because other developed countries like the US have continued to increase their transport emissions? While an explanation has been offered as to why rising incomes in developing countries lead to increase in energy demand for transportation, no explanation has been provided for a similar situation in developed countries. It is also therefore unclear if the statement "The highest growth rate in transport emissions was in the Asia region where emissions registered more than 7-fold growth between 1970 and 2010, increasing the share from 5% to 16% during the same period" is accurate simply based on these 2 end points rather than the gradient of the lines.	Accepted. Revised. The figure shows that high-income countries are largest contributor, and this is written in text: "There is a strong correlation of per capita transport emissions and the per capita incomes and alignment of the two variables is sharper in the high income countries (Fig 5.3.15) " The figure also depicts intermmediate growth rates, showing that most of the recent growth comes from upper-middle income countries. This is also stated in text.
24353	5	28	25	28	25	The data cited in this sentence is inaccurate. According to IEA, 2011. CO2 Emissions from Fuel Combustion: Highlights, OECD countries contributed 51% of the global emissions in transport sector in 2009.	Redrafted differently
22569	5	29				Regions are misleading - please use 10 world regions (like in the SRREN). The information is available - to put China and India in one region and North America, Europe and Australia + Japan etc in another does not make sense, as e.g. transport needs in those regions are VERY different due to geographical situations etc.	IPCC agreed regions adopted here
27532	5	29		29		The abbreviation "INT" to be explained.	Accepted in Figure 5.3.5.1
21665	5	29	1	29	1	The choice of figure type (staked contributions) makes it impossible to distinguish what happens in the different regions. Understanding regional trends is critical as this gives an idea of the natural dynamics.	revised but would be clattered with too many parameters plotted
36466	5	29	1			This figure needs a companion figure showing the trends in transport emissions per capita.	Graphs already congested to add more. Per capita emissions are dealt with in Sector Chapters
36468	5	29	10	29	11	Line needs the word "increased" at the end (as in "increased freight transportation").	Noted but not included now
36469	5	29	14	29	15	Please reword: population density may be associated with lower transportation emissions.	Noted but not included now
36470	5	29	15	29	15	Insert the word "overall" before "GHG emissions".	Noted but not included now
32164	5	29	17	29	21	It would be good to give the percentage of international transport (air passenger and freight, maritime separated) over all transport, and to give rate of increase	Sector Chapters have scope to deal with that detail
36471	5	29	17	29	19	Please revise this run-on sentence.	Accepted. The section has been revised.
36472	5	29	19	29	21	Please revise this run-on sentence.	Accepted. The section has been revised.
36473	5	29	22	29	26	What is transportation's contribution specifically?	Noted. There is a full chapter 8 on Transport.
36474	5	29	24	29	26	Just because GHG emissions in non-OECD countries continued to rise in 2008 and 2009 does not mean emissions were not affected by high oil prices and the recession. The relevant comparison is how high emissions in non-OECD countries would have been without those events.	Literature for that was not found.
19838	5	29	25			"Total world emissions" sounds a bit grandiose. I think you mean "global transport emissions in 2008"	adopted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
27531	5	29	26	29	26	The citation of "international Energy outlook 2011" to be re-considered. Propose to use "US EIA, 2011" as reference.	adopted
36475	5	29	27	29	28	Please rephrase: motor vehicles, economic growth, travel demand.	rephrased
36476	5	29	31	29	32	This assertion needs to be backed up with numbers and citations.	sentence revised and citation provided
40586	5	29	31	29	34	These sentences contain a important good practice for policy makers, so please put them in SPM and TS.	appreciated- but others want it deleted
36467	5	29	5	29	6	"increased economic activity leads to growing income per capita" -- not true as stated. We recommned that it be deleted. The remainder of the sentence does not require a citation.	Section revised
27530	5	29	6	29	6	The citation of "international Energy outlook 2011" to be re-considered. Propose to use "US EIA, 2011" as reference.	Accepted
19884	5	29	13	29	21	It is not clear whether the emission from electric power is attributed to the power generation sector or consumers. This is especially important to see the building sector(5.3.4.2) and household and commercial sector.	Energy section deals with this
34069	5	29	1	29	4	Where is the evidence to support the assertion that International Transport only reflect increases in transport emissions?	Refer to Fig 5.3.5.1
24354	5	29	31			The statement "led to strong reduction" is lack of evidence. In fact, no strong reduction in tranport emission can be found in EU and US.	Revised and redrafted differently
21666	5	29	31	29	34	What about the motivation of fuel taxes in the EU?	Added
22570	5	30				Again, regional break down is misleading. Climate conditions for buildings are very different and can not compared with each other.	Noted. IPCC agreed regions adopted here. it is true that buildings in cold and very warm regions may produce large emissions; other factors may influence; nevertheless, useful information may be drawn from the figure.
21667	5	30	10	30	11	The choice of figure type (staked contributions) makes it impossible to distinguish what happens in the different regions. Understanding regional trends is critical as this gives an idea of the natural dynamics.	Refer to Fig 5.3.5.1
36479	5	30	12			Editorial - Add a space before "and 47%"	noted but no longer included
36480	5	30	12	30	16	We believe that pie charts would be better than pure text.	Noted but additional space needed
36481	5	30	18	30	18	Please use a consistent format for citations.	Accepted
36482	5	30	18	30	19	This is an odd citation (cites title not author or organization). Please follow a consistent format for citations.	deleted
27533	5	30	18	30	19	The citation of "Greenhouse gas emissions trends and projections in Europe 2009" should be re-considered. Propose to use "EEA, 2009" as reference.	Accepted
36483	5	30	19	30	20	This sentence applies to which regions?	global situation
31402	5	30	2	30	2	Would suggest changing "huge fuel prices" to "high fuel prices"	Accepted
36484	5	30	21	30	27	Please reconcile these sentences "industrialized countries reduce the direct emissions from the buildings sector" followed in the next paragraph by "a strong relationship exists between GDP and final energy use.." These seem contradictory.	Noted but Section has been revised
36485	5	30	31	30	31	Caiptalize the first letter in surnames.	Ref deleted
19839	5	30	31			1988 is too old for a reference about future increases.	deleted
32166	5	30	32	30	32	Precise that burning (wood) biomass is generally neutral for CO2 emissions (apart from deforestation).	Other gases too besides CO2 but life cycle analysis would add to that too.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
27534	5	30	32	30	32	The citation of "international Energy outlook 2011" to be re-considered. Propose to use "US EIA, 2011" as reference.	Accepted
36477	5	30	5	31		This sentence needs a citation.	revised section
23873	5	30	6			What is included in "building sector emissions"? Electricity? Cement? Steel?	Based on IPCC 2006 categories
36478	5	30	6	30	7	Please reword (as growth does not mean flat): hence, grew less fast.	Revised parapgraph
36486	5	30	8	30	8	"Offset" would be better than "nullified".	Revised parapgraph
40587	5	30	8	30	8	Somehow, Fig. 5.3.1.does not contain the US. Data. Therefore, it is not possible to say that "The rising CO2 7 emissions from developing countries were nullified in the 1970s and 1990s by decreases in the USA 8 and in the 1990s by the economic decline of the EIT countries".	Fig 5.3.5.1 is containing global Buildings emissions data-in which USA data should contained
32165	5	30	9	30	9	What is EIT ? Why not use REF?	corrected as necessary-otherwise sections rephrased
21668	5	30	17	30	20	How do household emissions compare to those for countries where air conditioning is in widespread use? (e.g. USA)	Rephrased to show developed and Developing persp[ective
31403	5	30	5			This section should also mention the risk of "lock-in" in the buildings sector. Investments made now in buildings infrastructure will remain locked-in for a very long time. This is particularly important in developing countries where much of the building mass that will be standing in 2020 or 2030 has not yet been built.	Noted but relevant to Chapter 8 when moving to future and how best to provide mitigation.
36487	5	31	1	31	18	These paragraphs are very awkwardly phrased. Please revise them for clarity.	revised
36490	5	31	12	31	18	Is it true that "population growth is directly proportional to households"? There are likely trends in household size in many regions and there are differences in the number of people/household across regions, with some regions adding population faster than others. After that first sentence, the rest of the paragraph describes factors other than simply population growth that would affect energy demand.	Noted but Section rephrased
40589	5	31	12	31	18	The driver analysis of building sector is well done.	Appreciated- but now section curtailed
19841	5	31	12			Household size is surely changing. I suggest delete this sentence.	Revised
36491	5	31	24	31	26	The dip is present for all regions shown, not just OECD and REF; what caused the dip?	Revised fig 5.3.5.1 better illustrtaes the changes in industryyt emissions by the adopted economic regions
23874	5	31	28			What is included in "industry sector emissions"? Electricity? Cement? Steel?	Sector Chapter provide details but sources as per IPCC 2006 Guidelines
36488	5	31	3	31	5	Revisit and clarify this text, as it is unclear and lends no insights as written. Demand for space heating fell from 53 percent (of what is unclear) in 1990 to 53 percent (of what?) in 2005.It is difficult to understand what point this text is trying to make. China versus US? 1990 versus 2005 in China? Also, are the more recent data (eg AEO 2012). If not fixed, please delete.	Revised
36492	5	31	3	31	5	This sentence applies to which regions?	global situation
19840	5	31	3		5	This sentence needs clarifying. Does the17% to 16% correspond to 1990 and 2005. Same question for the 5% and for the 16-21%	Revised
40590	5	31	32	31	32	Please indicate EIT is abbreviation of Economics in transition.	Accepted where still necessary
36489	5	31	6	31	11	This paragraph is poorly worded (the second sentence is a fragment). Please either fix the language to make the intent/points of this paragraph clearer or delete it.	Noted but also instruction not to DELETE it- see comment 481 ID2
40588	5	31	6	31	8	An important finding and please do not delete it.	appreciated
27535	5	31	7	31	8	The citation of "UNEP 2008 Annual Report, 2009" should be re-considered. Propose to use "UNEP, 2009" as reference.	Accepted
27536	5	31	9	31	10	The citation of "UNEP 2008 Annual Report, 2009" should be re-considered. Propose to use "UNEP, 2009" as reference.	Accepted

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30088	5	31	27			This section emphasises industrial emissions growth in China. However, the key point that should come across, perhaps, is the increased complexity and changing landscape of industrial emissions since the last IPCC report - a transition from a world where both industrial supply and demand focused on OECD countries, to a rapidly changing landscape with increasingly complex golobal supply chains, expansion of new centers of industrial production and consumption including not only China but also vietnam, south africa, indonesia, malaysia, brazil etc. Perhaps including a paragraph on the rapidly rising centers of consumption attracting industrial investment may help. Ref: Backer, K. D. & Yamano, N. (2008). The measurement of globalisation us- ing international input-output tables. In OECD (Ed.), Staying competitive in the global economy: com- pendium of studies on global value chains chapter 2, (pp. 37–64). Paris: OECD. Available from: http: //browse.oecdbookshop.org/oecd/pdfs/product/9208061e.pdf#page=39.	Reference adopted in text
21669	5	32	1	32	17	The choice of figure type (staked contributions) makes it impossible to distinguish what happens in the different regions. Understanding regional trends is critical as this gives an idea of the natural dynamics.	Noted but provided revised figure 5.3.5.1
36493	5	32	1			Is there a better way to represent the data in the chart? The temporal nature of the figure is not easy to follow.	Noted but provided revised figure 5.3.5.1
30089	5	32	24	32	27	This paragraph should be updated in light of the recent shalegas boom in N. America	Probabaly an energy issue
36495	5	32	25	32	26	The shift from coal to gas was not, as described here, achieved before [the year] 2000, but is still accelerating. Authors should look at WEO2012, and update the analysis.	Noted and probabaly addressed in energy sector
36496	5	32	36	32	39	The authors should consider referring to the carbon leakage language in Box 5.1 to bolster/better explain this point (once the langauge in that Box is corrected).	New reference provided
30254	5	32	36	32	36	DVD players = consumer electronics?	Section revised
24355	5	32	37	32	39	The source needs to be indicated.	Section revised
36497	5	32	37	32	38	A citation (Chinese emissions from light industrial facilities) is needed for this statement.	Section revised
40591	5	32	37	32	39	Regarding light industries in China, it should be clearly described whether GHG emission itself is large, or GHG export is large.	provided a source to that effect
33668	5	32	40			Most of the reduction of industrial emissions over the 1990s was due	Accepted. The text has been revised.
36498	5	32	40	32	40	Please revise this sentence (English language construction is incorrect) for clarity.	Revised section
21670	5	32	47	33	2	What about the contribution of aerosols emitted by industry in Asia? This could have implications in the future if aerosol emissions are reduced as a result of improved technology or deindustrialisation.	aerosol source not available to address that issue
36499	5	32	47	32	48	Please revise this sentence (English language construction is incorrect) for clarity.	Section revised
36494	5	32	5	32	9	China's WTO membership is highly relevant to this chapter and should be discussed further.	Noted but space limits how much can be added.
34070	5	32	36		39	Citation for the study mentioned in this sentence "According to a study conducted in 2009, roughly half of China's new greenhouse gas emissions between 2002 and 2005 were produced by light industrial facilities producing goods for export" required.	Revised section
21072	5	33				If you want to follow the AFOLU designation, the right-hand panel shows "forestry and other land uses (including land use-change)", because AFOLU is one sector. Else, you have sub-sectors.	The figure has been redrawn and put as one figure for all the sectors
27537	5	33		33		I propose to use equal scales for both panels.	Accepted
36505	5	33	13	33	13	If China's share is small, could you provide a counter example to give an idea of average?	Noted. Sorry, we could not locate the text for this comment

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
21671	5	33	16	33	18	The choice of figure type (staked contributions) makes it impossible to distinguish what happens in the different regions. Understanding regional trends is critical as this gives an idea of the natural dynamics.	Noted. Each type of figure has its advantages and disadvantages. We have redrafted the figures for this section so that we believe they provide a good overview for the trends per sector over regions and the relation to income. The sector chapters will provide more details.
32168	5	33	19	33	23	Precise CH4, N2O…for each	Accepted
36506	5	33	25	34	31	There is little mention of building carbon stocks in forests, which is a significant mitigation measure. See for example http://www.edf.org/climate/redd-document-library. Also, a discussion on agricultural intensification versus extensifiction and related GHG impacts should be portrayed here. See for example, http://www.pnas.org/content/early/2010/06/14/0914216107.abstract.	Mitigation options have been discussed in Chapter 11
36507	5	33	25	34	31	The short section mostly focuses on population and its impact on ag production and deforestation. This seems to us to be an extremely unbalanced discussion. What about the impacts of changes in population and GDP on land use and land use change (which is not addressed at all here), which has large GHG implications.	Noted. We have coordinated with the AFOLU chapter and concluded it is very hard to draw simple empirical conclusions related to income and population for AFOLU.
33670	5	33	27	34	5	I miss the note that the GHG emissions from FOLU are almost all from non-Annex I regions.	Accepted. This is now explicitly mentioned in the intro for Section 5.3.5.
29369	5	33	27	34	5	For the very uncertain FOLU emissions I would to use more rounded percentages to reflect the relative uncertainty in this source. E.g. about 10% instead of "11%" or around 25% instead of "23%".	Noted. We are careful not to use too many digits, but we decided not to go as far as limit ourselves to effectively 1 digit.
29374	5	33	27	34	5	I miss the note that the GHG emissions from FOLU are almost all from non-Annex I regions.	Accepted. This is now explicitly mentioned in the intro for Section 5.3.5.
21073	5	33	28	33	28	AFOLU is a sector as a whole. If you want to differentiate further please use sub-sectors or other designations to avoid misunderstandings with regard to GHG reporting and accounting.	Rejected. The details are presented in the Sector Chapter 11.
19156	5	33	3	34	25	5.3.4.4 Agriculture, Forestry, Other Land Use (AFOLU). This gives good information about AFOLU. It discusses the effect of population increase.	Accepted
36500	5	33	3	34	31	In the beginning of the chapter, fisheries and aquaculture are mentioned along with the AFOLU sector. However, this sector is not discussed at all. Please add a section after AFOLU on this sector for completeness.	Noted. Because of lack of emissions related data, we have removed fishries and aquaculture from the final draft version.
36501	5	33	3	34	31	There are very few citations in this entire section (except from a few fom FAOSTAT without a year, and those for the figure). Please add where all this information is coming from. In past reports, deforestation emissions were higher than 11% (more like 18-20%). Why is this lower? Please include more sources to verify this number (as well as others in this section). AFOLU is a critical sector in terms of its relation to key drivers (population and GDP) and global emissions, almost on par with energy and transportation. This section is about one page long, whereas the other sections on energy and transportation are significantly longer. this is extremely unbalanced, a significant underrepresentation of the importance of this sector. Please bolster this section to better assess its role in relation to pop and GDP and global GHG emissions.	Accepted. More citations have been included. The AFOLU sub section has considerably increased relative to the other sub sections.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36502	5	33	3	34	31	There is little to no mention of forestry is this section: it focuses on agriculture and deforestation but not on the role of forestry, related markets and commodities, management or even trends and how this sector is intergrally related to the key drivers (pop and GDP). Please add more substance to this section on these elements.	Noted. In CH5 we can only present the head lines. The details are presented in CH11.
32167	5	33	4	33	4	4889 Mha ? I have 5677 Mha (Earth radius 6371 km, 4piR2, 70,71% Oceans, 38% agriculture)	4889 Mha is from FAOSTAT
34051	5	33	4	34	18	What year is the agriculture land and forest cover data from FAOSTAT for? A) Data in line 11 on pg 34 regarding cropland (also taken from FAOSTAT) shows only 1/4 of the value appearing in line 4 of pg 33 (4889Mha km2?- unit needs to be checked). Is the remaining 3/4 used for animal husbandry? If so this should also be reflected in the text and a comparison with 1970 should also be provided. This is important as it may reflect significant changes in eating habits and may provide mitigation options. b) The forest cover data appears to be for 2009 based on the information in pg 34 line 17. This should however be reflected earlier.	All the data pertains to 1970 and 2010 except forest area which is for 1990 and 2010. The data for 1970 for forestry is not available.
36503	5	33	4	33	4	"Agricultural lands occupy about 4889 Mha km2 (38%)". Having both Mha and km2 seems to be a typo. If not, please explain what this is.	It is a typo. We have used Mha throughout the text.
36504	5	33	5	33	5	FAOSTAT from when (please cite correctly).	2013
33669	5	33	8	33	15	I miss the note that the share in non-CO2 emissions from agriculture is mainly from non-Annex I regions.	Accepted. This is now explicitly mentioned in the intro for Section 5.3.5.
29373	5	33	8	33	15	I miss the note that the share in non-CO2 emissions from agriculture is mainly from non-Annex I regions.	Accepted. This is now explicitly mentioned in the intro for Section 5.3.5.
34071	5	33	19	33	36	What is the supporting evidence for the assertions in these 2 paragraphs regarding the source and composition of agriculture emissions? No citation provided. Figure to be provided like figure 5.3.14 for waste.	Citation has been provided (EDGAR, 2013)
34072	5	33	29	34	5	What is the supporting evidence for the assertions on the source of FOLU emissions? No citation provided. Figure to be provided like figure 5.3.14 for waste .	Citation has been provided (EDGAR, 2013)
29904	5	33	3			The discussion and the numbers in this section needs to be consistent with Chapter 11	Accepted
34052	5	34	22	34	25	This concluding statement does not appear to be properly supported by the data and analysis presented earlier. This could only be supported if regional analysis had been done as for preceding sections (including some analysis pertaining to key countries within those regional groupings) to determine if there is a consistent increase in food demand due to population increase, or if certain regions have seen a greater increase in food consumption/capita (for example measured in terms of caloric value) which is the cause of increasing food consumption. In certain developed nations, obesity has become a significant problem, while in some developing countries, lack of food availability results in malnutrition and starvation. The demand for food therefore does not appear to be a simple function of population but appears to have a more complex driver in terms of diet. Quantity and type of food consumed have differing impacts on GHGs. See: Annika Carlsson-Kanyama and Alejandro D Gonza´lez. Potential contributions of food consumption patterns to climate change. Am J Clin Nutr 2009;89(suppl):1704S–9S. The manner in which food is cultivated is also another factor. Energy use also has a strong link to lifestyles.	Noted. We have rephrased the statement and explicitly refer to CH11 for details.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
26010	5	34	26			Comment for the global scenario level: There are descriptions of EU and US measures taken to reduce this problem, however other parts of the world has a steep increase in GHG emissions from waste making the sum likely to be increasing in near future.	TAKEN INTO ACCOUNT: this aspect is important, but will be shown in Chapter 10 where is more appropiated. In Addis Ababa was analized with Chapters 10 and 12 and was decided that this explanation will be written for Chapter 10
36509	5	34	26	34	26	Where is the definition for waste? We could not find it. Please add a defintion of wasted (don't just give examples of what 'waste' is).	REJECTED - outside the scope of the chapter, topic covered in Chapter10. The brief definition of waste is very difficult according to their complexity, but maybe used the following: ¨ Waste means any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force ¨ or Waste, defined by Directive 2008/98/EC Article 3(1) as 'any substance or object which the holder discards or intends or is required to discard'. If it is necessary the definition will be in the Glossary
36510	5	34	27	34	27	Reword: doubled.	EDITORIAL: text revised
27538	5	34	27	34	30	I would expect an introductory note about methodological issues incl. limitation of evidence because of - e.g. - different regional waste collection rates and waste water treatment rates around the globe.	REJECTED - outside the scope of the chapter, topic enough covered in Chapters 10 and 12.
36508	5	34	6	34	25	Lines 6-10 list about over a dozen drivers from emissions from AFOLU. What is the definition of driver, as it is used for population and GDP as well as this long list of drivers.. Please use different terminology or more clearly define how this chapter uses the term 'driver'.	The sentences have been deleted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
35377	5	35	27		30	These lines state the GHG emission from the waste sector in a very general way. The data is based on the report (JRC 2012), which in fact does not make explicit what sources of GHG have been considered to calculate the emissions from the waste sector. In fact, it only mentions the fossil part of waste incineration, which is a small portion of all the sources involved in GHG emissions. Following the UNEP report 'Waste and Climate Change' it should be noted that sources of GHG in the waste sector come mostly from open and controlled landfills, being is the second source of anthropogenic methane. Moreover, biogenic emissions involved in incineration should also be accounted, following the IPCC 2006 guidelines. Furthermore, The 2006 IPCC Guidelines (IPCC, 2006) indicate that uncertainties for global emissions from waste can be as high as 10-30% for developed countries (with good data sets) to 60+% for developing countries that do not have annual data. Monni et al also noted that if alternative, but equally defensible, assumptions were adopted for future waste generation, their results for total methane emissions from landfills worldwide could be 40-50% lower, or 20-25% higher than those actually presented. These uncertainties should be explicitly mentioned. Reference: Monni, S., Pipatti, R., Lehtilla, A., Savolainen, I. and Syri, S., 2006. Global climate change mitigation scenarios for solid waste management. Technical Research Centre of Finland. VTT Publications, Espoo.	TAKEN INTO ACCOUNT - text revised with additional explanation, based in the ideas explained in the comment that are clear. But the comment is bad situated in page 35, lines 27 to 30. The reference(JRC, 2012) is based in IPCC Guidelines 2006 taken into account the main sources of GHG emissions from waste: solid wastes disposal on land, wastewater handling, waste incineration, and others, and it is based in GHG inventories and national communications delivered by countries in different Regions accepted by IPCC: Asia, OECD 90, LAM, MAF, and REF. It isn´t exact the affirmation: ¨ In fact, it only mentions the fossil part of waste incineration, which is a small portion of all the sources involved in GHG emissions ¨, were taken into account all main sources of GHG emissions of waste mentioned above. The reference of Monni, et.al.,2006 was revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
35426	5	35	27		30	These lines state the GHG emission from the waste sector in a very general way. The data is based on the report (JRC 2012), which in fact does not make explicit what sources of GHG have been considered to calculate the emissions from the waste sector. In fact, it only mentions the fossil part of waste incineration, which is a small portion of all the sources involved in GHG emissins. Following the UNEP report 'Waste and Climate Change' it should be noted that sources of GHG in the waste sector come mostly from open and controlled landfills, being is the second source of anthropogenic methane. Moreover, biogenic emissions involved in incineration should also be accounted, following the IPCC 2006 guidelines. Furthermore, The 2006 IPCC Guidelines (IPCC, 2006) indicate that uncertainties for global emissions from waste can be as high as 10-30% for developed countries (with good data sets) to 60+% for developing countries that do not have annual data. Monni et al also noted that if alternative, but equally defensible, assumptions were adopted for future waste generation, their results for total methane emissions from landfills worldwide could be 40-50% lower, or 20-25% higher than those actually presented. These uncertainties should be explcitedly mentioned. Reference: Monni, S., Pipatti, R., Lehtilla, A., Savolainen, I. and Syri, S., 2006. Global climate change mitigation scenarios for solid waste management. Technical Research Centre of Finland. VTT Publications, Espoo.	REPEATED: It is the same reviewer of Indonesia. The answer of LA in the same above: TAKEN INTO ACCOUNT - text revised with additional explanation, based in the ideas explained in the comment that are clear. But the comment is bad situated in page 35, lines 27 to 30. The reference(JRC, 2012) is based in IPCC Guidelines 2006 taken into account the main sources of GHG emissions from waste: solid wastes disposal on land, wastewater handling, waste incineration, and others, and it is based in GHG inventories and national communications delivered by countries in different Regions accepted by IPCC: Asia, OECD 90, LAM, MAF, and REF. It isn´t exact the affirmation: ¨ In fact, it only mentions the fossil part of waste incineration, which is a small portion of all the sources involved in GHG emissions ¨, were taken into account all main sources of GHG emissions of waste mentioned above. The reference of Monni, et.al.,2006 was revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
26934	5	35	27		30	These lines state the GHG emission from the waste sector in a very general way. The data is based on the report (JRC 2012), which in fact does not make explicit what sources of GHG have been considered to calculate the emissions from the waste sector. In fact, it only mentions the fossil part of waste incineration, which is a small portion of all the sources involved in GHG emissins. Following the UNEP report 'Waste and Climate Change' it should be noted that sources of GHG in the waste sector come mostly from open and controlled landfills, being is the second source of anthropogenic methane. Moreover, biogenic emissions involved in incineration should also be accounted, following the IPCC 2006 guidelines. Furthermore, The 2006 IPCC Guidelines (IPCC, 2006) indicate that uncertainties for global emissions from waste can be as high as 10-30% for developed countries (with good data sets) to 60+% for developing countries that do not have annual data. Monni et al also noted that if alternative, but equally defensible, assumptions were adopted for future waste generation, their results for total methane emissions from landfills worldwide could be 40-50% lower, or 20-25% higher than those actually presented. These uncertainties should be explcitedly mentioned. Reference: Monni, S., Pipatti, R., Lehtilla, A., Savolainen, I. and Syri, S., 2006. Global climate change mitigation scenarios for solid waste management. Technical Research Centre of Finland. VTT Publications, Espoo.	REPEATED - It is a different reviewer(of Spain) but the comment is the same. The answer of LA is the same above: TAKEN INTO ACCOUNT - text revised with additional explanation, based in the ideas explained in the comment that are clear. But the comment is bad situated in page 35, lines 27 to 30. The reference(JRC, 2012) is based in IPCC Guidelines 2006 taken into account the main sources of GHG emissions from waste: solid wastes disposal on land, wastewater handling, waste incineration, and others, and it is based in GHG inventories and national communications delivered by countries in different Regions accepted by IPCC: Asia, OECD 90, LAM, MAF, and REF. It isn´t exact the affirmation: ¨ In fact, it only mentions the fossil part of waste incineration, which is a small portion of all the sources involved in GHG emissions ¨, were taken into account all main sources of GHG emissions of waste mentioned above. The reference of Monni, et.al.,2006 was revised.
36511	5	35	7	35	7	Where is this data shown? And please add citations.	TAKEN INTO ACCOUNT - text revised and included reference, that is the same (JRC, 2012).
34073	5	35	7	35	8	Evidence regarding GHG composition of waste emissions not provided. Citation required.	TAKEN INTO ACCOUNT: text revised with additional explanation and citation
35464	5	36	13		17	This is a very significant quote that should be also referenced in chapter 10, in the Waste Excursus.	TAKEN INTO ACCOUNT - This topic was discussed with Chapter 10 in Addis Ababa and will be included in this Chapter.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
26972	5	36	13		17	This is a very significant quote that should be also referenced in chapter 10, in the Waste Excursus.	REPEATED. The reviewer comment of Spain is the same comment of Indonesia Reviewer.The answer is the same that above: TAKEN INTO ACCOUNT - This topic was discussed with Chapter 10 in Addis Ababa and will be included in this Chapter.
40593	5	36	22	36	22	Please unify the units to tO2(eq)[??]Or t CO2.	TAKEN INTO ACCOUNT - according with analysis with Chapter 10 in Addis Ababa this part will go to Chapter 10 and will be taken into account this Comment of Japan Reviewer
33672	5	36	24			China's waste sector wil reach 33.2 million tons in …	TAKEN INTO ACCOUNT - according with analysis with Chapter 10 in Addis Ababa this part will go to Chapter 10 and will be taken into account this Comment of Netherlands Reviewer that is correct
26011	5	36	33	36	34	Yes, the emissions per capita is almost constant but world population is steadily rising and so are the total emissions. - The GDP total is likely to rise faster than the decrease in emission per GDP. This due to that the economic and population growth is higher than the total emission reductions per economic or population unit. - Waste handling can be done more efficient (the EU and US figures) that has to be implemented in other regions to secure a declining emission trend in total mass values. Thus I would suggest a more concerned and/or expanded wording for the summary regarding global influence from waste handling. Note: - It is a net 127% increase in waste GHG emissions from 1970 to 2010 (an average 2,0% increase). It was almost constant some years in the 1990's but has speeded up again due to emissions mainly from waste water handling. Handling and mitigation possibilities: - Using existing technologies as waste separation, waste burning, concentrating waste handling facilities with energy recovery (biogas) or flaring high concentrated CH4 and thermal treatment of lower concentrated CH4 in total gives substantial and fast applicable mitigation potentials to relatively low costs (all above is in use in EU and US). - The CH4 that to a large extent is of biological origin will be converted to CO2 as a speed up of the natural oxidation and take away the CH4 adder. - If the CH4 also can be used as energy source it may directly replace some energy of fossil fuel origin. - Mitigation gives health benefits as per section 5.7	TAKEN INTO ACCOUNT - according with analysis with Chapter 10 in Addis Ababa this part will go to Chapter 10 and will be taken into account this Comment of Sweden Reviewer that is correct

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36512	5	36	35			The impact of urbanization, as it relates to different levels of income and stages of development as described in this sentence is inconsistent with the findings of Sovacool and Brown (2010)--this reference already appears in the chapter's bibliography. Their study of twelve metropolitan carbon footprints across 10 different countries found that the per capita carbon footprints of urban areas in developing countries were generally larger than the average for that country, while the opposite is true in developed countries, where urban carbon footprints tend to be smaller than non-urban footprints.	Noted. This is related to Section 5.4.
36513	5	36	37	36	37	Please add "per capita" before "GDP and GHG emissions" -- that's what's shown in Fig. 5.4.1.	Accepted - text corrected
36514	5	36	37	36	45	The authors should separate the discussion of Figure 5.4.1 in this paragraph into a discussion of panel (a) and then panel (b).	Accepted - text modfiied
40594	5	36	42	36	43	This figure shows a distinctive findigs relating GHG-GDP. Please introduce it into TS.	Noted
33671	5	36	5			Several reasons may explain these trends:…	EDITORIAL - according with analysis with Chapter 10 in Addis Ababa this part will go to Chapter 10 and will be taken into account this redaction Comment of Netherlands Reviewer
40592	5	36	8	36	12	Please indicate how much amount of CO2 (or energy) was reduced by energy production from wastes.	TAKEN INTO ACCOUNT - according with analysis with Chapter 10 in Addis Ababa this part will go to Chapter 10 and it is reflected in this Chapter the Comment of Japan Reviewer.
27539	5	36	8	36	8	The citation "Eurostat: Climate Change, …" should be re-considered. Propose to use "Eurostat, 2011" as reference.	TAKEN INTO ACCOUNT - according with analysis with Chapter 10 in Addis Ababa this part will go to Chapter 10, and it is corrected in this Chapter the redaction Comment of Germany Reviewer.
24246	5	36				The section lack references to ongoing research and implementation of enhanced models for driving and measuring societal progress, leaving the reader restricted to conventional models and indicators which fail to include and drive necessary emissions reductions.	Noted - this section reports the consensus view on the drivers of growth in mainstream economics as well as alternative views from the energy economics literature including Potsdam researchers (Jakob et al.). The reviewer has subsequently sent us an additional reference to Kubisweski et al. 2013 Ecological Economics, which we will refer to in the text.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
25976	5	36	36			Economic growth and development- this text reaches no conclusion and needs further synthesis work. It attempted to address so many factors, reported by so many authors, that it became confusing. Which factors are key? Which factors are secondary? Which are the main correlations that are of interest to climate change mitigation? It´s not clear. But, because the issue is so important, the chapter should be put elsewhere in the report, where it matters most for climate change policies.	Accepted: I have reorganized this section a little to put the main mainstream and alternative ideas on drivers of growth in the paragraph starting: "Mainstream economic theory…" This was moved from the beginning of the section on ecological economics and economic history viewpoints.
34074	5	36	38	36	39	Evidence for economic growth rate not provided. Citation required.	Accepted: References to the common database for the report will be added in the final draft.
27541	5	37		37		Font size to be enlarged.	Noted: The final report will be professionally designed.
29778	5	37		37		GDP data in market exchange rate, or PPP?	Taken into account: PPP - labels on figure will be modified accordingly.
24356	5	37	3	37	4	This figure use logarithmic coordinates, which omit the huge differences in actual value of per capita data between developed and developing countries. It is proposed to either use ordinary coordinates to substitute logarithmic coordinates, or illustrate every specific data while adopting logarithmic coordinates.	Rejected: Logarithmic axes make it easier to see details at low income levels. We have agreed at the 4th lead author meeting to note on Figure captions when logarithmic axes are used.
36515	5	37	3			This is not comprehensible or helpful. It is too hard to see. Please add clear discussion along with this graph.	Accepted: Agree that panel B is hard to understand - will be modified.
36516	5	37	3	37		The authors should explain that the sectoral shift they are discussing is with regards to share of economic GDP. the price of manufacturing goods may decrease while the actual units manufactured does not change. If this is the case, then the reduction in emissions due to sectorial shifts may still be significant when a "real shift" in the number of goods manufactured occurs.	This section does not discuss sectoral shift.
36517	5	37	4	37	6	Please revise this run-on sentence.	Accepted -sentence split in two.
36518	5	37	4	37	6	"Per capita emissions are positively correlated with per capita income" -- this is not what is shown for many regions in panel (b), just the opposite.	Rejected. At any point in time they are correlated but in some countries have seen declines over time as they got richer.
34075	5	37	6			Panel B of figure 5.4.1 does not show energy use, it only shows emissions per capita and GDP per capita. Another figure showing energy use should be inserted to support the assertion here.	Accepted - text corrected.
27540	5	37	6	37	6	The statement, that panel b of fig 5.4.1. shows a wide variation in energy use, is not the case; it only depicts the relationships between per capita GDP and percapita emissions.	Accepted - text corrected.
36519	5	37	16	37	17	Perhaps this set of definitions should be moved forward since these terms are referred to early in Chapter 5.	There are no definitions at this point in the text,
36520	5	38	1	38	1	"Vary in distance from the frontier of innovation"? Please revise for clarity.	accepted: This sentence deleted as it is superfluous

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
24245	5	38	20	38	35	As there is evidence for developed countries that limitationson energy availability does not constrain economic growth, it raises the question whether developing nations can "leap frog" and "catch up" (as is discussed on line 34, same page)or doomed to take the same development path as developed countries. A clarification from available research would be enlightening.	Taken into account: There hasn't been any research specifically on developing countries following up on Stern and Kander's idea of a weakening energy constraint on growth. The reviewer provided additional feedback on the potential for leapfrogging by developing countries. But this does not relate closely to the discussion of the role of energy as a constraint on growth in this part of the text. I believe that adding a dicussion on the question of whether energy is a constraint on growth in developing countries will get too much into the realm of speculation and original research.
36521	5	38	22	38	23	The authors could possibly delete "generally remain isolated in the resource economics field"; it adds nothing but a potential value judgment and could probably also be said about the other groups mentioned in the paragraph.	Accepted: Deleted.
36522	5	38	27	38	27	What is the meaning of an "organic energy production system"?	Taken into account: Changed to biomass to be clearer and reworded otherwise.
40595	5	38	7	38	12	This chapter shows the decouppling of emerging countries (e.g., China and India) from other developing countories, and this tendency should be surely recognized in analyzing the pros and cons of GHG emission from developing countries. Furthermore, mixing emerging countries and LDCs can cause a problem in equity. Therefore, this chapter should be kept and its summery shoud be put in SPM and TS.	Noted
35245	5	38	8	38	8	It is suggested to change ‘countries’ into ‘countries and regions’; and Taiwan should be referred to as “Taiwan, Province of China” as it is not a sovereign state.	Accepted - dropped reference to Taiwan to solve this problem.
19978	5	38	8	38	8	Here in the Figure Taiwan is regarded as an independent country. Suggest to change the phrase "countries" in the description under the table into "countries and regions".	Accepted - dropped reference to Taiwan in the text to solve this problem.
27543	5	39		39		In both axes the respective unit is missing, e.g.. [1] or [%].	Accepted: Units will be changed to percentages in the final report.
36523	5	39	1	39	5	Some discussion of the Kuznets curve literature addressing GHGs or CO2 specifically is needed here, since these pollutants show different results than conventional pollutants.	Accepted: This is a good point and has been added to the text. Specifically we added a reference to Shafik 1994 and the comment: "even early studies found that carbon emissions continue to rise with increasing income."
33673	5	39	13			… across countries there is in general a strong …	Editorial
27542	5	39	13	39	13	Delete "one" "there is".	Editorial

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
20585	5	39	16	39	16	Please add "For China, Li and Oberheitmann (2008) found that the country is still on the left hand rising part of the Environmental Kuznets Curve. The four year period of negative income elasticities of emissions between 1997 and 2000 which temporarily that lead to an Environmental Kuznets Curve like shape with a decreasing right hand part of the inverted U-type shape was only a structural break." Please cite as: Li, Y. and Oberheitmann, A. (2008). Main factors of decoupling China's energy related emissions from its economic growth – Where is China on the Environmental Kuznets Curve? ASIEN, 106, 7-23.	Rejected - I don't think specific reference to one country and not others is appropriate here. Based on the references cited here there is also good reason to be skeptical of the EKC concept in general.
36524	5	39	17	39	18	This discussed how structural change is measured but not what it is - please define clearly. Earlier in this chapter, it was stated that structural changes have minor impacts on emissions. Please reconcile.	Accepted -language changed to "might have an effect". Removed reference to measurement.
20584	5	39	2	39	2	Please add as citation for the Environmental Kuznets Curve itself "(Grossman and Krueger, 1991; Grossman and Krueger, 1995)". Please cite as Grossmann, G.; Krueger, A.: (1991). Environmental Impacts of a North American Free Trade Arrangement. Discussion Papers in Economics, No. 158. Woodrow Wilson School of Public and International Affairs, Princeton. Grossmann, G.; Krueger, A.: (1995). Economic growth and the Environment. Quarterly Journal of Economics 110 (2), 352-377.	Taken into account: This is a good point, but one reference is sufficient and peer reviewed references are preferred - therefore Grossman & Krueger 1995 was added.
33674	5	39	20			This separates the effect of overall economic …	Taken into account:This sentence has been deleted
36525	5	39	20	39	20	Please reword: the effect of overall economic scale.	Taken into account:This sentence has been deleted
33675	5	39	23			.. of manufacturing tends to follow an inverted-U ...	Noted
36526	5	39	44	39	45	This discussion says that trade doubled every 7 years. That is not reflected in the related emissions in figure 5.2.1, that shows a slower increase. Please reconcile.	Accepted. Figure 5.2.1 shows global emission growth and not growth in trade. However, I also recognise that the "doubling every 7 years" is up for debate. This has been addressed in 26012
40596	5	39				This chapter is very important under the current situation in increasing GHG emission from energing countries. Peahaps, there may be a lot of unclear things, however, we have to make from the view point of emerging contries	Noted
34078	5	4		6		It would be useful to show figure 5.8.1. in the Executive Summary. In terms of structure of the Executive Summary, it would be useful to discuss all the factors as depicted in his figure and also stated in lines 17-22 of pg 4 before discussing the drivers which would include trade. At the moment, the part on trade has been placed between the part on affluence and emissions intensity (lines 4-9, pg 5) and it should be moved to after all the parts on the 4 factors.	Taken into account: The ES was rewritten in order to highlight the main findings as well as to provide more space to discuss factors included in former Figure 5.8.1. This figure was not inserted in the ES to keep consistency to the other chapter's ES.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
24343	5	4	1	58	39	It is suggested to use the MER-based GDP instead of PPP-based GDP.	Rejected. After consulting experts, most consider the PPP preferrable when calculating emissions intensities, espcially when emission intensities are measured for aggregate economies including sectors where prices are not fully determined by the world market. Overall, the PPP is considered to be the best measure for overall wealth, and thus also for the amount of substances emitted per unit of wealth produced.
24344	5	4	1	58	39	GHG emissions data since 1970 used in this report is mainly from EGDAR database, however, the data before 1970 is from CDIAC database. In order to keep the consistency, for CO2 emission data, it is suggested to use CDIAC databast to replace the EGDAR database.	Rejected: The EDGAR database was chosen to allow the use of consistent data across all chapters of the report. The CDIAC data does not provide a breakdown of emissions by activities or industrial sectors. This is why we adopted the EDGAR database as a common data source for the Report.
36332	5	4	1	6	17	Throughout the Executive Summary, the uncertainty qualifiers (e.g., high confidence, medium agreement, medium evidence) are used incredibly confusingly - they appear associated with all kinds of different statements, often with multiple statements in one sentence such that you can't tell what it means. The two examples above are good examples. These need to be used much more carefully and clearly. Then, in the body of the chapter, where there are plenty of statements for which we know that there is substantial uncertainty, and for which the level of uncertainty is very policy relevant, there are no such qualifications.	Accepted: The ES was revised accordingly.
31391	5	4	13	4	14	What is meant by “forestry” in this respect? Deforestation? Is not forest management more likely to increase the land sink? Please see Ch 5, page 11, line 4 "CO2 emissions from land use change are due primarily to deforestation." Also cite TS.4.6 AFULU. It would be helpful if the term "Forestry" could be included in the Annex1 Glossary.	Forestry is the practice of managing and using for human benefit the natural resources that occur on and in association with forest lands. It includes activities such as production of non-timber products, watershed management, wildlife protection, eco-tourism, pest control and fire management.
36336	5	4	17	4	22	The main results of these decompositions need to be presented in the Executive Summary but they are missing; it is more a summary of trends that is presented.	Accepted: The ES was revised accordingly.
30838	5	4	18			"IPAT and Kaya" will not be known to non-specialists. Recommend not using these terms in the Executive Summary and finding a simpler way to explain the methodologies used.	Accepted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30837	5	4	2			This introductory sentence stating CO2 is "the most important GHG" is a little vague and could be sharpened to more clearly specify the reason for that importance.	Taken into account - ES text clarified to be more specific as: "CO2 remains the major anthropogenic GHG measured in CO2-equivalent based on global warming potential with a 100 year time horizon "
19180	5	4	2	4	3	The most important greenhouse gas is unbdoubtedly water vapour. There is no evidence that any of these gases harm the climate	Noted in part - ES text clearly identifies CO2 as the most important *anthropogenic* GHG, and is refering to emissions. Water vapour is not an emission, but a climate feedback. There is strong evidence that GHGs are changing the climate (e.g. WG I assessment), so the latter comment is not accepted.
30555	5	4	2			It cn be corrected s " CO2 continues to be the most important anthropogenic greenhouse gas because of its significant continuous increase in concentration.Its increase is mainly…..	Noted -detailed wording of the ES has changed to eliminate this issue.
19154	5	4	22	4	24	"Global population has increased by 87%, from 3.7 in 1970 to 6.9 billion in 2010 (high confidence). The direct effect of population on emissions is a proportional increase". By 2050 population is forcast to increase by another 2 billion +. Unless agricultural and slivicultural productivity increases at the same rate of population increase, deforestation will not be halted, never mind reversed. This is why rural development, using existing sustainable resources is so important coupled with realistic family planning initiatives. Also see P. 18.	Noted
33653	5	4	23			… from 3.7 billion in 1970…	Accepted - text revised.
34063	5	4	23	4	33	The argument states that the direct effect of population on emissions is a proportional increase. However further on in the paragraph, it states that the gap between top and bottom countries in per capita emissions exceeds a factor of 50! Most population growth occurs in countries with lower per capita emissions. India, one of the most populous countries in the world, has a very low per capita emission as shown in 5.4.1 (GDP/capita time series)	Accepted - text revised.
36338	5	4	23	4	33	Something about convergence across countries should be mentioned in this paragraph.	Accepted: We are reviewing this section to make it more inline with the detailed chapter text.
36337	5	4	24	4	33	It is not accurate to say that the "direct effect of population on emissions is a proportional increase" as there is no reason to believe that each additional person would increase global net GHG emissions by the same amount regardless of any other considerations. Indeed, the rest of the paragraph after that sentence discusses the wide variance between per capita emissions between countries and even that is based on average emissions per person, not marginal emissions of adding more people. Te discussion should be revised to reflect this.	Noted. We do discuss the context dependence as the comment recognizes.
31392	5	4	25	4	30	Please consider to include some data on the development of per capita emissions by region here in the Executive Summary.	Taken into account: The ES was revised and more discussions on per capita emissions by region was incorporated (see Section 5.2).
25314	5	4	25	4	30	It would be useful to report changing share (%) in total global emission. Emission per additional person is interesting but not a very useful information.	Taken into account: The ES was revised and percentages on changing share were included (see Section 5.5, 5.8 and ES).

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
23846	5	4	28	4	29	Instead of the factor 50, another way to present this is the mean and standard deviation? A factor 50 may just pick up two outliers.	Rejected - the idea is to present the range and the factor of 50 does just that.
19181	5	4	3	5	6	The effects of greenhouse gases are caused by atmospheric concentrations, not emissions, The relationship between these is unknown.	Noted - emissions are the proximate causes of the changes in concentrations, therefore the focus on emissions is appropriate. The relationship between the two is uncertain, but not unknown and is assessed by WG I.
35241	5	4	31	4	32	The conclusion, to some extent, denies the contribution of urbanization to increased emission and is not supported by the underlying report. Literatures referred in section 5.3.2.2 indicate that “in the early phase of urbanization, emissions increase (page 20, line 40-41)”, while others believe that “the contribution of urbanization on emissions was not significant (page 20, line 24-25).” Therefore, the conclusion that “urbanization has subtle effects on emissions” could not be drawn. It is suggested to delete this sentence in the ES.	Accepted - Revised sentence and uncertainty statement.
30839	5	4	34			What is PPP?	Accepted: Purchasing power parity. We have added this definition the first time the term is mentioned
36339	5	4	35	4	35	We are surprised that there's only medium confidence on per capita income increase.	Rejected: This is a reference to the actual percentage change, not the direction.
36333	5	4	4	4	4	The absence of uncertainty estimates in the GHG emissions estimates is notable. Please add.	Taken into account - Discussion of uncertainty, where available in the literature, has been added throughout the chapter and note of this is mentioned in the ES.
35242	5	4	40	4	44	The arguments on emission factors, drawn from the conclusion of Kaya decomposition in section 5.3, are unbalanced and inaccurate. The existing selection of time spans in Kaya decomposition is inappropriate, and cannot reflect the impact of financial crisis after 2008. In fact, the decrease of emission in some developed countries during 2008-2009 is because of the decrease in GDP per capita instead of being balanced by decreased emission-intensity. It is suggested to extend and redefine time spans as 1950-1970, 1970-2007, 2008-2010 to correspond to the actual economic cycle, and to add the results to Figure 5.3.1 on page 16.	Rejected. First, reliable data are not available before 1970s. Second, the Kaya identity figure does show continuous time series covering all periods after 1970. Targetting 2-3 years data and extracting a major trend out of them seems implausible.
23847	5	4	40	4	46	The decrease in emission intensity and the sector shift from ag to industry to services may be correlated? Are you suggesting they are not linked (by saying the shift is "less important")?	Rejected: The conclusion of the relevant section is that shifts between sectors have made a minor contribution to the global reduction in energy intensity.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
35243	5	4	44	4	46	This conclusion, to some extent, denies the contribution of industrialization to emission increase and is not supported by the underlying report. However, it contradicts with the finding in the chapter, which claims that before the completion of industrialization, the sector shifts, from agriculture to industry and services, is very important for the development of emissions. (See on page 25, lines 30-31, mentions that “Globally, structural changes play a minor role in determining trends in energy use and CO2 emissions, though they can be important in individual countries. Lines 36-38 Wing (2008) finds that structural change explained most of the decline in energy intensity in the United States (1958-2000), especially before 1980.”) The share of the service industry in developed countries’ economy did not exceed 60% until the completion of industrialization. The agreement level of this conclusion is low, and it is not appropriate to take this conclusion in the ES. It is suggested to delete this conclusion from the ES.	Accepted. The ES has been thorougly reviewed. It is now balanced with a reference to how emissions paths connect to sector developments.
21655	5	4	6	4	6	"Fluorinated gases represent a minuscule amount over the entire time span". Is this the trend between 1970 and 2010 or the absolute contribution?	Taken into account - Text edited to be more specific.
23844	5	4	6			"miniscule" is not very precise. Can you give a %?	Accepted: The ES was revised accordingly.
27505	5	4	6	4	6	Please add: "Fluorinated gases represent a minuscule amount over the entire time span in industrial manufacturing."	Taken into account - Text edited to be more specific.
23845	5	4	7	4	48	On this page there are several % increases. How were these calculated? One would expect the percentage increases is calculated as (last-first)/first*100? If that is the case, the 290% should be 190%? It is worth double checking all the values in this page as it seems some might be incorrect. Something increasing from 100 to 290 would be a 190% increase, not 290%.	Taken into account: percentages were reviewed and revised accordingly
36334	5	4	7	4	16	The numbers provided for sectoral emissions only add up to the total emissions provided if waste GHG emissions are not included. They may not be huge, but if ~3% of global GHG emissions, they would be presumably be around 1.5 GtCO2e/yr so seems they should be included in the totals to ensure full coverage.	Accepted. Waste emissions are sometimes included in Industrial emissions, and sometimes separated. We phrased more carefully in the Final Draft.
40568	5	4	7	4	16	This part contains too many figures and not easy to grasp the image. Please summarize them into a table or a figure for easier understanding.	Taken into account: The ES was revised and structured in different way to simplify the reading
36335	5	4	8	4	16	What does "high confidence" in a figure with no error bars mean? And what does "medium agreement, robust evidence" mean when it appears at the end of the paragraph?	Taken into account: where appropriate Figures across the chapter where modify to include indication of uncertainty. Uncertainty language will be placed closer to the statements they refer to.
34042	5	4	7	4	16	The calculations for increase of emissions from the energy,transport and AFOLU sectors as noted here are incorrect. For example, for the energy sector, the increase is 187% [(17.5-6.1)/6.1]% and not 290% (17.5 is about 290% of 6.1, hence an increase of 290% would be 6.1+17.5=23.6). Likewise, for transport, the increase is 131% and not 231% as noted. For AFOLU (not FOLU), the increase should be 20% (not 25%) = [(12-10)/10]%	Accepted. Calculations have been redone using newest data.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
27503	5	4	1	6	17	Overall, this ES includes much data but falls a bit short of extracting policy-relevant insights from it. What do these numbers mean? How big are they? When presenting evidence, please put your numbers always into context and explain in what respect this is relevant information for policymaking. Please provide information on the uncertainty ranges of data. You do not mention that the growth rate of emissions was higher in the period 2000-2010 than in previous decades (see SPM). Why? Why do you only look at data from 1970 onwards? It would be useful to focus more on the effects of the drivers than on the characteristics of the driver. While the reader gets a lot of information on population growth, economic growth etc. the influence of these drives is not well presented. Is globalization (trade integration) or technological change increasing or decreasing emissions? Comprehensibility would be improved significantly if every paragraph in your Summary stated its key finding in the first sentence, qualified with an uncertainty statement, and substantiated with relevant evidence in the paragraph body and referenced to sections at its end.	Taken into account: The ES was revised accordingly. Regarding the time span, several figures in the chapter, including emission flows and stocks started all the back to 1750 (Fig. 5.2.2). The emphases on the last decade is to cover new data and information created after IPCC AR4. Regrading the influence on drivers on past emissions trends, the revised version of Chapter 5 tries to improve the explanation of the influence of the different drivers identified on past emissions trends. The literature often describes the drivers and their influence on emissions in a qualitative fashion. This fact, together with the interlinkages among drivers, makes diffcult to single out the influence on past emissions of the each of the drivers (see sections 5.1 and 5.8). For forward looking analysis of the drivers in future trends, please refer to Chapter 6.
30251	5	4	10	4	12	Data to be made consistent with what appears in industry chapters, moreover I find there are inconsistent data within your SOD (e.g. Exec Summ. vs section 5.3.4.3)	Accepted. We have sent our sector sections to the sector chapters for consistency checks.
26312	5	4	13	14	15	the sentence says: "Emissions from agriculture, forestry and other land uses (FOLU) increased by 25% from 10 to 12 Gton CO2/y over the same period." It must say "(AFOLU)" and the increase from 10 to 12 Gton is 20%, not 25%.	Revised: Emission from agriculture, forestry and and other land uses (AFOLU) increased by 20% from 9.3 to 11.2 Gt CO2 eq./yr over the same period.
34452	5	4	2	4	6	Authors in the AR4 estimated global anthropogenic GHG emissions in 2004 to amount to 49 Gt CO2eq. You say in 2010 the same phenomenon amounts to 50 Gt CO2eq. Contrary to your own statement, there has been almost no growth in total emissions if one compares AR4 and AR5 data. Global GHG emission estimates in AR4 where 7-8% higher than in the AR5. These differences need to be explained and discussed in the context of uncertainties. Please check your main findings against AR4 findings and explain divergences.	Accepted: We have added information about uncertainty in emissions and differences between data sources in the chapter. Revisions to the EDGAR database explain the differences between AR4 and the current report.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
27504	5	4	2	4	6	AR4 (2007) used the EDGAR database of dec 2006; new AR5 uses an update of the EDGAR database of 2012. Possibly this inconsistency has its origin here. Possibly not only relevant in Ch.5, but for the entire WG III report. a) The AR4 estimated global anthropogenic GHG emissions in 2004 to amount to 49 Gt CO2eq. You say in 2010 the same phenomenon amounts to 50 Gt CO2eq. Contrary to your own statements, this would mean that there has been almost no growth in total emissions? Please, explain this. b) For every single key finding, please disclose your confidence level in its accuracy.	Accepted. We explicitly refer the discrepancies between the AR4 and AR5 data and discuss the implications in Section 5.2.
24345	5	4	44	4	46	This statement is not supported by the description in the underlying report and the agreement level of this statement is low, which means that it is not appropriate to take this as a key conclusion and put it in ES. It is suggested to delete this sentence in the ES.	Accepted: The ES was revised accordingly.
23358	5	4	7	4	16	This comment applies both to this parag. of the ES as well as to other places in the text where emissions data are given: the distinction between direct and indirect emissions (i.e. link between energy supply and energy demand sectors) is not obvious to the lay reader. The terms direct and indirect emissions are used within this chapter without an appropriate clarification at the start. Please add an explicit statement for this early on (e.g. start of ES, introduction). See the introduction to Energy chapter for an example of how to illustrate boundaries and explaining the concepts as they apply to energy. Nevertheless we think the broader discussion, i.e. complexities in attributing emissions to sectors, should be framed in chapter 5, not 7. See our related comment on this (e.g. double counting) for this chapter.	Taken into account: In the SOD we referred to indirect emissions in Section 5.3.4.4, 5.5.2.1. We removed the first reference to indirect emissions, and the second reference we believe is clear from the context. We added a sentence in Section 5.3.5 that chapter 5 deals mostly with direct emissions, while Chapter 9 deals with both direct and indirect emissions from the buildings sector. We checked the text and find no other references to indirect emissions.
25317	5	40	1	40	5	It may be included from the reference (Pal Barun , Sanjib Pohit ,Joyashree Roy (2012), Social accounting matrix for India, Economic Systems Research, Volume: 24, Issue: 01, pages 77 - 99. http://dx.doi.org/10.1080/09535314.2011.618824 -page 91) that "Indian economic structure with Service sector bias positions Indian economy better in climate change debate with low energy intensity".	Accepted: Reference and idea added.
36527	5	40	1	40	2	In an earlier paragraph on this page, it was suggested that sectoral shifts away from the industrial sector reduce emissions less than commonly thought. This is also suggested later in this paragraph.	Taken into account: Yes, that is correct - but it is still an issue worth discussing.
33676	5	40	11			… energy efficiency which reduce the energy intensity …	Editorial

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
35246	5	40	28	40	42	This paragraph regards China as a “previously centrally planned economy”, which is inappropriate. Some parts of the content in this paragraph is incorrect and irrelevant to this section. It is suggested that this paragraph break into two and be redrafted as follows: The reform of previously centrally planned economies has been an important factor in the development of greenhouse gas emissions. Emissions and energy intensity was high in the former Soviet Union and many Eastern European countries prior to reform and declined as their economies were reformed. Like some centrally planned economies, China’s energy intensity was very high compared to similar but market oriented countries before 1980, and it decreased sharply between 1980 and 2000, as China opened its economy through market-based reforms (Ma and Stern, 2008). Energy and emissions intensity rose again from 2000 to 2005, mainly due to the exhaustion of easy catch-up opportunities in energy efficiency (Stern, 2012) and weakening of energy efficiency policy institutions over time (Zhou et al., 2010). On the other hand, China's carbon intensity of energy supply has increased steadily over time (Stern and Jotzo, 2010). Since 2005, the emission intensity (emissions/GDP) has declined as the central government has adopted more ambitious energy and emissions intensity reduction policies, which have been quite successful. Structural change has played a small role only in these large movements of the past three decades (Ma and Stern, 2008) (Steckel et al., 2011).	Taken into account: Not sure if objection is to referring to China as "previously centrally planned" - implying that it isn't now - or to referring to it as a centrally planned economy. Have rewritten this section to refer simply to reform of centrally planned economies as follows: "The reform of centrally planned economies has been an important factor driving changes in greenhouse gas emissions. Emissions and energy intensity were high in China, the former Soviet Union and many Eastern European countries prior to reform and declined as their economies were reformed. China serves as a case in point. "
33677	5	40	29			Emissions and energy intensity were high in China, …	Editorial
36530	5	40	29	40	29	The "development of greenhouse gas emissions" is an awkward phrase.	Editorial
36528	5	40	3	40	3	Please reconcile with trade emissions in fig 5.2.1.	Rejected: Line 3 refers to the share of GDP in agriculture and services globally, so unclear what the issue is.
36531	5	40	34	40	34	The relationship of this sentence to the previous sentence is not clear. Please revise to better connect the two to each other.	Editorial
27544	5	40	4	40	4	The reference in brackets should be: "World Bank, 2011" .	Editorial
26012	5	40	43	40	44	Check the figure 10% per year ! I Found WTO documentation with index 625 in 1970 and index 6825 in 2010 the average annual rate for Merchandise is 6,1% (a doubling in 12 years). Source that is enclosed at comments@ipcc-wg3.de WTO Chart 03 World merchandise trade volume	Accepted. I have updated the data as suggested.
27545	5	40	44	40	44	The term "world trade" should be explained, in particular in regard to trade between countries or regions. How is the trade between EU27 member states reflected; how within other trade regions of America, Asia, Oceania, …?	Accepted. The term "world trade" has been changed to "trade" to reflect all trade between countries.
19843	5	40	45			Does this text intend to make a distinction between "associated" and "embedded" emissions? If not, let's use one term throughout.	Accepted. The word "associated" has been removed to ensure consistency.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36529	5	40	5	40	6	This example does not elucidate the point made in the opening sentence of the paragraph. Can an example be given of a country importing lower emission intensity goods and services.	Noted. Yes, French exports to China. The sentence simply acknowledges that trade does not just flow from carbon intensive countries to less carbon intensive countries but is can go both ways. With such limited space the example of China was chosen becasue of has the most significant imapct of emissions from exports.
21672	5	40	28	40	42	It's important to discuss the changes in aerosol emissions associated with the changes in industrial emissions output. These aerosols have much shorter atmospheric residence times than CO2 and other GHGs. This also links with the "global dimming" phenomenon and can have regional impacts on temperature and precipitation.	Rejected: This section discusses the role of reform in centrally planned economies - unclear why we should discuss global dimming here.
26892	5	41				It would be important to add that about a third of food for human consumption is wasted globallly (FAO & Interpack, 2011, Save Food, Global Food loses and food waste), and add that in developping countries 40% of food waste happen after harvest and during processing whereas in industrialised countries over 40% food wastage occurs at retail and consumer level (European Commission http://ec.europa.eu/food/food/sustainability/indez_en.htm	Accepted - text inserted
36532	5	41	1	41	1	References need to follow a consistent format (eg- Ottrich and Bringeau (2010) estimate that…).	Accepted. Updated to ensure consistency
36533	5	41	18	41	20	Box 5.1: Where are these term definitions coming from? These do not seem consistent with previously used IPCC definitions. Please add citations. The definition for leakage here does not reflect that leakage can be negative or positive.	Accepted. A good point. This box was put together as a cross-cutting activity involving numerous chapters. Supporting references have now been provided.
36535	5	41	21			Change the header in bold to "Changes in relative fuel prices" and move any discussion of trade effects to the paragraph below (see next comment).	Accepted. Agree and changed
36534	5	41	21	41	23	Box 5.1: "Changes in the relative prices and international trade whereby national climate regulation reduces demand for fossil fuels, thereby causing a fall in world prices resulting in an increase in demand outside the jurisdiction." Please add citation as well as a clearer link to leakage. The change in prices largely caused by the GHG emissions changes (largely from land use or land use management change or related activities) which impact the supply of commodities (which could be an increase or decrease). In the case where supply increases, world prices would fall which may spur consumption outside the jurisdiction. the initial change in land use/management could be caused by policy (not necessarily a national climate policy) or other factors, such as markets or socioeconomic changes of behavior.	Accepted. A good point. This box was put together as a cross-cutting activity involving numerous chapters. Supporting references have now been provided.
36536	5	41	24	41	25	Box 5.1: this seems to be industrial C leakage of a sort - as a company may move to another country/jurisdiction. make this clearer, add a citiation for this clearer definition and relate why it is important in this context ie businesses may relocate due to competivitiveness issues caused by climate-related policies. competitiveness is a huge issue largely unaddressed here.	Accepted. These definitions have been revised to take this into account and references provided.
36537	5	41	24	41	25	Change the header in bold to "Competitiveness effects" and talk both about the relocation of industry to unregulated countries and the increase in net imports by regulated countries from unregulated countries. Also, cross check this focus area with other chapters	Accepted. These definitions have been revised to take this into account and references provided.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36538	5	41	26	41	28	Box 5.1: define the term, rather than just give an example.	Accepted. These definitions have been revised to take this into account and references provided.
36539	5	41	26	41	28	This explanation needs to be improved, it's hard to understand.	Accepted. These definitions have been revised to take this into account and references provided.
30090	5	41	29	41	30	Weak consumption leakage needs to be better defined. What characterises 'weak' as opposed to 'strong' is not that fact that the effect is unintended (strong leakage can also be an unintended consequence of cliamte policy) but that fact that it is induced by factors other than climate policy. See Peters, G. (2008). Reassessing carbon leakage. In The 11th Annual Conference on Global Eco- nomic Analysis “Future of Global Economy” Helsinki. Available from: https://www.gtap.agecon.purdue. edu/resources/download/3751.pdf.	Agreed. The definition has now been changed with this in mind to "Weak consumption leakage describes the increase of emissions in one country as a consequence of actions or policies that are unrelated to climate policy (such as a changed quantity or composition of imports) in another country."
36540	5	41	29	41	30	Box 5.1: why is this 'weak'? If there are consumption emissions as counted in this document (hard to trace back to where this is actually defined) wouldnt this be consumption-caused leakage?	Accepted but this is not how the literature defines this. There is considerable literature that uses the term "weak leakage" so the decision was made to reflect the literature and not introduce new terms. The reference being Barrett et al (2013)
36541	5	41	29	41	30	What does the term "weak consumption leakage" mean? We found no instances of it on Google and it is not clear from the explanation given.	We have not used "Google" as a method to include literature but refer to the academic peer-reviwed literature on the subject. There are numerous peer-reviewed publications that use the term "weak leakage" and these are referenced in the text. In particular, please refer to Barrett et al (2013)
35247	5	41	31	42	35	It is suggested to add specific data of export-related embodied carbon in this section. On page 41-42, only global export-related embodied carbon data is mentioned, while the respective data from developing and developed countries is missing. For example, according to Perters’ study (Growth in emission transfers via international trade from 1990 to 2008), “from 1990-2008, the total export embodied carbon from non-annex B countries to annex B countries increased from 0.4Gt to 1.6 Gt. 33% of the growth of non-Annex B emissions can be assigned to Annex B consumption. International trade is a significant factor in explaining the change in emissions in many countries, from both a production and consumption perspective.” It is suggested to add this and other similar research findings in to this section. In addition, the description on the effect of carbon leakage is not balanced. There are studies concluding that the effect of carbon leakage is much smaller. Findings from such studies should be reflected as well.	Noted. Without suggested references on leakage it is difficult to fully respond to this comment. Figure 5.5.1 does show developed and developing countries. In addition, the refernece from Peters et al has formed an important part of the analysis.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
33678	5	41	31			As presented in …	Accepted. This has been updated for clarity. Cas had been deleted and instead it reads "The consumption accounts presented in section 5.3.3.2...
23881	5	41	31			What is CA?	Accepted. This has been updated for clarity. Cas had been deleted and instead it reads "The consumption accounts presented in section 5.3.3.2...
36542	5	41	31	41	31	What are CAs?	Accepted. This has been updated for clarity. Cas had been deleted and instead it reads "The consumption accounts presented in section 5.3.3.2...
27546	5	41	31	41	31	The sentence starts with "CAs presented in Section 5.2. ..." - Who is "Cas"? The contributing authors?	Accepted. This has been updated for clarity. Cas had been deleted and instead it reads "The consumption accounts presented in section 5.3.3.2...
19842	5	41	31			Text missing	Accepted. This has been updated for clarity. Cas had been deleted and instead it reads "The consumption accounts presented in section 5.3.3.2...
23882	5	41	37	41	47	I cannot replicate most of these numbers. I get 81% not 61%. I get 30% and 40%, not 10% and 26%. Can you double check, and perhaps send an email for clarification.	Accepted. The text has been simplified and now reads "In 2008, this figure had increased to 7.8 Gt CO_2, by 62% over 18 years (average annual increase of 4.3%) (Peters et al., 2011a). Between 1990 and 2000 the growth in the embedded carbon dioxide emissions of products being traded grew by 10%. Between 2000 and 2008, carbon dioxide emissions embedded in trade grew by a further 26%, demonstrating a more recent and rapid increase (Peters et al., 2011a). "

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30091	5	41	40	42	6	It should be noted here that there remain methodological and data issues underlying the literature quantifying embodied carbon in trade such that different studies produce very different estimates of trade embodied emissions at the country level. See Sato,M.(forthcoming).Embodied carbon in trade:A survey of the empirical literature. Journal of Economic Surveys. Currently available as working paper Sato, M. April 2012. Embodied carbon in trade: a survey of the empirical literature. Working Paper, Grantham Research Institute, London, UK. http://www2.lse.ac.uk/GranthamInstitute/publications/WorkingPapers/Abstracts/70-79/embodied-carbon-in-trade.aspx	Accepted. We recognise the variation in results due to uncertainity by providiing ranges. Additional text has been added to present this uncertainity. This being "The key reason for increased uncertainty is that MRIO datasets combine data from large and often incoherent data sets. The uncertainties relate to issues including calibration, balancing and harmonisation, use of different time periods, different currencies, different country classifications, levels of disaggregation, inflation, and raw data errors (Lenzen et al., 2004; Peters, 2007; Weber, 2008; Lenzen et al., 2010; Peters, 2012). Many of these manipulations reflect inconsistent reporting practices in different countries and regions, and a process of harmonisation can greatly reduce the necessary manipulations, and hence, uncertainties (Peters and Solli, 2010; Barrett et al, 2013)." I have not used the references suggested as we are advised to draw conclusions from published peer-review literature. There is a deadline for inclusion of the end of 2013.
23880	5	41	9	41	12	Some statistics to confirm these statements here would be useful	Noted. Agreed but could not find a peer-reviewed publication therefore we have presented the data.
27547	5	42	10	42	10	The reference "Change and Development, 2000" is unclear.	Accepted. This was a mistake, reference has been deleted.
23884	5	42	12			This Lenzen study is national, and not global?	Accepted. Text has been changed to "Lenzen et al (2012) confirms..."
36543	5	42	16	42	18	The statement "less than 100% offset by" is not clear.	Accepted. Agreed. Sentence has been changed to "in all these cases the increase in final demand was greater than the emission reduction caused by structural change and efficiency improvements, leading to an overall in consumption-related emissions."

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36544	5	42	18	42	21	As discussed in this section, energy intensity depends on more than just behavior. Perhaps this could be word to say that energy intensity, which is influenced by behaviour,....	Rejected. The term "behaviour" is not used in this sentence.
21673	5	42	24	42	35	This section needs to make clear what definition of carbon leakage is used to understand the % changes given. Are these output changes for particular sectors compared with business as usual.	Rejected. The leakage rate is defined in this paragraph (p.42, l.28): "...rates of leakage (i.e. the fraction of unilateral emission reductions that are offset by increases in other regions".
23885	5	42	24	42	35	This is introducing a new type of carbon leakage, and may confuse some readers. I would make it very clear that strong leakage is a subset of strong leakage and explain clearly how they are differently defined. This relates to my earlier comment on the box about very clear definitions to avoid confusion.	Agree. We have added the following: "In particular, it [emissions embodied in trade] doesn't allow identifying which fraction of observed changes in regional emissions can be attributed to regulatory changes, such as adoption of climate measures, undertaken elsewhere (this is often called 'strong carbon leakage' in the literature).
30092	5	42	24	42	35	Since the AR4, several papers have analysed carbon leakage using more empirically-based methods, and find statistically significant positive effects, but much smaller in magnitude relateive to modelling studies. E.g. Aldy, J. E. & Pizer, W. A. (2011). The competitiveness impacts of climate change mitigation policies. NBER Working Papers 17705, National Bureau of Economic Research, Inc. Available from: http://www.nber.org/papers/w17705.pdf.; Gerlagh, R. & Mathys, N. A. (2011). Energy abundance, trade and industry location. Nota di Lavoro 003.2011, Fondazione Eni Enrico Mattei, Milan. Available from: http://www.feem.it/ userfiles/attach/20111171430134NDL2011- 003.pdf.; Michielsen, T. O. (2013). The distribution of energy-intensive sectors in the USA. Journal of Economic Geography. Available from: http://joeg.oxfordjournals.org/content/early/2013/01/15/ jeg.lbs045. and Sato and Dechezlepretre (2013) Asymmetric industrial energy prices and international trade; Grantham Research Institute on Climate Change and the Environment Working Paper	Rejected. With the exception of the study by Michielsen (2013), none of the mentioned papers has been published in a peer-reviewed journal. Hence, they cannot be included in the chapter. Michielsen (2013) focuses on how endowments with energy resources affect industry location in the US. These results are relevant for climate policy making; yet, they cannot directly be transferred in order to derive conclusions with regard to leakage.
36545	5	42	28	42	29	The phrase in parentheses, "i.e. which fraction of unilateral emission reductions are set off by increases in other regions" should be changed to "i.e. the fraction of unilateral emission reductions that are offset by increases in other regions."	Accepted. Has been changed - thank you.
33679	5	42	3			… sectors, and spur the invention…	Page 42, line 3 does not mention sectors.
40597	5	42	30	42	35	The estimated value of carbon leakage, 5-19%, is a important description to picture the current situation of carbon embedding trading. Therefore, this sentence should not be deleted, and have to be cited in SPM and TS.	Accepted and changed

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30532	5	42	33	42	35	while the reference for numerical modeling to the 12-model comparison in Böhringer et al., 2012, correctly states the range of leakage with 5 to 19%, in the very same journal issue it is also shown that the consistent neglect of industrial process emissions implies a significant downward bias of these numerical quantifications of leakage by means of CGE models so far: industrial process emissions only account for 10% of global GHG emissions, but in those sectors simultanously trade exposed and energy intensive they often account for the dominat share of GHG emissions. Therefore they are highly relevant in leakage quantification. Nevertheless, basically all multiregional CGE quantifications only cover combustion emissions (as only these are covered in IEA and thus GTAP GHG emission data, for example). In particular Bednar-Friedl et al., 2012, show that acknowledging industrial process emissions raises the leakage ratio by a third (and equally important: raises the effectiveness of carbon border adjustment measures from a mere 25% leakage reduction to one reducing two thirds of leakage). To acknolwedge this, the last sentence in this paragraph could be extended by something like: "[...] with a mean value of 12%, but showing significantly higher then these leakage rates when industrial process emissions are correctly accounted for (Bednar-Friedl et al, 2012)". Reference: Bednar-Friedl, B., Schinko, T., Steininger, K.W. (2012), The relevance of process emissions for carbon leakage: A comparison of unilateral climate policy options with and without border carbon adjustment , Energy Economics 34, Supplement 2: S 168-S180, http://dx.doi.org/10.1016/j.eneco.2012.08.038	Accepted. The following sentence has been added: "However, taking into account (non-energy related) industrial process emissions, which are not included in the latter model comparison, may result in higher leakage rates, as some of the most energy- as well as trade-intensive sectors are also important sources of industrial process emissions (Bednar-Friedel et al. 2012 find that accounting for industrial process emissions raises the leakage rate by one third)."
36546	5	42	33	42	35	"A recent model comparison of 12 computable general equilibrium models (Boehringer et al., 2012) finds leakage rates between 5% and 19%, with a mean value of 12%" should be made into a stand-alone sentence to underscore that this is more recent work -- as opposed to Babiker (2005) cited above which is much older and assumes increasing returns to scale.	Accepted. Has been changed to "However, it has also been pointed out that for most industries energy accounts for only a small fraction of total costs and that therefore leakage should not be expected to render unilateral climate policies grossly ineffective (Hourcade et al., 2008)., This is confirmed byand a recent model comparison of 12 computable general equilibrium models (Boehringer et al., 2012) finds leakage rates between 5% and 19%, with a mean value of 12%". Thank you.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
22314	5	42	42	43	9	These paragraphs show an uncritical acceptance of the neoliberal conceptualization of the productivity and economic impacts of trade liberalization, even though such paradigm is not universally accepted and whose fundamental assumptions, in fact, have been debunked both by well-known academics and international organizations. The paragraphs should hence be reworded to present a more balanced perspective by highlighting that inappropriate, undue, or overly hasty trade liberalization could result in increased welfare and productivity losses especially in developing countries, particularly in situations in which the trading partners are of unequal economic strength. For references, see inter alia UNCTAD, Trade Development Report 1981-2011: Three Decades of Development Thinking (UNCTAD/GDS/2012/1, April 2012, at http://unctad.org/en/PublicationsLibrary/gds2012d1_en.pdf), pp. 22-25, which provides a concise critique taken from various UNCTAD Trade and Development Reports (from the 1990s to the 2000s) of the neoliberal trade liberalization paradigm on the basis of the empirically-shown shortfalls of the paradigm as applied in the real world; Joseph Stiglitz, Social Justice and Global Trade, Far Eastern Economic Review (March 2006, Vol 169:2, at http://www.globalpolicy.org/images/pdfs/0306stiglitzjustice.pdf); Joseph Stiglitz, Globalization and Its Discontents (2002); Yilmaz Akyuz, Trade, Growth and Industrialisation: Issues, Experiences and Policy Challenges (TWN Trade and Development Series No. 28, 2005, at http://twnside.org.sg/title2/t&d/tnd28.pdf); Mehdi Shaffaedin, Trade liberalization, industrialization and development: experience of recent decades (MPRA Paper No. 26355, April 2010, at http://mpra.ub.uni-muenchen.de/26355/1/MPRA_paper_26355.pdf)	Noted. The section reports on the gap between consumption and production based emissions and does not take a view on trade as a good or bad activity, merely as the necessary activity to link production to consumption.
34053	5	42	45	42	47	add citations to support how trade affects productivity.	Accepted - reference added.
23879	5	42	5			Peters et al 2011b would say 20-26%, not 23-24.	Accepted and changed. Thank you
23883	5	42	9			I would change "is defined" to "is often defined"	Accepted and changed. Thank you
31404	5	42				Although the focus is on trade and productivity this section should also mention the contribution of increased trade to increased transport emissions. Or refer to another relevant section discussing this.	Accepted - included a mention of trade-induced emission increases because of transport.
23886	5	43	1	43	4	http://www.ingentaconnect.com/content/els/00221996/2001/00000054/00000001/art00093	Accepted - reference added.
23887	5	43	1	43	4	A relevant refer for this section is http://www.sciencedirect.com/science/article/pii/S0022199600000933. Also recent work such as by Koopmans et al, e.g., http://www.nber.org/papers/w14109	Accepted - references added.
34054	5	43	1	43	2	Citation for this that trade allows for production of higher quality final products required.	Accepted - reference added.
32169	5	43	11	43	11	What is FDI ?	Accepted - FDI abbreviation has been explained.
27548	5	43	11	43	11	The abbreviation FDI is not explained, but should be done.	Accepted - FDI abbreviation has been explained.
34056	5	43	14	43	15	What incentive do foreign entrants have to share their knowledge with domestic suppliers and customers? This should be stated here apart from providing the citation.	Accepted - added a substances that explains the mechanism why foreign entrants want to share knowledge with suppliers and customers.
36547	5	43	43	48		This entire section would make more sense in the beginning, as this actually described consumption emissions, whereas text in beginning does not; it rather goes right into the overly complex analysis without setting the stage or even defining the relevant terms. Move this section up to replace or better explain sec 5.3.1.	Noted. I entirely agree. However, I have little say over the structure and your suggestion was requested but the plenary has the final say. Due to such limited word allowance to this section it is difficult not to state with the analysis.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36548	5	43	45	44	14	This explains how a method is used to allocate consumption and territorial emissions but it does not explain how that the method derives those respective emissions. More explanation of how these estimates are derived is needed, especially as this graphic is included in the SPM and TS.	Accepted. I have extended the definition of consumption-based emissions which now includes a description of the methodology. This can be found in Box 5.1
34055	5	43	8	43	9	Not very clear how trade liberalisation affects R&D incentives as the statement says increase (decrease) - the bracketed decrease should be explained?	Accepted - clarified the incremental effect of trade liberalization in import-competing sectors through dynamic R&D incentives, and explained the mechanism with additional reference.
40598	5	43				This chapter describes trading can enhance the technological progress of developing countories, and thus environmental improvement. However, there are no summary of this chapter. So, please make a summary of this chapter and cite it to TS.	Noted. We do cite this section in the ES. We will propose to include it the TS.
33680	5	43				Please be clear when referring to GHG and when to (fossil-fuel related) CO2 only, in text and figures.	Accepted. CO2 data has been used because the models have considerable uncertainity surrounding the non-GHG emissions. The term ~CO2" clearly only inlcudes CO2 emissions and therefore further text was not deemed important.
29370	5	43				Please be clear when referring to GHG and when to (fossil-fuel related) CO2 only, in text and figures.	Accepted. CO2 data has been used because the models have considerable uncertainity surrounding the non-GHG emissions. The term ~CO2" clearly only inlcudes CO2 emissions and therefore further text was not deemed important.
40600	5	44	12	44	14	Apart from the carbon leakage, developing countries should enjoy the economical benefits, and also technological progress as discussed in chapter 5.4.2. Therefore, the description of this sentence seems to be a little single sided.	Noted. It is not the aim of the section to decide who the beneficaries of production and consumption systems but to show the trends in consumption and production emissions.
36549	5	44	15			IThe legends are incorrect: fix reference to meaning of red lines and blue dotted lines. Please correct.	Rejected. Checked and legend is correct.
36550	5	44	15			The text above this graphic (starting on page 43, line 46) refer to this Box and then cites GHG emission estimates from Annex B (not in graphic) from (Peters et al., 2011a) and (Wiedmann et al., 2010). However, the legend for the graphic cites Lenzen et al. (2010). Are the percentage estimates from Peters and Wiedmann reflected in the graphic? If so, please make this explicit.	Rejected. No they are not. We had to decide which dataset to use and we can only select one for the figure. Therefore we selected the Eora database (Lenzen et al, 2010) for the figure but also wanted to include the findings from other studies in the narrative.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36551	5	44	15			There is nothing here in the definition or related text that explains if this graphic is just energy CO2 or all inclusive (energy is only 60% of global emissions). It is not clear if LULUCF emissions from food production, for example, are in/excluded. All emissions (not just energy) should be included but if not this must be explicit. Is this full lifecycle analysis or not? Be explicit.	Accepted. It is not just CO2 related to the energy sector but total CO2 emissions. This is clear in the text where it refers to CO2 emissions.
36552	5	44	15			Uncertainty of these estimates should be included (currently not broached at all). Is this an accepted IPCC approach?The relative efficiency of goods produced in one region of the world vs another should also be provided. What quantity of emissions are associated with the production of a good in an OECD90 country, compared with the production of the equivalent good in Asia, combined with the emissions in the packing and shipment of this good to the OECD90 country in question?	Noted. The data used is taken from MRIO models that provide a complete supply chain assessment. A discussion of the carbon intensity of goods and servcies is included in the chapter and makes reference to research by Davis et al to make this point.
29372	5	44	16	44	19	Add: ") CO2 emissions ..". Replace in line 19: GHG by CO2.	Accepted and changed
23594	5	44	16	44	16	Figure caption replace "Territorial (blue lines) versus consumption-based (red dotted lines) CO2 emissions" by "Territorial (blue dotted lines) versus consumption-based (red lines) CO2 emissions"	Rejected. I've checked the figure and the lines are correctly assigned.
27549	5	44	16	44	16	The description of the figure is not correct, as the blue lines are dotted, not the red ones.	Accepted. Thank you. Have updated the text below the figure.
23888	5	44	2			Where is the 5% from? In Peters et al 2008 it is about 7% and in Peters et al 2010 it is about 1%. It is important to note that for any numbers going to 2010 are greatly affected by the Global Financial Crisis. It is worth mentioning this and checking the results	The data is taken from your paper in PNAS. The figure in the supplementary information suggestes that consumption-based Annex B emissions in 1990 were 3960 MtC and in 2010 they werev 4147 MtC. I make this a 5% increase.
25456	5	44	21	44	23	Add the following literature. T. Homma, K. Akimoto and T. Tomoda, Quantitative evaluation of time-series GHG emissions by sector and region using consumption-based accounting, Energy Policy 51, 816-827 (2012).	rejected. I am happy that the current literautre supports the arguments.
23890	5	44	23			Minx et al is a relevant reference here http://pubs.acs.org/doi/abs/10.1021/es201497m	Accpeted and now included.
23889	5	44	24			"per value added" should be "per output"?	Accepted and changed. Thank you
23891	5	44	25			Would the "most of these studies" really be "all of these studies"?	Accepted. Correct. Changed. Thank you
33681	5	44	3		3	Add after "territorial": fossil-fuel related CO2. Add in this section that this analysis captures about 2/3 of all GHG emissions: only fossil-fuel related CO2 emissions and that relative shares and trends will be different when includes CO2 from LULUCF and non-CO2 sources.	Accepted and updated in the description of the chart.
29371	5	44	3		3	Add after "territorial": fossil-fuel related CO2. Add in this section that this analysis captures about 2/3 of all GHG emissions: only fossil-fuel related CO2 emissions and that relative shares and trends will be different when includes CO2 from LULUCF and non-CO2 sources.	Accepted and updated in the description of the chart.
40599	5	44	9	44	11	Section 5.4.1.estimates the 5-19% of emission is embedded in the trading. Therefore, please cite this part and evaluate quantitatively.	Rejected. This figure is an estimate of carbon leakage rates and not the total emissions embodied in trade. This figure is reported earlier in the section with the estimate of 20 - 26% and referenced to work undertaken by Peters.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36553	5	45	1	45	1	This section doesnt provide a balanced view of the Rebound Effect. It mostly presents the case of a high rebound effect. Not much discussion is given for the arguments that a low rebound effect exists. Please provide a more balanced discussion of the reound effect.	Rejected. I strongly disagree. The section does not take a personal view of the level of rebound but reports the evidence from peer-reviewed literature. The full range is shown relying on papers that have reviewed over 550 papers. This shoes a range of 10 - 30%.
23892	5	45	12			"We call these"? Perhaps change language	Accpeted. Agreed. This has been updated.
30093	5	45	14	45	20	More recent reviews e.g. Wiedmann, T., Wilting, H. C., Lenzen, M., Lutter, & Palm, V. (2011). Quo vadis MRIO? methodological, data and institutional requirements for multi-region input-output analysis. Eco- logical Economics, 70(11), 1937–1945. and Sato,M.(forthcoming).Embodiedcarbonintrade:Asurveyoftheempiricalliterature.Journal of Economic Surveys. Currently available as working paper Sato, M. April 2012. Embodied carbon in trade: a survey of the empirical literature. Working Paper, Grantham Research Institute, London, UK. http://www2.lse.ac.uk/GranthamInstitute/publications/WorkingPapers/Abstracts/70-79/embodied-carbon-in-trade.aspx highlight also the issues around uncertainty, which explains why consumption-based approaches have not yet been adopted seriously into policy making	Accepted. Peer-reviewed publications mentioned in the comment have now been included.
25457	5	45	17	45	20	Large uncertainties of the consumption-based emissions, compared to the territorial-based, should be mentioned. This is an important issue.	Accepted. Agreed. The following text has been included, "The methodology employed is predominately “Multi-Regional Input-Output Analysis” (MRIO). The key reason for increased uncertainty is that MRIO datasets combine data from large and often incoherent data sets. The uncertainties relate to issues including calibration, balancing and harmonisation, use of different time periods, different currencies, different country classifications, levels of disaggregation, inflation, and raw data errors (Lenzen et al., 2004; Peters, 2007; Weber, 2008; Lenzen et al., 2010; Peters, 2012). Many of these manipulations reflect inconsistent reporting practices in different countries and regions, and a process of harmonisation can greatly reduce the necessary manipulations, and hence, uncertainties (Peters and Solli, 2010; Barrett et al, 2013)."

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
23893	5	45	17			"We call these"? Perhaps change language	Accepted. Agreed. This has been changed.
23894	5	45	17			Perhaps say "emissions from the produciton of exports" instead of just "exports", etc	Accepted. Thanks for the suggestion. This has been changed.
23895	5	45	18			Is the reporting by DEFRA in the UK official? Perhaps worth mentioning somehow?	Accepted. This line has now been deleted.
31405	5	45	21	45	27	This is a good paragraph and should also be included in the SPM which it is not as far as we can see.	Noted. Couldn't agree more!
34057	5	45	24	45	26	It would be useful to state here the actual rate of consumption emissions growth per 1% growth of increase of GDP per capita as done earlier to show the relative decoupling in OECD countries when comparing territorial emissions with GDP/capita. (line 22-24)	Noted. The following sentence covers this issue "Calculating emissions based on a consumption-based approach sketches a more negative view on the decoupling of economic growth from greenhouse gas emissions. According to York (2007), territorial emissions showed a relative decoupling; emissions grew by 0.73% for every 1% increase in GDP per capita from 1960 to 2008."
23526	5	45	31	45	31	add "social groups" behind regions? This is equally relevant for varying emissions in relation to behaviour	Accepted. Inserted "social groups"
24247	5	45	39			When stating that "Consumption patterns are shaped…" it should also be recognized that these decisions are determined by market supply, i.e. what is available or perceived as available - which is also confirmed on p. 48, line 13-17, and on p. 57, line 23.	Noted. No change made though since it is already considered later on in the section
36555	5	45	4			Box 5.2: Move this to earlier in the chapter.. The term is first used on page 14.	Accepted. This has been updated because as this statement should have linked to Box 5.1.
23897	5	45	40			"strong" needs a reference	Noted - text modified and examples follow with references
36557	5	45	40	45	41	"...non–economic factors such as behaviour" should be rephrased as "non–economic behavioral factors".	Reject. Text modified
36556	5	45	40	45	42	Although there may be factors other than those included in neoclassical theory that influence behavior, behavior is not a "non-economic factor". Economics is a behavioral science that seeks to explain how people make decisions based on their incentives and operating within resource constraints.	Noted. Text modified
25318	5	45	41	46	7	Reference needs to be made to GEA (2012) Chapter 21 and also of Roy Joyashree and S. Pal (2009), Lifestyle and climate Change: Link awaiting activation, Current Opinion in Environmental Sustainability, 1:192–200	Noted. Text inserted
23527	5	45	42	45	43	Consumption of other goods and services (i.e. related to indirect emissions) are also highly related to identity, status and norms. Line 41 - in which sense is behaviour a non-economic factor - do you mean status, identity, norms here?	Noted. Text modified

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
23529	5	45	46	46	7	This paragraph sounds a little confusing to me - should two issues be distinguished here: 1) socially constituted values always shape practices (but this includes intrinsic and extrinsic values) 2) There is evidence that intrinsic values are related to pro-environmental behaviours, more so than extrinsic values (e.g. Osbaldiston, R. & Sheldon, K.M., 2003. Promoting internalized motivation for environmentally responsible behavior: A prospective study of environmental goals. Journal of Environmental Psychology, 23 (4), 349-357; Guagnano, G.A., 2001. Altruism and market-like behavior: An analysis of willingness to pay for recycled paper products. Population and Environment, 22 (4), 425-438).	Noted. Text modified
23528	5	45	47	45	47	"values imbibed by people" - this is an outdated way of conceptualising values - values are not just internalised but constituted and transformed through social interaction, e.g. see Hards, S., 2011. Social practice and the evolution of personal environmental values. Environmental Values, 20 (1), 23-42;	Noted. Text modified
36554	5	45	4	45	20	At the end of this sentence, consider adding a reference to "the significant carbon monoxide and other environmental benefits that resulted from China's large-scale cookstove replacement program (Brown and Sovacool, 2011)." Climate Change and Global Energy Security: Technology and Policy Options, M. A. Brown and B. K. Sovacool. MIT Press, 2011.	Rejected. The focus on this section is trends in consumption based emissions and trade and therefore we have limited space to discuss other environmental issues such as carbon monoxide.
21674	5	45	15	48	36	This section is incomplete and misses references to changes other than energy such as changing food and transportation habits. See for example, Faber et al.: "Behavioural climate change mitigation options and their appropriate inclusion in quantitative longer-term policy scenarios", Main Report, CE Delft, April 2012. Available at: http://ec.europa.eu/clima/policies/roadmap/docs/main_report_en.pdf	Accepted - references added
19691	5	45	28	48	48	It would be also worth mentioning the increasing literature on agent-based modelling approaches to climate mitigation in explaining behaviour and offering as well interesting policy insights in addition to behavioural economics. Examples of ABMs with application to climate change are: Windrum P, Fagiolo G, Moneta A. Empirical validation of agent-based models: alternatives and prospects. J Artif Soc Soc Simul 2007, 10:8; OR Beckenbach F, Briegel R. Multi-agent modeling of economic innovation dynamics and its implications for analyzing emission impacts. Int Econ Econ Policy 2010, 7:317–341; OR Janssen M, de Vries B. The battle of perspectives: a multi-agent model with adaptive responses to climate change. Ecol Econ 1998, 26:43–65.	Rejected. This section does not focus on approaches/methodologies, but on whether behaviour influences emissions and how it can be used to bring about change
23896	5	45				This section really needs some quantification. I would have thought that a strong message in the literature is that emissions are primarily driven by income, with behavioural aspects representing a second order effect. It is worth a few references at the start and a clarification of this point. Even if behaviour is important, it would be misleading if a policy maker thought that this was the most important aspect.	Reject. There is uncertainty on exactly how important income and behavioural aspects are - difficult to quantify
36562	5	46	11	46	11	The authors should rephrase to something along the lines of "Disparities in energy consumption" if this is what's meant.	Noted. Sentence deleted
36563	5	46	15	46	15	Add a reference after Dhakal, 2009, to Sovacool and Brown (2009) which corroborates this conclusion.	Accepted - already included
36564	5	46	24	46	24	According to (http://www.aceee.org/blog/2012/08/rebound-effect-real-not-very-large), direct rebounds are LESS than 10%.	Reject. Grey literature - other studies do indicate that rebounds can be fairly large
36558	5	46	3	46	7	Please add a citation for the sentence "emissions per unit of food…"	Accepted. Citation added
33682	5	46	31			… climate change policy measures, and …	Accepted. Editorial change made.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36565	5	46	33	49	48	Please cross reference with Chapter 3 as there is overlap. Please reconcile with that chapter, which may include deletion or abbreviation of the coverage on behaviour here.	Noted. Final version of ch3 may be compared for overlaps & suggested additions/deletions - request CLA intervention.
23530	5	46	34	47	15	Perhaps also refer to sociological accounts of practice change which provide a more comprehensive account of the socio-technical co-constitution of practices and practice change, e.g. Shove, E., Pantzar, M. & Watson, M., 2012. The dynamics of social practice. Everyday life and how it changes London: Sage; Spaargaren, G., 2004. Sustainable consumption: A theoretical and environmental policy perspective. In Southerton, D., Chappels, H. & Van Vliet, B. eds. Sustainable consumption: The implications of changing infrastructures of provision. Cheltenham: Edward Elgar, 15-31.	Noted. Reference used to add text in following section.
30845	5	46	34			It is unusual for IPCC reports to have a sub-header listed in question form.	Accepted. Reworded to "Factors driving change in behaviour"
23901	5	46	35	46	42	But do you put forward a "theory of behaviour"? Or just say there needs to be one? Some references are needed.	Noted. Sentence deleted.
36559	5	46	4	46	7	If the intent of the paragraph is to talk about non-economic behavioral factors, then this last sentence should deleted or moved somewhere else; this is economic behavior.	Noted. Reworded to explain the link with cultural factors
36566	5	46	40	46	40	In addition to "findings from psychology" add "and other factors such as "asymmetric information".	Reject. Original sentence deleted due to modification in text.
36567	5	46	43	46	45	The energy efficiency gap is not a common finding in economics, but of bottom-up type engineering studies. The economics literature has questioned the existence of such a gap. Suggested citation: Allcott, Hunt, and Michael Greenstone (2012). “Is There an Energy Efficiency Gap?” Journal of Economic Perspectives, Vol. 26, No. 1 (Winter), pages 3-28.	Accepted. Text modified based on suggested citation.
23898	5	46	5			I am not sure why poor people are "inherently frugal". I would argue the frugality is because of a lack of money, and if these some people had high income over a sustained period they may not be frugal at all. If you keep this text, a reference is certainly needed.	Accepted. Reworded and referenced.
23899	5	46	5	46	7	Do they have low waste (output) relative to input, or they have low waste because they have low input? I am not sure if this is the reason for low energy use. In some western countries the waste recycling will be very high but energy consumption very high. This is an income factor.	Noted. Reworded to explain as per comment earlier as well
36560	5	46	5	46	7	This is an unsubstantiated and unprofessional statement about specific groups of people. Please delete it.	Rejected. Reworded to clarify.
23900	5	46	8	46	23	Some quantification is needed here. How important are other factors relative to income.	Reject. Not possible to quantify and rank factors according to relative importance.
34059	5	46	8	46	12	Unclear how the 2 figures referred to support the statement that GDP per capita is not the only factor causing significant differences in CO2/ capita and CO2/unit economic activity as figure 5.3.2 shows decomposition of territorial and consumption emissions for 2 regions (Asia and OECD) and figure 5.5.1 shows total and per capita consumption and territorial emissions for the 5 regions generally used generally in this report. Further explanation of how these 2 figures support this assertion is required here.	Noted. Reference to figures moved out of the behavour section
36561	5	46	8	46	23	We suggest rewriting paragraph to more directly make a point.	Noted.
25977	5	46	34			What drives change in behaviour?- this text should reach a conclusion or, at least, pinpoint a few leading drivers that affect consumption and climate change	Accepted. Heading changed to "Factors affecting change in behaviour". Some text modificatons included/references added
19845	5	47	1		15	This would be a good place to refer to some of the concepts in Chapter 2.	Noted.
23903	5	47	36			I would have thought of behavioural measures as those that were not "forced". A standard is forced (you have no choice), and so are they really behavioural measures?	Noted. Non-price intervention influencing behavior

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
33683	5	47	5			… psychology and behavioral economics come notions …	Accepted. Editorial change made.
24248	5	47	37			Here and repeatedly in the chapter, the need and opportunity for new models which can distribute cost & benefits among stakeholders and over time is evident. This should be highlighted and preferably elaborated with research findings and successful examples. This perspective is also highly relevant, and addressed, in Chapter 16, which should be pointed out.	Noted.
23902	5	47				Is there any literature that compares efficiency of behavioural measures with standard economic measures (like taxes)? Is the policy maker better to use taxes or behavioural measures or both?	Noted. Literature is inconclusive on extent to which something can be achieved though there is mention of relevance of both
23531	5	48	13	48	17	This means that interventions may also need to address infrastructures to achieve more effective behaviour change	Noted. Yes, no change made
29532	5	48	22			This sentence is misleading "However, energy-efficient appliances do not necessarily result in a reduction of overall energy consumption due to increased use of these appliances, i.e. the "rebound effect"." Rebound is a minor phenomenon that affects some enduses, but this sentence makes it sound like rebound is pervasive and that it can wipe out all energy savings from efficiency measures, but there is absolutely no empirical evidence for such a statement.	Noted. Reworded text
30164	5	48	22	48	25	These statements imply that rebound effects from efficient appliances are greater than 100%, but there is limited evidence for this interpretation. Text revision: However, energy-efficient appliances may lead to an increase in energy service demand due to the lower cost of these services, i.e. the "rebound effect". The rebound effect may partially offset emissions savings from energy efficient appliances, as discussed in section 5.6."	Noted. Reworded text as above
36571	5	48	26	48	29	"Many consumption oriented environmental studies suggest…" is stated yet only one study is cited in this paragraph. This is a strong assertion that needs more citations to substantiate it.	Accepted. Additional references added & reworded to " consumption oriented environmental studies"
36572	5	48	26	48	36	There is a change of tone in this paragraph from the rest of section 5.5.2.3; it moves from positive to normative territory and introduces some value judgments that may not be univerally shared, e.g. lines 31-33.	Noted. Text modified /moved within section
36568	5	48	3	48	12	information provision and behavioral nudges have been found to be cost-effective when compared to more conventioanl abatement technologies. Citation suggested: Allcott, Hunt, and Sendhil Mullainathan (2010). "Behavior and Energy Policy." Science, Vol. 327, No. 5970 (March 5), pages 1204-1205.	Noted. Reference added and text modified
35407	5	48	33		36	Zero Waste strategies propagate SD, eco-efficiency and sustainable consumption and production, so it cannot be said that such strategies are missing. Just the opposite, case studies show that the different dimensions of a SCP strategy can be found in current waste management policies in the following places: San Francisco, Buenos Aires, Guipuzcoa (Spain), Flanders, Alaminos (Phillippines), Pune and Mumbai (India). See case studies in 'On the road to zero waste. Successes and Lessons from Around the World, by GAIA Global Alliance for Incinerator Alternatives, 2012.	Noted. Text reworded to remove "missing"
35461	5	48	33		36	Zero Waste strategies propagate SD, eco-efficiency and sustainable consumption and production, so it cannot be said that such strategies are missing. Just the opposite, case studies show that the different dimensions of a SCP strategy can be found in current waste management policies in the following places: San Francisco, Buenos Aires, Guipuzcoa (Spain), Flanders, Alaminos (Phillippines), Pune and Mumbai (India). See case studies in 'On the road to zero waste. Successess and Lessons from Around the World, by GAIA Global Alliance for Incinerator Alternatives, 2012.	Noted. Text reworded to remove "missing" - comment repeated

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
29555	5	48	33		36	Zero Waste strategies propagate SCP, eco-efficiency and sustainable development so they ar enot missing. The sentence about this in the SOD should be deleted. Just the opposite, case studies show that the different dimensions of a SCP strategy can be found in current waste management policies in the following places: San Francisco, Buenos Aires, Guipuzcoa (Spain), Flanders, Alaminos (Phillippines), Pune and Mumbai (India). See case studies in 'On the road to zero waste. Successess and Lessons from Around the World, by GAIA Global Alliance for Incinerator Alternatives, 2012.	Noted. Text reworded to remove "missing" - comment repeated
26969	5	48	33		36	Zero Waste strategies propagate SD, eco-efficiency and sustainable consumption and production, so it cannot be said that such strategies are missing. Just the opposite, case studies show that the different dimensions of a SCP strategy can be found in current waste management policies in the following places: San Francisco, Buenos Aires, Guipuzcoa (Spain), Flanders, Alaminos (Phillippines), Pune and Mumbai (India). See case studies in 'On the road to zero waste. Successess and Lessons from Around the World, by GAIA Global Alliance for Incinerator Alternatives, 2012.	Noted. Text reworded to remove "missing" - comment repeated
36574	5	48	38			This seems too elementary to be included as a text box. The points are useful and could be incorporated into the main text, much earlier in the chapter.	Noted. The FAQ has been moved to an earlier position in the chapter. It remains as an FAQ, but its earlier position in the chapter produces te intended result of making it anticipatory rather than redundant.
36573	5	48	38	48	48	We suggest deleting this FAQ. It is so simplistic, that it doesnt add anything. Delete or make it more analytic and supported with citations.	Rejected (but noted). The repositioning of the FAQ gives it a different function in the chapter, and it serves now as a context-setting FAQ, rather than a conclusion. The suggested more quantitative material then follows in the individual sections that now come after the FAQ. Presenting the quantiatiev material directly in the FAQ would require the FAQ to ahctually present the detailed material in the following subsections. A quantitative forecast has been added, and the reposition nests the FAQ in the middle of hte information (and references) on which the FAQ is based.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36569	5	48	5	48	6	We disagree with the statement that "provision of information or awareness creation by itself is unlikely to bring about significant change inconsumption behaviour and redution in emissions…." Five large US cities now mandate the disclosure of energy performance data for commercial buildings, based on evidence that such programs could transform real estate markets. Benchmarking the energy consumption of homes and commercial buildings has the potential to reduce information asymmetries in the marketplace and to lower the discount rates used by consumers in the sector. Providing information addresses a barrier to the deployment of energy-efficient technologies that other approaches cannot. Studies have found that providing information can reduce discount rates anywhere from 3% to 22%. Coller and Williams (1999) suggest that information about energy consumption will result in a 5% decline in discount rates for energy decisions made by the median population, an estimate that is adopted by Cox, Brown, and Sun (2012)." Cox, Matt, Marilyn A. Brown, and Xiaojing Sun. 2012. "Making Buildings Part of the Climate Solution by Overcoming Information Gaps through Benchmarking," Georgia Institute of Technology, School of Public Policy Working Paper #72 (http://www.spp.gatech.edu/aboutus/workingpapers). examples also those from US EPA: TRI, US GHGRP	Accepted. Reworded to bring in the difference of opinion.
36570	5	48	5	48	6	There is a general lack of illustration from the manufacturing literature in this chapter, about organizational decision-making, market failures and co-benefits from energy efficiency improvements. Add the following to the end of this sentence: ", and the addition of sensors and process controls to improve industrial energy efficiency can also cut O&M costs, lead to better products, and minimize waste and water consumption (Brown, et al., 2013)." Marilyn A. Brown, Paul Baer, Matt Cox, and Yeong Jae Kim. 2013. "Evaluating the Risks of Alternative Energy Policies: A Case Study of Industrial Energy Efficiency," Forthcoming in Energy Efficiency.	Reject. Cited literature does not fit in to make the point clearly
22571	5	49	19	49	28	The IPCC´s SREEN provides a clear overview about this subject - chapter 1 and 10 provide in depth analysis about the possible contribution of technological change to mitigation. This reference and information must be added to this paragraph and must be added throughout the entire chapter.	Reject, after checking the SRREN, it turns out almost all of the work cited is forward-looking and therefore relatively speculative. This chapter only looks at historical evidence of the impact of technological change on (factors and) emissions.
30846	5	49	29			It is unusual for IPCC reports to have a sub-header listed in question form.	Accept, but since the section does not give an unambiguous answer to the question, will keep the title as it is. IPCC reports do not explicitly avoid having questions in paragraph titles.
29533	5	49	32			More incorrect statements on rebound: "According to some studies, due to a combination of rebound effects (see section 5.6.2) and an observed bias in R&D investments towards more cost- effective energy savings, which is the mitigation option that contributes to the rebound effect, the result of technological change could be an increase in emissions (Fisher-Vanden and Ho, 2010)." This statement implies that this is a pervasive phenomenon when it is a minor one that affects some end-uses. Gillingham, Kenneth, Matthew J. Kotchen, David S. Rapson, and Gernot Wagner. 2013. "Energy policy: The rebound effect is overplayed." Nature. vol. 493, no. 7433. 01/24/print. pp. 475-476. [http://dx.doi.org/10.1038/493475a]	Accept, the statement is too strong, will adjust it. Section 5.6.2 on the Rebound effect will take into account the new reference.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
19692	5	49	29	50	10	It is important to add in this section the observation from the economic modelling of climate change mitigation literature that technological change has the potential to contribute to lower emissions and push down mitigation costs if low-carbon technologies are endogenously modelled, crowding-out restrictive assumptions relaxed and a significant policy instruments affecting induced technological change simultaneously considered - see for example the discussion in Scrieciu, S., Barker, T. and F. Ackerman (2013) “Pushing the Boundaries of Climate Change Economics: Critical issues to consider in climate policy analysis” Ecological Economics (New Climate Economics) vol.85: 155-165	Reject. The point is fair but this chapter is supposed to report on historical trends and drivers and not about modelling the future. The comment is probably taken up by chapter 6.
21656	5	5	1	5	3	The importance of consumption-based emissions needs to be quantified, at least for Annex I and non-Annex I countries (or provided as a range for groups of countries). Otherwise, the interpretation of the role of consumption is left open.	Rejected. I am not sure how the importance can be quantified.
21657	5	5	10	5	23	The mix of time periods in this paragraph makes it difficult to follow. The historical comments could be removed as they are less relevant.	Taken into account: clarity about time spans was incorporated
21658	5	5	15	5	17	This statement is valid for the globe only. In the EU, the Kyoto Protocol has changed the drivers and trends regionally. Future policies could expand this protocol globally.	Noted
23849	5	5	15	5	16	"Fast economic growth leads to higher turnover". What do you mean, that capital stock is retired before its standard end of life? Fast economic growth could also be spend on consumption, or is it only ever spent on investments?	Accepted: Agree that this terminology is bad. The idea is that when the capital stock is growing fast its average age will be younger. Fast economic growth is driven by technological change and associated capital investment. Growth of GDP should be correlated with growth of the capital stock. This issue no longer seems to be discussed in the main text and therefore this comment sould be dropped from the ES.
36341	5	5	15	5	17	"Fast economic growth leads to a higher turnover of the capital stock, offering opportunities to switch to more energy-efficient technologies (low to medium confidence)." This statement carries several different claims -which ones is the confidence low in? Please clarify.	Accepted: This issue no longer seems to be discussed in the main text and therefore this comment will be dropped from the ES.
40569	5	5	15	5	17	The large improvement of energy efficiency of emerging country is large, here, please describe the effect of technology transfer from developed countries, which was one of the main topics of IPCC AR4. UNFCCC reports that ratio of CDM with energy transfer is obviously decreasing for energing countries. (UNFCCC, P27, Benefits of the Clean Development Mechanism 2012 (2012))	Reject. There is no evidence in the literature that the technology transfer in the CDM has a discernable impact on the overall energy efficiency of emerging countries.
21659	5	5	17	5	19	The shift in fuel mix from coal to oil/gas has been reversed since 2000 and is now the highest since 1966. It is important to highlight the trend over the past few decades.	Accepted: Propose (see response to review editor)
21660	5	5	28	5	29	Please clarify this statement. The processes mentioned are key in contrast to what?	Taken into account: The process mentioned are key underlying drivers of emissions trends. The language was improved to make it clearer.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
23850	5	5	30			"Technological change drives overall economic growth", but earlier (page 4) it is written "innovation and investments are among the key long term drivers of economic growth". So what is it?	Taken into account - the text of the Executive Summary has changed such that the inconsistency is resolved
31393	5	5	31	5	32	We do not see that there is necessarily a link between increased labour productivity and increased emissions.	Agreed. We rephrase the sentence in the Final Draft.
29165	5	5	32	5	34	Emphasis on the rebound effect in the executive summary seems more than seems appropriate given the coverage in the rest of the chapter.	Accepted. The ES has been completely revised and the rebound is referred to more clearly.
36342	5	5	33	5	35	This is one of many mentions of the rebound effect in this chapter where the text implies that GHG-reducing benefits of technological innovations may be offset by the rebound effect. The text should be more careful to indicate that GHG-reducing benefits could be partially offset and to provide citations indicating the quantitative size of this effect.	Rejected. This is exaclty what the section has done. Numerous studies are quoted that demosntrate the scale fo rebounds from over 550 studies.
23851	5	5	34			"may be partially or completely offset by the rebound effect". The way it is worded now seems that the rebound effect offsets all gains.	Accepted. The text in ES is revised: "Innovations that potentially decrease emissions can lead to more intensive use of resources, diminishing the potential gains from increased efficiency, a phenomenon called the “rebound effect”"
33654	5	5	36			… after the 1970s, …	Taken into account: language was improved to make the sentence clearer.
23848	5	5	4	5	9	Trade, theoretically, leads to a more effecient allocation of resources. Carbon is not one of those resources, and so whether trade is good or bad for climate will depend on whether the efficient producers have carbon intensive production or not. Transport will probably be minor, particularly for most manufactured products.	Accepted. We have included the mechanism referred to in the revision.
21661	5	5	40	5	47	It is important to include some information on the role of behaviour for mitigation, at least in the form of an informed guess or an upper bound otherwise this paragraph reads like everything is possible just by changing behaviour.	Accepted. The text is thoroughly revised and describes the lack of evidence for implications on macro level for results from micro studies.
31394	5	5	42	5	45	Seems like the statement on low agreement, limited evidence applies only to the first part of the sentence: "...evidence on the effects of specific behaviourial changes on past emission trends." Please Check, and conside to rephrase.	Accepted - reworded - rating may be changed to robust evidence, high agreement
23525	5	5	43	5	45	Could add references here to the literature on consumption and emissions by social groups, e.g. Büchs, M. & Schnepf, S.V., 2013. Who emits most? Associations between socio-economic factors and uk households' home energy, transport, indirect and total co2 emissions. Ecological Economics, 90, 114-123; Baiocchi, G., Minx, J. & Hubacek, K., 2010. The impact of social factors and consumer behavior on carbon dioxide emissions in the united kingdom. Journal of Industrial Ecology, 14 (1), 50-72; Weber, C.L. & Matthews, H.S., 2008. Quantifying the global and distributional aspects of american household carbon footprint. Ecological Economics, 66 (2-3), 379-391; Lenzen, M., Wier, M., Cohen, C., Hayami, H., Pachauri, S. & Schaeffer, R., 2006. A comparative multivariate analysis of household energy requirements in australia, brazil, denmark, india and japan. Energy, 31 (2-3), 181-207.	Accepted - text modified - sentence added in text as new comment

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36343	5	5	44	5	45	Why this is low agreement/limited evidence? What about examples such as the GHG impacts of higher imcomes, more terrestrial animal-based protein diets (eg production of beef), increased soy production etc for global consumption? This occurs in concert with the trade element above - shipping more food around the world (eg bananas and palm oil) should support the statement that there are "large variations in emissions implied by different consumption patterns and lifestyles." Fair enough that there is not much quantitative info on the effects of specific behavioural changes but the overall trends/major changes have been seen. The authors should revisit this agreement/evidence statement in order to determine if it accurately reflects the literature.	Accepted - rating may be changed to robust evidence, high agreement
24346	5	5	6	5	7	This conclusion is lack of literature support. First of all, this conclusion is conflict with the statements in the underlying report of this chapter. For example, on page 32, line 36-39,"Rapid growth in export industries has also driven emissions growth. Also on page 42, line 16-18,"Trade has allowed countries with a higher than global average emission intensity to import lower emission intensity goods and vice versa. For example, exports from China have a carbon intensity four times higher than exports from the US (Davis and Caldeira, 2010)." Secondly, there are several literatures pointing out that "since the relatively higher emission factor in developing countries, global GHG emission will increase due to the growth in export of developing countries. References: 1.Shui, B. and R.C. Harriss. The role of CO2 embodiment in US-China trade. Energy Policy [J], 2006. 34(18): p. 4063—4068。"US–China trade has increased global CO2 emissions by an estimated 720million metric tons". 2.Peters G.P., J.C. Minx, C.L. Weber, and O. Edenhofer (2011a). Growth in emission transfers via international trade from 1990 to 2008. Proceedings of the National Academy of Sciences. (DOI:10.1073/pnas.1006388108) "We find that the emission transfers via international trade often exceed the emission reductions in the developed countries. Consequently, increased consumption in the Annex B countries has caused an increase in global emissions contrary to the territorial emission statistics reported to the UNFCCC."	Noted. I appreciate the comment and defining what is the driver of emission growth will always be challenging. In this case, the driver could be trade, or consumption driving trade and promoting trade liberisation. I don't think there is a direct conflict between the statements that you mention. All are true but I agree that further clarity is required on the main message. Therefore, in this section trade is described as a vehicle to facilitate the link between production and consumption. This will be fully reflected throughout the chapter.
34043	5	5	6	5	8	Trade not a significant driver? The chapter later describes the contribution of trade (section 5.5.1) for example in terms of emissions embedded in trade, which have risen due to trade liberalisation and the lower decoupling of GDP growth and consumption based emissions in industrialised countries.The disparity between production and consumption emissions would not be so great if trade was not a significant driver.	Accepted. Implying causation is never easy and we must be careful to assign responsibility for emission growth to one isolated variable. Consumption is seen as a driver and trade links production and consumption. However, I apppreciate the comment and have changed this sentence to better reflect the difficultly of applying causation.
36340	5	5	7	5	9	This is a strong assertion, seems there should be an agreement/confidence statement concerning it. Please provide a confidence/agreement statement as well as appropriate citations or a reference to the appropriate underlying section(s).	Accepted: The text was revised.
25319	5	50	11	50	16	Additional reference can be useful as it presents developing country perspective vis a vis developed country (Sanstad A.H. , Joyashree Roy, Jayant A. Sathaye (2006) , Estimating Energy –Augmenting Technical Change in developing Country Industries, Energy Economics, Special Issue).	Accept, will add reference and text. Thank you for the suggestion

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
23904	5	50	15	50	16	Chinese energy intensity has been rising in recent years, is this due to a reversal in technological change?	Reject, China's energy intensity has been declining over the past years. A more recent reference will be included in the text.
36575	5	50	17	50	18	The first sentence doesn't make sense. Please revise it.	Accept, remove sentence that starts with "Koh and Magee". Too complex and perhaps not terribly relevant to the points the section tries to make
36576	5	50	19	50	20	"...energy technology has annual progress rates of a diversity of functional performance metrics of 19-13%..." -- this part of the sentence is very unclear. Please revise.	Accept, remove sentence that starts with "Koh and Magee". Too complex and perhaps not terribly relevant to the points the section tries to make
36577	5	50	20	50	28	Here and elsewhere in the chapter, there is relatively little discussion of the effects of price incentives on private behavior. For instance, this section mentions that technological change in energy was pronounced in periods of great political sense of urgency, including high energy prices, but high energy prices would be expected to increase private investment in energy efficiency and energy technology even in the absence of greater political urgency because higher energy prices increase the returns to development and implementation of energy-saving activities.	Taken into account - the point on price incentives, although the paper cited shows that the price increase is due to the political sense of urgency. Section 5.5 on behaviour will also address this.
22572	5	50	29	50	36	The fact that policy has an effect of systemic developments has been very well documented in numerous publications. The IPCC SRREN chapter 11 provides a well documented overview and is more balanced than to have only one isolated reference (-> Dechezleprete 2008) - add reference SRREN chapter 11	Reject, after checking the SRREN, it turns out almost all of the work cited is forward-looking and therefore relatively speculative. This chapter only looks at historical evidence of the impact of technological change on (factors and) emissions.
30847	5	50	37			Why is "Rebound Effect" capitalized here? Other sub-headers are not capitalized and this term is not capitalized elsewhere in this section.	Accepted. This has been changed.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
29534	5	50	37			Even more incorrect statements on rebound. The following statements adopt the macroeconomic modeler's view of rebound, but these models are not "empirical" in the sense that they are measuring real phenomena. Instead, they are using a highly aggregate characterization of the economy to assess changes in energy use that are dependent on detailed structural aspects of the economy THAT ARE NOT EXPLICITLY CHARACTERIZED IN THESE MODELS. For example, where is the representation of actual demand charges and energy charges faced by real utility customers? Those are not included, so how can econometric models reproduce consumer's actual responses to an increase in efficiency? The answer: THEY CANNOT.: "There are numerous empirical studies relying predominately on econometric techniques to evaluate rebounds. A comprehensive review of 500 studies suggests that direct rebounds are likely to always be over 10% and could be considerably higher (i.e. 10% less savings that the projected saving from engineering principles). For household efficiency measures the majority of studies show rebounds in the region of 30-35%, meaning that efficiency measures achieve 65-70% of their original purposes (Greening et al., 2000; Bentzen, 2004; Sorrell, 2007; Sorrell et al., 2009); (Haas and Biermayr, 2000); (Berkhout et al., 2000); (Schipper and Grubb, 2000); (Freire González, 2010). However, there are further projected losses in addition to direct rebounds through economy-wide 14 effects. These indirect rebound effects are likely to be larger due to long-run growth effects and in 15 some cases could be larger than the initial saving resulting are higher resulting in “backfire” also 16 known as Jevons’ paradox (Brookes, 1990; Sorrell, 2009)." Gillingham, Kenneth, Matthew J. Kotchen, David S. Rapson, and Gernot Wagner. 2013. "Energy policy: The rebound effect is overplayed." Nature. vol. 493, no. 7433. 01/24/print. pp. 475-476. [http://dx.doi.org/10.1038/493475a]	Noted. I don't state anywhere that econometric models include all elements of potential rebound effect. The reviewer has created there own issue and then knocked it down. In response to the comment I have dleted the word "empirical". In addition the paper mentioned by Gillingham is a comment and not a peer-reviewed journal article. we have been told to avoid such literature.
25316	5	50	37	51	28	Reference can help improve the information. (1) Harry Saunders (2013). Is what we think of as “rebound” really is just income effect in disguise, energy policy (2)Chakravarty D, Dasgupta S, Roy J. :Rebound effect: how much to worry?. Current Opinion in Environmental Sustainability 2013, 5. DOI No. 10.1016/j.cosust.2013.03.001	Noted. I have reviewed both articles and included one of them in the text.
27019	5	50	42	50	43	Citation for this sentence on direct rebounds in productive sectors (e.g. firms): Saunders, Harry D. "Historical evidence for energy efficiency rebound in 30 US sectors and a toolkit for rebound analysis," Technological Forecasting and Social Change, In Press (2013) available online 11 January 2013 at http://dx.doi.org/10.1016/j.techfore.2012.12.007	Accepted and now included.
30094	5	50	30	50	30	Dechezleprêtre (2008) has been published as Dechezlepr tre, A., M. Glachant, I. Ha i , N. Johnstone and Y. Ménière. 2011. Invention and transfer of climate change–mitigation technologies: A global analysis. Review of Environmental Economics and Policy 5:109-130. Please ûpdate reference šč č	Accept, thank you for the suggestion.
30095	5	50	30	50	31	Dechezleprêtre (2008) (actually Dechezleprêtre (2011), see above) only look at patents, not R&D investments. Their results suggest that the Kyoto Protocol has had a positive impact on innovation in climate change mitigation technologies.	Accept, will change to "Dechezleprêtre (2011) find that the Kyoto Protocol has a positive impact on patenting and therefore innovation output and cross-border technology transfer, .."
30096	5	50	30	50	31	In a more recent paper, Calel and Dechezleprêtre (2012) show that the European Union Emissions Trading Scheme has boosted innovation in clean technologies. Reference: Calel, R. and Dechezleprêtre, A., 2012. Environmental Policy and Directed Technological Change: Evidence from the European carbon market. Grantham Research Institute on Climate Change and the Environment Working Paper No. 75	Accept, will add reference and text. Thank you for the suggestion, also check whether there is counterevidence

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30097	5	50	30	50	31	Aghion et al. (2012) show that higher fuel prices increase innovation in clean vehicles (electric and hybrid cars) and reduce innovation activity in gasoline-based engines. Reference: Aghion, P., Dechezleprêtre, A., Hemous, D., Martin, R., and Van Reenen, J. (2012). Carbon Taxes, Path Dependency and Directed Technical Change: Evidence from the Auto Industry. Working Paper 18596, National Bureau of Economic Research.	Accept, will add reference and text. Thank you for the suggestion
23905	5	50				This article has a relevant review of the literature which may be relevant in this section http://www.nature.com/nature/journal/v493/n7433/full/493475a.html	Accepted. Thank you for the suggestion. Other comments also mentioned this publication and it has now been included in the review.
30165	5	50				The statement "A comprehensive review of 500 studies suggests that direct rebounds are likely to always be over 10% and could be considerably higher (i.e. 10% less savings that the projected saving from engineering principles)" contradicts statements in other sections of the WGIII (see 15.5.4.2 for the case of transport). Many of the studies in past literature using conflicting methodologies, some of which are known to overestimate the rebound effect (Sorrell and Dimitropolous, 2008) http://www.sciencedirect.com/science/article/pii/S0921800907004405 Other references for the rebound effect: Azevedo et al. (2013) "The Rebound Effect: Implications of Consumer Behavior for Robust Energy Policies" Available at:http://www.irgc.org/wp-content/uploads/2013/04/IRGC_ReboundEffect-FINAL.pdf. The direct and indirect rebound effect are linked, with a higher direct rebound effect implying a lower indirect rebound effect and vice versa (Thomas and Azevedo, 2013) http://www.sciencedirect.com/science/article/pii/S0921800912004764. Another reference for the indirect rebound effect (also in the range stated) see: Thomas and Azevedo, 2013b. http://www.sciencedirect.com/science/article/pii/S0921800912004715	Accepted. Thank you for this very useful comment. I've have now included text that refers to the review and also raised the issue of the link between direct and indirect rebounds. I also found the taxonomy of rebound effects useful and have extended the text to reflect this.
23362	5	50	37	51	28	General comment; the section reports findings on rebound effects from households; for completeness it could also be mentioned that some econometric studies (for private transport sector) in Germany find direct rebound effects of up to 60%; see a) Frondel, M., Peters, J. and Vance, C. (2008) Identifying the Rebound: Evidence from a German Household Panel, The Energy Journal 29(4), 154–163. b) Frondel, M., Ritter, N. and Vance, C. (2012) Heterogeneity in the Rebound Effect – Further Evidence for Germany, Energy Economics34, 461–467. c) Frondel, M. and Vance, C. (2009) Do High Oil Prices Matter? Evidence on the Mobility Behavior of German Households, Environmental and Resource Economics 32 (1), 102–109. d) Frondel, M. and Vance, C. (2013) Re-Identifying the Rebound: What About Asymmetry? The EnergyJournal, forthcoming.	Accepted. I felt that transport was under represented in this section sio have included your study of transport in Germany.
36578	5	50	37			This value seems quite high and is likely specific to certain measures. Please provide citations for this value.	Rejected. Numerous references are shown to show the full range of rebounds in the section. This has been further extended taking into account comments from this review process.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
39159	5	50	37	51	28	There are several problems with this section that ought to be addressed: 1) the 10-30% for direct rebound only applies only to a subset of end-uses, but the text implies that it is a general phenomenon; 2) the ill-defined concept of "productive sectors of the economy" implies that this is a large and important phenomenon that is well substantiated in the literature - which it is not; 3) There's really no evidence for an effect as large as this (even the macro modelers seem to agree on this) and, as such, it does not deserve such prominence in such an important document; 4) The distinction between developed and developing economies is an important one, but the discussion lacks important context about where rebound might be a problem and where it isn't. One article to consider including would be Gillingham, Kenneth, Matthew J. Kotchen, David S. Rapson, and Gernot Wagner. 2013. "Energy policy: The rebound effect is overplayed." Nature. vol. 493, no. 7433. 01/24/print. pp. 475-476. [http://dx.doi.org/10.1038/493475a]	Noted. 1) The text explicitly mentions that these studies relate to household level studies. It states "). For household efficiency measures the majority of studies show rebounds in the region of 30-35%...". 2) I am confused by this comment. The word "productive" does not appear in the section on rebound. 3) I report the findings from peer-reviewed publications that document the range of the rebound effect. I find it difficult to know what else should be done. Without a suggested reference it is difficult to consider this comment any further. I have included the references that are mentioned below in an attempt to extend the literautre covered to give a more thorough appraisal. 4) Thank you for this suggestion. This reference is now included.
27550	5	50	37	52	18	Short subchapters "The rebound effect" and "Infrastructure choices & lock-in" deal with two generally underestimated aspects, that are of outstanding importance in the context of drivers, trends and mitigation. Unfortunately, both in chapter 5 as well as in the two main summary documents, there are only few helpful proposals for policy makers to be found how to overcome this dilemma.	Noted. We agree with the reviewer that such would be valuable information. Yet the empirical literature does not provide much guidance on conditions when the two effects are more or less present.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
27030	5	50	37			Note that this section offers a makes one serious ommission. It does not address macro-economic rebound effects in any sense. The aggregate impact of widespread energy efficiency improvements at a microeconomic scale can combine to drive several macroeconomic mechanisms that also contribute to total economy-wide rebound, as both producers and consumers respond to changes in energy service costs: MARKET PRICE EFFECTS: Widespread improvements in energy efficiency can be sufficient to drive a large-scale decrease in energy demand. The resulting decrease in energy market prices will encourage greater overall use of related energy services and a rebound in energy demand. COMPOSITION EFFECTS: Widespread improvements in energy efficiency in production processes will favor energy-intensive sectors of the economy, for which energy inputs make up a larger portion of production costs. The result should be an increase in consumer demand for energy-intensive goods and services and an overall shift in the composition of the economy towards energy-intensive sectors, driving a rebound in related energy consumption. ECONOMIC GROWTH EFFECTS: All else equal, an overall increase in energy productivity of the economy will spur greater economic output and growth and result in an increase in energy demand. See Jenkins et al. 2011 for this discussion. See also Sorrell 2007 and 2009. Rebound effects on this scale are best captured in economy-wide economic models that can capture the interactions between different sectors and the contribution of energy efficiency to overall economic productivity and thus economic growth and by extension energy demand. A number of such economywide studies of rebound are surveyed in both Jenkins et al. 2011 and IRGC 2013 (full citations above).	Noted. I searched science direct and could not find one publication of Jenkins et al (2011). Therefore I am assuming that it is not a peer-reviewed article. However, I take this point seriously and have extended the description of indirect rebound effects.
20277	5	51				Airlines are not infrastructures, but airports are (by your definition)	accepted. Not airlines, but aircraft as its lifetime lasts for half a century. Change will be made.
20278	5	51				Don't say that infrastructures emit. They may do, but the main point is that they enable activities that emit - like flying.	accepted. Changes to be made

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
27023	5	51	10	51	13	This is a particularly important point that rebound effects in emerging economies are likely to be much larger than in developed nations. It is also emphasized by International Risk Governance Council, "The Rebound Effect: Implications of Consumer Behavior for Reobust Energy Policies," IRGC 2013, avaiable at: http://www.irgc.org/wp-content/uploads/2013/04/IRGC_ReboundEffect-FINAL.pdf; and in Jenkins, Jesse et al. "Energy Emergence: Rebound and Backfire as Emergent Phenomena," Breakthrough Institute, 2011, available at: http://thebreakthrough.org/blog/Energy_Emergence.pdf. Similarly, the Asian Development Bank notes in their 2013 Asia Development Outlook: "A large and growing body of research has shown that energy efficiency gains do not bring one-for-one reductions in energy consumption because of the so-called “rebound effect.” In extreme cases, improved efficiency can backfire, spurring outright increases in energy consumption. ... What is particularly troublesome for Asia is that rebound effects appear to be larger in developing economies than in industrialized economies." While unfortunately few studies have been conducted of direct rebounds in emerging economies, here are several to include in addition to Roy (2000). This may deserve to be it's own paragraph: Zein-Elabdin (1997) studies direct rebound after improved stoves were used in the Sudan finding rebounds of 42 percent. Davis et al (2012) evaluate rebound in Mexico finding rebounds following a regrigerator and air conditioner replacement program of up to 93 percent for refrigeration and over 100 percent (e.g. backfire) for air conditioning. Wang et al. (2012) studies direct rebound in passenger transportation in urban China, finding a national average rebound effect of 96 percent, with significant regional variation from 2 percent in Shanghai to 246 percent in Jilin province. Foquot (2012) suggests that elasticities of demand for energy and thus rebound effects are likely to decline as nations develop. Lee and Lee (2010) survey energy price and income elasticities in several emerging economies finding values significantly higher than in developed economies, indicating potential for significantly larger rebound effects in emerging economies. Citations: Asian Development Bank, "Asian Development Outlook 2013: Asia's Energy Challenge," Asia Development Bank, April 2013, available at: http://www.adb.org/sites/default/files/pub/2013/ado-2013.pdf; Davis, L., Fuchs, A. and Gertler, P., Cash for Coolers, National Bureau of Economic Research Working Paper no. 18044.; Lee, C.-C. and Lee, J.-D., “A panel data analysis of the demand for total energy and electricity in OECD countries”, The Energy Journal, 31, 1, 1–24.; Fouquet, R., “Trends in income and price elasticities of transport demand (1850–2010)”, Energy Policy Special Issue on Past and Prospective Energy Transitions, 50, 62–71.; Wang, H., Zhou, P. and Zhou, D.Q., “An empirical study of the direct rebound effect for passenger transport in urban China”, Energy Economics, vol. 34, 452–460.; E.O. Zein-Elabdin. "Improved stoves in Sub-Saharan Africa: the case of the Sudan," Energy Economics, 19(4): 465-475. 1997.	Accepted. Thank you for this very useful response. Many of the references you -mnetion are no incldued in the text and the paragraph on developing countries has been extended.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
27024	5	51	13			This paragraph should conclude with a sentence regarding direct rebound effects in productive sectors of the economy. Roughly two-thirds of global primary energy consumption occurs in the productive sectors of the economy engaged in producing, transporting, and marketing intermediate and final goods and services (Exxon 2009, others). As such, rebound effects in this portion of the economy are particularly important to global climate mitigation efforts. Unfortunately, very few studies have carefully examined rebound in these sectors (Jenkins et al., 2011). A. An exception is Saunders (2013), which examines 30 different productive sectors in the United States during the period 1960-2000, finding long-run rebound effects ranging from 14 percent to 120 percent depending on sectors. Most sectors cluster between rebounds in the range of 25-60 percent. Winebrake et al. (2012) also survey a few extant estimates of direct rebound in commercial trucking, finding long-run rebound values in the range of 12-45 percent. While few other studies have directly examined rebound in industrial or commercial contexts, the ease with which energy services can substitute for other inputs in industrial production greatly impacts the magnitude of direct rebound for firms (Saunders, 1992, 2000b, 2013 As such, estimates of the elasticity of substitution of energy for other inputs to production may provide an order of magnitude estimate of direct rebound in such sectors. Greening et al (2000) survey such estimates notingsubstitution elasticities ranging from 0.4 to 0.8, and in a few rare cases, finding values greater than 1.0. Such results are consistent with the findings in Saunders (2013). Sources: Saunders, Harry D. "Historical evidence for energy efficiency rebound in 30 US sectors and a toolkit for rebound analysis," Technological Forecasting and Social Change, In Press (2013) available online 11 January 2013 at http://dx.doi.org/10.1016/j.techfore.2012.12.007; Harry D. Saunders. A view from the macro side: rebound, backfire, and Khazzoom-Brookes, Energy Policy, 28(6-7): 439-49. 2000; Harry D. Saunders. The Khazzoom-Brookes postulate and neoclassical growth, Energy Journal: 13(4): 131. 1992; Lorna Greening, David L. Greene and Carmen Difiglio. Energy efficiency and consumption -- the reboundeffect -- a survey. Energy Policy, 28(6-7): 389-401. 2000; ExxonMobil. Outlook for Energy: A View to 2030. ExxonMobil, December 2009; Jenkins, Jesse et al. "Energy Emergence: Rebound and Backfire as Emergent Phenomena," Breakthrough Institute, 2011, available at: http://thebreakthrough.org/blog/Energy_Emergence.pdf; James J. Winebrake et al. "Estimating the direct rebound effect for on-road freight transportation," Energy Policy, 48: 252-259.	Accepted. Thank you for this very useful response. Many of the references you mnetion are no incldued in the text and the paragraph on developing countries has been extended.
27026	5	51	14	51	19	This paragraph should note that there is a direct trade-off between indirect rebound due to the re-spending effect and direct rebound, as the total energy savings available for re-spending is lower when direct rebound is higher (and vice versa). This was observed in Jenkins et al. (2011) (see note above for citation) and demonstrated quantitatively in Thomas nd Azevedo (2013a and 2013b). Thomas, B. and Azevedo, I.L., “Estimating Direct and Indirect Rebound Effects for U.S. Households with Input-Output Analysis Part 1: Theoretical Framework”, Ecological Economics, 86, pp 199–210.; and Thomas, B. and Azevedo, I.L., “Estimating Direct and Indirect Rebound Effects for U.S. Households with Input-Output Analysis Part 2: Simulation”, Ecological Economics, 86, pp, 188–198.	Accepted. Many of the citations mentioned are now included.
19418	5	51	14	51	19	The Saunders citation is incorrectly characterized. Saunders measures DIRECT rebound effects only, not indirect or economy-wide effects. Indirect and economy-wide effects will add to this. And the range across 30 US sectors is from a low of 14% to a high of 120% (backfire). The aggregated average is around 50%.	Accepted. Your paper on the US economy is now included.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
19421	5	51	14	51	19	This paragraph seriously understates the uncertainty and risk related to rebound effects. Policy makers are ill-served by underreporting of uncertainty and risk, as has been wisely acknowleged by the IPCC. There is strong and growing evidence that rebound effects can easily rise to backfire proportions in developing countries, as first warned by Joyashree Roy in her 2000 article. Examples include Li and Yonglei (2012), who showed economy-wide energy efficiency rebound in China over the period 1997-2008 to have been very large, including "backfire" conditions in three of those years. Lin and Liu (2013) analyzed passenger transportation in China over the period 1994-2010 and found backfire (rebound approximately equal 107%). The simple idea here is that energy efficiency gains, by effectively reducing the price of energy services, make energy more affordable to the energy poor, thus opening up vast new potential energy demand sources. SImilar to the effect of energy subsidies. Further, it borders on hubris to ignore the results from Tsao et al. (2010), who showed essentially 100% rebound for lighting energy over three centuries, six continents, and five technologies. Can we at least acknowledge the high degree of uncertainty? Li, L. and H. Yonglei, "The energy efficiency rebound effect in China from three industries perspective." Energy Procedia 14 (2012): 1105-1110. Lin, B. and X. Liu (2013), Refined oil pricing mechanism reform and energy rebound for passenger transportation in China, Energy Policy (in press). Tsao, J.Y., Saunders, H.D., Creighton, J.R., Coltrin, M.E., Simmons, J.A., 2010. "Solid state lighting: an energy-economics perspective." Journal of Physics D: Applied Physics 43 (35), 354001 also Saunders, H.D. and Tsao, J.Y. "Rebound effects for lighting," Energy Policy, 49(2012): 477-478	Accepted. I have ensured that the degree on uncertainity is more widely recognised and also incldued a specific section on developing country rebounds.
27025	5	51	15	51	17	Saunders (2000) should also be cited here for it's contribution to this discussion. Harry D. Saunders. "A view from the macro side: rebound, backfire, and Khazzoom-Brookes," Energy Policy, 28(6-7): 439-49. 2000	Rejected. The intention of AR5 is to update previous versions and therefore references post 2007 have been used.
27027	5	51	17	51	19	An additional citation for this sentence: Druckman, Angela, Chitnis, Mona, Sorrell, Steve and Jackson, Tim (2011) Missing carbon reductions? Exploring rebound and backfire effects in UK households. Energy Policy, 39 (6). pp. 3575-3581.	Accepted. Reference now included
36581	5	51	22	51	22	Please reword : are coupled with rises.	Accepted. The sentence has been revised to read "Rebounds effects are often diminished where energy efficiency improvements are coupled with an increase in energy prices."
27028	5	51	24	51	25	"Therefore the relative scale of the saving is a good indicator of the potential size of the rebound effect." I am not aware of any studies making this point. Please include a suitable citation or strike this sentence. The scale of rebound effects depend on many things, but the size of the initial energy saving is not particularly relevant. Smaller savings can have relatively large rebound effects as well, as it does not require a substantial change in output or behavior to erode a large portion of such small initial savings.	Accepted. I hvae attempted to better represent the scale of uncertainity.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
27029	5	51	25	51	28	This is exactly right. You might also note that as rebound effects vary considerably by context, including end-use activity, economic sector, and economic context (e.g. developed or developing nation), it is important to refer to the best current research on the magnitude of rebound in each context. Additional research into the scale of rebound in emerging economies and in productive sectors of the economy would be particularly relevant to policy making, as emerging economies will be drivers of virtually all expected energy demand growth in the coming decades and productive sectors of the economy are home to roughly 2/3rd of total primary energy consumption worldwide (Saunders, 2013; see above for citation). These points were also raised in Jenkins et al. 2011 and in IRGC 2013 (see above for full citations).	Noted. Thank you for the comment. I have not been able to locate the publications mentioned.
22573	5	51	29	52	18	The high importance of grid infratsructural changes (for the implementation of renewables) are entirely neglected in this paragraph and must be added.	rejected. Power grid infrastructure can be modified to accept renewables. Distributed power supply and long distance power transimission have their own advantages and there is no easy say which is superior to the other. Things depends.
23906	5	51	31			"The review in this part", well, I thought it was an "assessment" and not a "review"	accepted. Changes to be made
31406	5	51	33	51	35	Buildings should also be mentioned in this sentence.	accepted. Changes made
35408	5	51	33		36	Investment in waste disposal facilities (incinerators) is an example of a path dependency and lock-in of an industry barrier that will prevent material efficiency strategies for a long period of time. In the case of incinerators, the generalised lock-in has created a situation of incineration overcapacity -more capacity to burn than waste is or will be available- with at least 80% of MSW being recyclable (ref: Altair, 2013, Characterisation of households residual fraction in Gipuzkoa, Spain) building incineration capacity to burn more than 20% of the waste available is locking in waste prevention and recycling policies i the future. A recent study proves how this lock-in effect in place such as Denmark, Sweden, Germany or Holland is threatening recycling and encouraging the shipment of waste that otherwise could be treated locally with less environmental cost. Ref: JOfra M., Ventosa I., 2013 "Incineration overcapacity and waste shipping in Europe: the end of the proximity principle?"	noted. Overcapacity is a different issue.
35462	5	51	33		36	Investment in waste disposal facilities (incinerators) is an example of a path dependency and lock-in of an industry barrier that will prevent material efficiency strategies for a long period of time. In the case of incinerators, the generalised lock-in has created a situation of incineration overcapacity -more capacity to burn than waste is or will be available-, with at least 80% of MSW being recyclable (ref: Altair, 2013, Characterisation of households residual fraction in Gipuzkoa, Spain) building incineration capacity to burn more than 20% of the waste available is locking in waste prevention and recycling polciies i the future. A recent study proves how this lock-in effect in place ssuch as Denmark, Sweden, Germany or Holland is threatening recycling and encouraging the shipment of waste that otherwise could be treated locally with less environmental cost. Ref: JOfra M., Ventosa I., 2013 "Incineration overcapacity and waste shipping in Europe: the end of the proximity principle?"	see above

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
26970	5	51	33		36	Investment in waste disposal facilities (incinerators) is an example of a path dependency and lock-in of an industry barrier that will prevent material efficiency strategies for a long period of time. In the case of incinerators, the generalised lock-in has created a situation of incineration overcapacity -more capacity to burn than waste is or will be available-, with at least 80% of MSW being recyclable (ref: Altair, 2013, Characterisation of households residual fraction in Gipuzkoa, Spain) building incineration capacity to burn more than 20% of the waste available is locking in waste prevention and recycling polciies i the future. A recent study proves how this lock-in effect in place ssuch as Denmark, Sweden, Germany or Holland is threatening recycling and encouraging the shipment of waste that otherwise could be treated locally with less environmental cost. Ref: JOfra M., Ventosa I., 2013 "Incineration overcapacity and waste shipping in Europe: the end of the proximity principle?"	see above.
36579	5	51	4	51	6	This comment seems speculative. As stated about China, many newer cities are using less land area for roads than the US. This seems to imply that the emission use will be less?	Accepted. The last line of the paragraph has been revised thoroughly.
21675	5	51	47	51	49	Please expand on the caveats surrounding estimates of transport emissions or provide supporting references. For example, are railways are powered by nuclear-derived electricity, fossil fuel-derived electricity or diesel? High-speed rail may also provide relatively higher emissions.	accepted. Text revised to accommodate concern that it is not always valid that railways have lower emissions vis-a-vis road and air transport.
33684	5	51	6			… 10% less savings than …	Noted. The explanation was given in brackets at the end of the sentence. "A comprehensive review of 500 studies suggests that direct rebounds are likely to always be over 10% and could be considerably higher (i.e. 10% less savings that the projected saving from engineering principles)."
27020	5	51	6	51	10	This sentence should clarify that the range of rebound figures discussed therein refers almost exclusively to studies of household efficiency measures in developed/OECD nations. Insert the following bracketed language: "For household efficiency measures [in developed/Annex 1 nations] the majority of studies..."	Accepted. The sentence now states "household efficiency measures the majority of studies show rebounds in the region of 30-35%..." (thus making it clear that this relates to household studies.
36580	5	51	6	51	7	This paragraph does not say much about infrastructure. Please revise it.	Accepted. The last line of the paragraph has been revised thoroughly.
27021	5	51	7	51	8	This sentence should add that this range of figures is for the sum of both direct & indirect rebound. E.g. this sentence should include the bracketed insertion: "For household efficiency measures the majority of studies show [the sum of direct and indirect] rebounds in the region of 30-35%, meaning that 8 efficiency measures achieve 65-70% of their original purposes..." The range for direct rebounds alone is in the 10-30% range, as per discussion in the SPM paragraph on rebound and as in the citations here (Sorrell 2007, 2009; Greening et al. 2000) and Dimitropoulos 2007 (citation in comment below).	Noted. This sentence has been changed following your suggestion to include the bracketed text.
27022	5	51	8	51	10	Another good peer reviewed lit review on this topic to add to the (already strong!) list of citations here: Dimitropoulos, John, "Energy productivity improvements and the rebound effect: An overview of the state of knowledge," Energy Policy, 35 (12): 6354-6363.	Accepted. Thank you for the suggested text. This has now been included.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
31407	5	51				This section is very important in underlining the urgency of action. Therefore to further strengthen it some more data on the risk of lock-in could be quoted. IEA in the World Energy Outlook 2012 estimated that 81% of the total CO2 emissions allowable in the energy sector up to 2035 in a 2 degree C scenario is already locked-in with the existing energy infrastructure.	accepted.
40601	5	51	50			This chapter summarize that the lock in effect determines the future more than several decades, Therefore, With regarding the situation of the rapidity diverging the developing countries, it is necessary to highlight the summary of this chapter in the SPMs.[?]As an example,[?]the following reference can be cited. (The economics of solar power, Peter Lorenz, Dckon Pinner, Thomas Seitz,The McKinsey Quarterly, (June, 2008)	partly accepted. CLA to have iyt included in TS. Reference not to be cited as it is grey literature, not peer-reviewed paper.
32488	5	510				The page numbers refer to the pages of the pdf document (and do not coincide with the page numbers as printed in the bottom right of the document. Life Cycle Assessment (LCA) is standardused by ISO with that name. Therefore, it should never be referred to as Life Cycle Analysis. Furthermore, once defined, it can be referred to simply as "LCA". Many important works of Brandão et al. (e.g. 2013) and Levasseur are missing, which are particular relevant to chapters 8 and 11. These are: -Brandão M, Levasseur A, Kirschbaum M, Cowie A, Weidema B, Jørgensen SV, Hauschild M, Chomkhamsri K, Pennington D (2013) Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting. The International Journal of Life Cycle Assessment 18 (1) 230-240. DOI: 10.1007/s11367-012-0451-6. http://link.springer.com/article/10.1007%2Fs11367-012-0451-6 -Levasseur A, Lesage P, Margni M, Brandão M, Samson R (2012) Assessing temporary carbon sequestration and storage projects through land use, land-use change and forestry: comparison of dynamic life cycle assessment with ton-year approaches. Climatic Change. DOI: 10.1007/s10584-012-0473-x. http://www.springerlink.com/content/b3251u56v728m870/?MUD=MP13. -Levasseur A, Brandão M, Lesage P, Margni M, Pennington D, Clift R, Samson S (2012) Valuing temporary carbon storage. Nature Climate Change 2, 6–8. doi:10.1038/nclimate1335. http://www.nature.com/nclimate/journal/v2/n1/full/nclimate1335.html. -Brandão M, Mila i Canals L, Clift R (2011) Soil Organic Carbon changes in the cultivation of energy crops: implications for GHG balances and soil quality for use in LCA. Biomass & Bioenergy35 (6). 2323–2336. Special issue: Modelling Environmental, Economic and Social Aspects in the Assessment of Biofuels. http://www.sciencedirect.com/science/article/pii/S0961953409002402 -Brandão M, Clift R, Mila I Canals L, Basson L (2010) A Life-Cycle Approach to Characterising Environmental and Economic Impacts of Multifunctional Land-Use Systems: An Integrated Assessment in the UK. Sustainability 2(12): 3747-3776. Special issue: Life Cycle Sustainability Assessment. http://www.mdpi.com/2071-1050/2/12/3747/pdf -Mueller-Wenk R and Brandão M (2010) Climatic impact of land use in LCA - carbon transfers between vegetation/soil and air. The International Journal of Life Cycle Assessment 15(2) 172-182. http://www.springerlink.com/content/02628184t2q98051/fulltext.pdf -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. Springer. 125pp. -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. PhD thesis. Centre for Environmental Strategy (Division of Civil, Chemical and Environmental Engineering), Faculty of Engineering and Physical Sciences, University of Surrey, UK. 246 pp. Appendices 541 pp. -Mulligan D, Edwards R, Marelli L, Scarlat N, Brandão M, Monforti-Ferrario F (2010) The effects of increased demand for biofuel feedstocks on the world agricultural markets and areas. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-16220-6. http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/16193/1/en24464_iluc%20workshop.pdf -Brandão M, Levasseur A (2011) Assessing temporary carbon storage in life cycle assessment and carbon footprinting: outcomes of an expert workshop. Joint Research Centre, European Commission, Ispra, Italy	Accepted. Will use standard terms.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
32489	5	512		513		The page numbers refer to the pages of the pdf document (and do not coincide with the page numbers as printed in the bottom right of the document. Life Cycle Assessment (LCA) is standardused by ISO with that name. Therefore, it should never be referred to as Life Cycle Analysis. Furthermore, once defined, it can be referred to simply as "LCA". Many important works of Brandão et al. (e.g. 2013) and Levasseur are missing, which are particular relevant to chapters 8 and 11. These are: -Brandão M, Levasseur A, Kirschbaum M, Cowie A, Weidema B, Jørgensen SV, Hauschild M, Chomkhamsri K, Pennington D (2013) Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting. The International Journal of Life Cycle Assessment 18 (1) 230-240. DOI: 10.1007/s11367-012-0451-6. http://link.springer.com/article/10.1007%2Fs11367-012-0451-6 -Levasseur A, Lesage P, Margni M, Brandão M, Samson R (2012) Assessing temporary carbon sequestration and storage projects through land use, land-use change and forestry: comparison of dynamic life cycle assessment with ton-year approaches. Climatic Change. DOI: 10.1007/s10584-012-0473-x. http://www.springerlink.com/content/b3251u56v728m870/?MUD=MP13. -Levasseur A, Brandão M, Lesage P, Margni M, Pennington D, Clift R, Samson S (2012) Valuing temporary carbon storage. Nature Climate Change 2, 6–8. doi:10.1038/nclimate1335. http://www.nature.com/nclimate/journal/v2/n1/full/nclimate1335.html. -Brandão M, Mila i Canals L, Clift R (2011) Soil Organic Carbon changes in the cultivation of energy crops: implications for GHG balances and soil quality for use in LCA. Biomass & Bioenergy35 (6). 2323–2336. Special issue: Modelling Environmental, Economic and Social Aspects in the Assessment of Biofuels. http://www.sciencedirect.com/science/article/pii/S0961953409002402 -Brandão M, Clift R, Mila I Canals L, Basson L (2010) A Life-Cycle Approach to Characterising Environmental and Economic Impacts of Multifunctional Land-Use Systems: An Integrated Assessment in the UK. Sustainability 2(12): 3747-3776. Special issue: Life Cycle Sustainability Assessment. http://www.mdpi.com/2071-1050/2/12/3747/pdf -Mueller-Wenk R and Brandão M (2010) Climatic impact of land use in LCA - carbon transfers between vegetation/soil and air. The International Journal of Life Cycle Assessment 15(2) 172-182. http://www.springerlink.com/content/02628184t2q98051/fulltext.pdf -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. Springer. 125pp. -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. PhD thesis. Centre for Environmental Strategy (Division of Civil, Chemical and Environmental Engineering), Faculty of Engineering and Physical Sciences, University of Surrey, UK. 246 pp. Appendices 541 pp. -Mulligan D, Edwards R, Marelli L, Scarlat N, Brandão M, Monforti-Ferrario F (2010) The effects of increased demand for biofuel feedstocks on the world agricultural markets and areas. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-16220-6. http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/16193/1/en24464_iluc%20workshop.pdf -Brandão M, Levasseur A (2011) Assessing temporary carbon storage in life cycle assessment and carbon footprinting: outcomes of an expert workshop. Joint Research Centre, European Commission, Ispra, Italy	Accepted. Will use standard terms.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
35482	5	52				The inclusion of the informal recycling sector has co-benefits at environmental, social and economical level, within a sustainable Development framework. A remarkable example can be found in Mumbai, a megacity with a challenging waste management system, where most of the waste is collected by the municipality and brought to the 3 main landfills. In 2013, the city expects to pay USD 375 million for this system, a 40% increase from 2012, as costs for transportation, copating and dumpsite expenses are expected. While the Indian Municipal Solid Waste Rules of 2000 require source separation and prohibit landfilling of biodegradable waste, there is no recycling or composting program. Nevertheless, there is a thriving informal recycling economy. Informal refers to the fact that it is not regulated by government agencies; there are no rules for pricing recyclables, or protection for waste pickers. One non-governmental organization, Stree Mukti Sanghatana (SMS), has been training and organizing women waste pickers since 1975. Because poor, low-caste women comprise 85 percent of the waste picker population, SMS started the Parisar Vikas (PV) program in 1998 to train this group as “parisar bhaginis,” or “neighborhood sisters,” teaching them the principles of zero waste, how to sort and handle waste from multi-family dwellings, composting and biogas plant management, gardening, and how to organize as worker cooperatives and negotiate contracts. The Parisar Vikas (PV) programs employ 600 women (bhaginis) in almost 150 locations in Mumbai, ranging from institutional campuses to housing apartments. SMS serves as the umbrella organization that runs the PV program, and there are ten waste picker cooperatives that manage sites. The cooperatives enter into recycling contracts with institutions, apartment complexes, businesses, and the municipality. They collect waste directly from households or community waste bins, and separate it. They bundle the dry, recyclable waste for sale to industry recyclers. Residuals and organics are picked up to be processed in composting and biogas facilities. Example: Tata Institute for Social Sciences: cooperative operates a snack bar, sorting operation, and biogas facility. The snack bar generates 25 - 30 kg of clean, source-separated, organic waste per day. Supplemented with outside sources, this feeds the 100 kg/day capacity biogas plant. Gas from the plant meets a quarter of the canteen’s cooking gas needs. The operation has been so successful that the institute added another 500 kg/day plant at its larger canteen, and is constructing a third plant to service their new 1,000-student hostel. A key innovation in PV’s model is the adoption of a locally viable technology for biogas creation, called the Nisargruna Biogas Plant. Each plant belongs to the institution or society where it is located, and bhaginis are contracted annually to operate them. The plant was developed to convert on-site organic waste (almost any biodegradable waste including kitchen waste, paper, animal dung, bio-sludge, poultry manure, agro-waste, and biomass) at an individual institution or apartment building into useful methane and high-quality manure (fertilizer) to then be sold back to households or local businesses. The benefits: a. Only 50 m2 are required for a plant that processes 100 kg per day. b. The resulting biogas is 85 percent methane, more efficient than the 50 percent methane typical of most biogas plants. c. The largest part of the waste stream –organics- can be processed and used very close to where it is produced. d. Small footprint, lack of odors, and direct use of biogas for heating e. Avoids the pollution that results from landfilling wet waste. Conclusion – the Parisar Vikas program works and provides co-benefits:	Noted. A detailed discussion of waste treatement is provided in Ch12 on settlements.
20279	5	52				It is very doubtful if LCAs as applied to individual projects can really do anything about lock-in. Lock-in happens at wider system levels, and relates to much more over-arching choices and decisions.	Noted. Also at wider system level, such at urban planning, an analysis of future emissions induced by current choices can be part of a 'life cycle' analysis.
20280	5	52				Section 5.8 has no references. What is the point of this section?	Noted. In this section we bring together the connection between the various sections. We go beyond the summary, which is the main ES objective.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
26990	5	52				The inclusion of the informal recycling sector has co-benefits at environmental, social and economical level, within a sustainable Development framework. A remarkable example can be found in Mumbai, a megacity with a challenging waste management system, where most of the waste is collected by the municipality and brought to the 3 main landfills. In 2013, the city expects to pay USD 375 million for this system, a 40% increase from 2012, as costs for transportation, copating and dumpsite expenses are expected. While the Indian Municipal Solid Waste Rules of 2000 require source separation and prohibit landfilling of biodegradable waste, there is no recycling or composting program. Nevertheless, there is a thriving informal recycling economy. Informal refers to the fact that it is not regulated by government agencies; there are no rules for pricing recyclables, or protection for waste pickers. One non-governmental organization, Stree Mukti Sanghatana (SMS), has been training and organizing women waste pickers since 1975. Because poor, low-caste women comprise 85 percent of the waste picker population, SMS started the Parisar Vikas (PV) program in 1998 to train this group as “parisar bhaginis,” or “neighborhood sisters,” teaching them the principles of zero waste, how to sort and handle waste from multi-family dwellings, composting and biogas plant management, gardening, and how to organize as worker cooperatives and negotiate contracts. The Parisar Vikas (PV) programs employ 600 women (bhaginis) in almost 150 locations in Mumbai, ranging from institutional campuses to housing apartments. SMS serves as the umbrella organization that runs the PV program, and there are ten waste picker cooperatives that manage sites. The cooperatives enter into recycling contracts with institutions, apartment complexes, businesses, and the municipality. They collect waste directly from households or community waste bins, and separate it. They bundle the dry, recyclable waste for sale to industry recyclers. Residuals and organics are picked up to be processed in composting and biogas facilities. Example: Tata Institute for Social Sciences: cooperative operates a snack bar, sorting operation, and biogas facility. The snack bar generates 25 - 30 kg of clean, source-separated, organic waste per day. Supplemented with outside sources, this feeds the 100 kg/day capacity biogas plant. Gas from the plant meets a quarter of the canteen’s cooking gas needs. The operation has been so successful that the institute added another 500 kg/day plant at its larger canteen, and is constructing a third plant to service their new 1,000-student hostel. A key innovation in PV’s model is the adoption of a locally viable technology for biogas creation, called the Nisargruna Biogas Plant. Each plant belongs to the institution or society where it is located, and bhaginis are contracted annually to operate them. The plant was developed to convert on-site organic waste (almost any biodegradable waste including kitchen waste, paper, animal dung, bio-sludge, poultry manure, agro-waste, and biomass) at an individual institution or apartment building into useful methane and high-quality manure (fertilizer) to then be sold back to households or local businesses. The benefits: a. Only 50 m2 are required for a plant that processes 100 kg per day. b. The resulting biogas is 85 percent methane, more efficient than the 50 percent methane typical of most biogas plants. c. The largest part of the waste stream –organics- can be processed and used very close to where it is produced. d. Small footprint, lack of odors, and direct use of biogas for heating e. Avoids the pollution that results from landfilling wet waste. Conclusion – the Parisar Vikas program works and provides co-benefits:	taken into account. Issue covered in cestoral chapter
24249	5	52	14	52	18	"Avoiding the lock-in" is crucial and urgently needs informed decicion-makers which enables genuine transformation of infrastructre and systems. From this perspective it's misleading to only mention "choice of materials and construction". Here the challenge & opportunity in the global urbanization trend should be included, and the pivotal role of making the right decisions in the planning phase - in particular how the integration of physical and digital (ICT) infrastructure can achieve climate positive lock-in effects.	accepted. We include a sentence where we write "to reduce undesired lock in effects with respect to … physical infrastructure" as in the comment. We believe that ITC is part of the physical infrastructure.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36584	5	52	19			We suggest providing a list of the mitigation strategies that are addressed in this chapter.	noted. We now write in the intro "We focus on cross-sectoral air pollution literature and the role of pollutant emission trends and briefly discuss the difficulty for assessing the role of co-benefits as an underlying driver when it plays a role for GHG mitigation decisions."
36585	5	52	20	54	32	The authors should review these sections and reconcile with similar sections in Chapter 3 (3.5.3) and chapter 6.	accepted. We have coordinated, make linkages and refer to CH3.
40602	5	52	20			Chapter 6 also deals with co-benefit. So, it would be better to avoid redundancy. Nevertheless, the description of co-benefit treated both Chapter 5 and 6 are rather qualitative. It would be better to make firmer discussion based on the quantitative one. Also, a fair description based on balanced description from cobenefit and risk should be made here. Chapter 5 and 6 can share their role.	accepted. We have coordinated, make linkages and refer to CH3.
23907	5	52	29			WGI uses "Near Term Climate Forcers" instead of "short-lived climare forcers". Check that everything is consistent.	Accepted. The term does not come back in the revised section.
31408	5	52	33			Please consider to explain the light rail example more elaborate.	noted.
30848	5	52	33	52	42	This Box seems like a random selection of information. Suggest providing more context about what is being described.	noted, text rewritten
23908	5	52	33			The Shindell et al 2012 paper is relevant for the box?	noted, text rewritten
34304	5	52	33	52	42	I suggest adding 'for health objetives' to the title of the box and adding cross-references to other places of the report where health co-benefits are assessed (in all sector chapters).	noted, text rewritten
32170	5	52	34	52	34	Precise Charlotte, NC, USA	noted, text rewritten
19846	5	52	34		36	This is a co-benefit of light rail, not a co-benefit of climate change mitigation. The Californian Air Resources Board has quantified some cobenefits including cost reductions in household energy and health care.	noted, text rewritten
25686	5	52	43	53	2	This part should be revised to explain that it is important to use coal power efficiently from a viewpoint of energy security and economic efficiency. IGCC (Integrated Gasification Combined Cycle) technology is developing and has potential to reduce CO2 emission in the future, as described in (IEA, 2011, page7, page42 Fig14) and (Janos, 2009, page5, page7 Figure1 and Table 1). These literatures are listed in the No10 line of this table.	noted, text rewritten
36586	5	52	43	52	44	This is the only true discussion of mitigation. This seems unduly short. Please consider expanding it.	noted, text rewritten
32459	5	52	43	53	2	It lack of the aspect of energy security and higly efficient coal fired power plant should be mentioned as a way of reducing greenhouse gas.	noted, text rewritten
36582	5	52	5	52	8	There are more energy efficiency non-energy benefits than what is listed here. http://www.iea.org/media/workshops/2012/energyefficiency/Friedrichs.pdf liists a few.	noted, text rewritten
36583	5	52	9	52	13	This sentence is not clear. Please revise it.	noted, text rewritten

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
34311	5	52	19			Although this section reads well, the majority of the material is unfortunately redundant with the assessment done in other chapters of the report - particularly the sector chapters and the synthesis in 6.6. For the next draft, I suggest a bigger focus on methodological issues around the quantification of cross-sectoral co-benefits and the associated welfare effects to complement the often qualitative assessment of sector chapters. This assessment can be restricted to those issues that are not already assessed in AR4. Three ideas that would link well with the rest of chapter 5: First, one important component of each study on co-benefits is the projection of a policy baseline for the respective context. Reporting historic emmission trends of the most important air pollutants (e.g. SO2, black carbon etc.) of selected regions, discussing the coverage of these trends in the most-referenced air pollution co-benefits papers and discussion of implications of related assumptions on the final results would be very interesting and complement the assessment in other chapters (building on page 54, lines 17-24). Second, discussing the types of models usually used for quantification of co-benefits, thereby differentiating cost-benefit analysis vs cost-effectiveness analysis, static vs dynamic optimization, empirical vs normative valuation techniques and linking this to the co-benefits framing section in chapter 3 (3.5.3) and other related sections (2.3.3, 2.3.4, 3.4, 3.7.1.1, 3.7.2.1) would help the reader to understand the contingency of the results on these issues. Finally, the dependence of co-benefits/adeverse side-effects on case- and site-specific circumstances as well as on the implementation practice mentioned in other chapters (e.g. section 6.6) could be further discussed here on a meta level (building on FOD section 5.10.3) Please replace the term 'risk trade-off' with 'adverse side-effect' throughout the section as the former should only be used when the discussion evolves around trading off different risks (example: increase of climate risk if a mitigation option such as BECCS is not implemented vs increase of risk related to this particular option such as groundwater contamination).	taken into account: coordination with X-cutting group and TSU
31409	5	52				This section should also mention the co-benefits from mitigation in the AFOLU sectors. Avoided deforestation, reforestation and improved agricultural practices often directly impact the adaptation ability of land areas. Improved vegetation density leads to reduced erosion, better water quality, reduced land degradation, reduced risk of landslides, etc.	taken into acocunt. Issue covered in sectoral chapter.
35398	5	52				This section should include a reference to the important co-benefits that can be met in waste management projects that put emphasis in reduction, reuse and recycling of waste within a framework of materials efficiency following principles not to landfill or incinerate any waste (commonly known as zero waste). These projects are efficient climate change mitigation strategies with important co-benefits to other social, economical and environmental dimensions. The most remarkable examples can be found in 'On the road to zero waste. Success and Lessons from Around the World, by GAIA Global Alliance for Incinerator Alternatives, 2012.	taken into account. Issue covered in cestoral chapter
35452	5	52				This section should include a reference to the important co-benefits that can be met in waste management projects that put emphasis in reduction, reuse and recycling of waste within a framework of materials efficiency following principles not to landfill or incinerate any waste (commonly known as zero waste). These projects are efficient climate change mitigation strategies with important co-benefits to other social, economical and enviornmental dimensions. The most remarkable examples can be found in 'On the road to zero waste. Successess and Lessons from Around the World, by GAIA Global Alliance for Incinerator Alternatives, 2012.	see above
29546	5	52				Please check the examples provided in 'On the road to zero waste. Successess and Lessons from Around the World, by GAIA Global Alliance for Incinerator Alternatives, 2012. These experiences show several important co-benefits that can be met in waste projects that put emphasis in reduction, reuse and recycling of waste within a framework of materials efficiency following principles not to landfill or incinerate any waste.	taken into account. Issue covered in cestoral chapter

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
26960	5	52				This section should include a reference to the important co-benefits that can be met in waste management projects that put emphasis in reduction, reuse and recycling of waste within a framework of materials efficiency following principles not to landfill or incinerate any waste (commonly known as zero waste). These projects are efficient climate change mitigation strategies with important co-benefits to other social, economical and enviornmental dimensions. The most remarkable examples can be found in 'On the road to zero waste. Successess and Lessons from Around the World, by GAIA Global Alliance for Incinerator Alternatives, 2012.	taken into account. Issue covered in cestoral chapter
29635	5	52	20			Positive co-benefits evidence can be found under inclusive frameworkers, where informal recycling become dignified and done under proper health and safety manners. In Brazil, more than 80 000 waste pickers working in cooperatives, recycled almost 80% of all materials in the country and work with safety equipments (Dias 2010). In Buenos Aires, more than 2000 wastepickers collected and recycled all recyclable materials in the city, using uniforms, public-collective transport (thus reducing transport emissions). While in India, Delhi and Pune informal recyclers mitigates climate change impacts while provide livelihoods for dozen thousands of wastepickers (Chintan 2011, GAIA 2012)	taken into account. Issue covered in cestoral chapter

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
32490	5	527				The page numbers refer to the pages of the pdf document (and do not coincide with the page numbers as printed in the bottom right of the document. Life Cycle Assessment (LCA) is standardused by ISO with that name. Therefore, it should never be referred to as Life Cycle Analysis. Furthermore, once defined, it can be referred to simply as "LCA". Many important works of Brandão et al. (e.g. 2013) and Levasseur are missing, which are particular relevant to chapters 8 and 11. These are: -Brandão M, Levasseur A, Kirschbaum M, Cowie A, Weidema B, Jørgensen SV, Hauschild M, Chomkhamsri K, Pennington D (2013) Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting. The International Journal of Life Cycle Assessment 18 (1) 230-240. DOI: 10.1007/s11367-012-0451-6. http://link.springer.com/article/10.1007%2Fs11367-012-0451-6 -Levasseur A, Lesage P, Margni M, Brandão M, Samson R (2012) Assessing temporary carbon sequestration and storage projects through land use, land-use change and forestry: comparison of dynamic life cycle assessment with ton-year approaches. Climatic Change. DOI: 10.1007/s10584-012-0473-x. http://www.springerlink.com/content/b3251u56v728m870/?MUD=MP13. -Levasseur A, Brandão M, Lesage P, Margni M, Pennington D, Clift R, Samson S (2012) Valuing temporary carbon storage. Nature Climate Change 2, 6–8. doi:10.1038/nclimate1335. http://www.nature.com/nclimate/journal/v2/n1/full/nclimate1335.html. -Brandão M, Mila i Canals L, Clift R (2011) Soil Organic Carbon changes in the cultivation of energy crops: implications for GHG balances and soil quality for use in LCA. Biomass & Bioenergy35 (6). 2323–2336. Special issue: Modelling Environmental, Economic and Social Aspects in the Assessment of Biofuels. http://www.sciencedirect.com/science/article/pii/S0961953409002402 -Brandão M, Clift R, Mila I Canals L, Basson L (2010) A Life-Cycle Approach to Characterising Environmental and Economic Impacts of Multifunctional Land-Use Systems: An Integrated Assessment in the UK. Sustainability 2(12): 3747-3776. Special issue: Life Cycle Sustainability Assessment. http://www.mdpi.com/2071-1050/2/12/3747/pdf -Mueller-Wenk R and Brandão M (2010) Climatic impact of land use in LCA - carbon transfers between vegetation/soil and air. The International Journal of Life Cycle Assessment 15(2) 172-182. http://www.springerlink.com/content/02628184t2q98051/fulltext.pdf -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. Springer. 125pp. -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. PhD thesis. Centre for Environmental Strategy (Division of Civil, Chemical and Environmental Engineering), Faculty of Engineering and Physical Sciences, University of Surrey, UK. 246 pp. Appendices 541 pp. -Mulligan D, Edwards R, Marelli L, Scarlat N, Brandão M, Monforti-Ferrario F (2010) The effects of increased demand for biofuel feedstocks on the world agricultural markets and areas. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-16220-6. http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/16193/1/en24464_iluc%20workshop.pdf -Brandão M, Levasseur A (2011) Assessing temporary carbon storage in life cycle assessment and carbon footprinting: outcomes of an expert workshop. Joint Research Centre, European Commission, Ispra, Italy	Accepted. Will use standard terms.
21676	5	53	11	53	14	This paragraph mentioned the different aerosol effects and the balance between warming and cooling. There are other sections in this chapter where it would be relevant to mention this.	noted, text rewritten
34307	5	53	15	53	19	This is interesting material but is redundant with the more detailed discussion of energy security co-benefits in section 6.6. Please liaise with the responsible LAs for coordination purposes.	Accepted. Revision has been coordinated with commenter
24141	5	53	19	53	21	I agree to keep the reference of (Sano et al., 2005) taking a clear example for economic co-benefits in the cement industry.	noted, text rewritten

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
34308	5	53	19	53	21	This is interesting material but should be added to section 10.8.1 that deals with co-benefits in the industry sector. Please liaise with the responsible LAs for coordination purposes. Please take also into account that the term 'co-benefit' is meant to be applied to effects "without yet evaluation net effects on welfare" (see Annex I). Following this definition, it is not clear what 'economic co-benefit' is supposed to mean here. The same goes for 'the value of co-benefits' on page 54, line 8.	noted, text rewritten and coordinated with xcut
34309	5	53	22	53	26	This is interesting material but should be added to section 11.7 that deals with co-benefits in the AFOLU sectors. Please liaise with the responsible LAs for coordination purposes.	noted, text rewritten and coordinated with xcut
34060	5	53	25			reafforestation should be reforestation/afforestation?	Accepted. The word 'reafforestation' has been removed.
21074	5	53	25			Please either use "reforestation and afforestation" and refer to the KP or use only "afforestation", as "reafforestation" is an outdated term.	Accepted. The word 'reafforestation' has been removed.
34310	5	53	27	53	34	This is interesting material but should be added to section 8.7 that deals with co-benefits in the transport sectors. Please liaise with the responsible LAs for coordination purposes.	noted, text rewritten and coordinated with xcut
27551	5	53	29	53	34	In the corresponding part of the SPM (p. 21, lines 14-17, 22), line 14 refers only to "...short term welfare gains", line 15 only to "...pollutant emissions..." line 16 and 17 concluding on " reducing health risks". Also line 22 refers only to improved "air quality, reducing the impacts on human health" . These statements leave out the medium and long term co-benefits for health arising from other mechanisms than a reduction of air pollutions. This is partly outlined in WGIII_AR5_Draft2_CH05 p 53 line 29-34. It is also elaborated on in FOD WGII AR5 Chapter 11, paragraph 11.7. p. 35, line 41-42 and in Table 11.7. lowest two box-lines. Therefore a sentence should be inserted in the SPM e.g. in line 29 before "Increasing ..." reading: Substantial health benefits also result directly from the mitigation of GHG - however on a medium- and long-term base.	noted, this comment addresses the SPM, not CH5.
34305	5	53	3	53	6	This is interesting material but should be added to section 6.6 that deals with air pollution co-benefits in a more detailed way. Please liaise with the responsible LAs for coordination purposes.	noted, text rewritten and coordinated with xcut
36587	5	53	35	53	36	The magnitude of the diminishment is debatable.	noted, we could not locate the text where the comment refers to.
27552	5	53	38	53	43	Throughout the report, an increase in employment has the connotation of a positive side effect of mitigation actions while a decrease is perceived as a negative side effect or trade off. The idea that more employment is good is a normative one and is only valid within a market economy where livelihood and hired labor are strongly connected. It is debatable if by 2050 (or even 2100) an increase in human labor is still deemed positive. In general one what assume that mankind strives for a situation with less work. Of course, in that case either the remaining work or the corresponding income has to be split more evenly among the population.	Noted. CH5 deals mostly with historic trends, in which employment is, as the commenter notices, positively valued.
34312	5	53	38	53	42	Explainging the underlying reasons for the different results and linking this with sectoral assessment of employment effects (e.g. 9.7.2.1) might help the reader to understand the forces at work.	noted, text rewritten and coordinated with xcut
34313	5	53	42	54	2	Please cut the text and cross-reference the respective sections where these risks are extensively discussed (7.9.2 and 11.A.5).	noted, text rewritten and coordinated with xcut
31410	5	53	44	53	45	Should add "social impacts" after environmental impacts.	Accepted. We have included social to the thorouglhy revised section.
30849	5	53	45	53	47	This sentence should be more nuanced. Biofuels are a contributing factor to nominal food price increases along with other factors such as weather, trade barriers, US dollar depreciation, speculation, etc. Also, agricultural land areas in developed countries really haven't changed recently and consequently the link to displacement of diverse ecosystems is not a major issue in those countries as it might be in developing countries seeing a rapid intensification of agricultural production, in part because of biofuels.	Accepted. The section has been thoroughly revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30110	5	53	7	53	10	Why would climate policies stimulate a move from biomass to commercial fuels (I assume electricity, gas and LPG?) Biomass is usually considered carbon-neutral, unlike the commercial fuels, so a move away from biomass to electricity (unless carbon-free), gas or LPG would increase GHG emissions. Does the statement refer to the fact that biomass produces black carbon, or that it is often unustainably harvested and therefore not carbon neutral? If so, this should be clearly explained in the text.	Accepted. The section has been thoroughly revised.
34306	5	53	7	53	14	This is interesting material but should be added to section 9.7.3.1 that deals with co-benefits of mitigation options for cooking in a more detailed way. Please liaise with the responsible LAs for coordination purposes. The same goes for lines 35-36.	noted, text rewritten and coordinated with xcut
24127	5	53				In many countries, waste pickers provide the only form of solid waste collection. For example, data contained in Brazil's official statistical system show that over a quarter million persons are engaged in waste picking in that country. Though a small proportion of the population, these workers are responsible for the high rates of recycling in Brazil. CEMPRE – a not for profit association dedicated to promoting recycling within the context of integrated waste management in Brazil – published data showing that in 2008, nearly 92 per cent of aluminium and 80 per cent of cardboard in Brazil was recycled. The organization's database Ciclosoft 2008 also shows that only seven per cent of municipalities have implemented official source-segregation schemes. Thus, it concluded the high rates of recycling are achieved by waste pickers (be it organized or non-organized) mainly working outside of municipal recycling schemes. The GTZ/CWG study "Economic Aspects of the Informal Sector in Solid Waste 2007" shows that it makes sense for cities to build their solid waste systems by integrating traditional waste pickers. The research covered six cities on four continents. The focus of the study was on the relationship between formal and informal solid waste activities. The table below shows the value and contribution of informal waste pickers to solid waste management systems. Table 1 – 2007 GTZ/CWG Findings City Number of waste pickers Average earnings (Euro per day) Child earnings (% of adult) Women earnings (as % of men's earnings) Total recycled (formal) % Total recycled (informal) % Total avoided costs for collection plus avoided costs for disposal for waste system (x Euro 1000/year) Cairo (Egypt) 40,000 4,3 - 13% 66% 14,473 Cluj –Napoca (Romania) 3,226 6,28 - 87% 5% 9% 63 Lima (Peru) 17,643 5,4 25% 60% 0.3% 20% 15,758 Lusaka (Zambia) 402 6,52 80% 4% 3% 1,472 Pune (India) 8,850 2,8 30% 56% - 22% 2,218 Quezón City (The Philippines) 10,105 6,26 63% 100% 2% 23% 4,210 Total 6 cities 80,304 38,193 The main findings of the GTZ/CWG study are:	noted, text rewritten

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36588	5	53	35	53	36	This paragraph is repetitious with the same statistics that are discussed at the beginning of the chapter.	noted, text rewritten
36589	5	53	35	53	36	What is the message in this table? It is not described in the text. Are the numbers meant to describe the percent increase?	noted, text rewritten
35248	5	53	37			Existing review related to the risks and trade off of mitigation actions is too weak. It is suggested to add some more paragraphs to describe the following risks and trade off, e.g. the cost of mitigation actions, the impact on employment and the poor and vulnerable groups, and risks of economic transitions, etc.	Accepted. There is very limited empirical evidence, which is the focus of CH5. We have included literature on these points in Section 5.7.2
31411	5	54	14	54	15	Please provide more specific information about what participation that are being referred to.	Accepted. The section has been revised.
35376	5	54	19			Suggestion to delete the sentence: "Economic co-benefits are also reported for both of the cement plant owner and local government to treat municipality wastes in the cement kiln, while it also reduces GHG emissions (Sano et al., 2005)." The reasons is that incineration of wastes in cement kilns, both municipal solid waste and industrial waste, have been reportedly negative for the social, economical and environmental aspects of the local waste management in several towns and countries. The co-benefits from burning hazardous wastes to the cement kiln plants should be excluded from the CDM as the CO2 emissions from particular hazardous waste materials are still unknown. See report by GAIA: Vargas, J.T. & Vilella, M., 2013. From Bordo Poniente to CEMEX : the CDM's support for waste incineration in cement factories. (January) in http://www.no-burn.org/downloads/From%20Bordo%20Poniente%20to%20CEMEX%20_final.pdf. See other reports about the pollution related to incineration of waste in cement kilns: Carrasco, F., Bredin, N. & Heitz, M., 1994. Atmospheric Pollutants and Trace Gases. , pp.1484–1490.; García-Pérez, J. et al., 2013. Cancer mortality in towns in the vicinity of incinerators and installations for the recovery or disposal of hazardous waste. Environment international, 51, pp.31–44. Available at: http://www.ncbi.nlm.nih.gov/pubmed/23160082 [Accessed April 16, 2013].	Accepted. The section has been revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
35425	5	54	19			Suggestion to delete the sentence: "Economic co-benefits are also reported for both of the cement plant owner and local government to treat municipality wastes in the cement kiln, while it also reduces GHG emissions (Sano et al., 2005)." The reasons is that incineration of wastes in cement kilns, both municipal solid waste and industrial waste, have been reportedly negative for the social, economical and environmental aspects of the local waste management in several towns and countries. The most remarkable examples are in Spain, where incineration of waste in cement kilns has mostly obeyed economical interests from the cement companies which are currently under much pressure due to the crisis faced in the construciton sector. The public administration does save money in the short-term sending waste to be incinerated in the cement kilns instead of paying for it to be incinerated in the conventional plants or buried in the landfills. However, incineration of waste in cement kilns is still at the bottom of the Waste Hierarchy for Waste Management options according to the European Commision Directives on Waste. The disposal of waste, whether this is in incinerators or in cement kilns, is the least preferable option in comparison to the prevention, reuse or recycling of waste, which offer much advantage in terms of mitigation of GHG emissions, benefits for the local economy through jobs creation, and sustainable development through resource efficiency. For information about Spain please see the report: Puig, I., Jofra, M. & Calaf, M., 2012. La puerta de atrás de la incineración de residuos. Other remarkable examples have been found in Mexico, where the incineration of waste from the Mexico City in cement kilns in the neighbouring state of Hidalgo has stopped after breaching the local and national law. Since the incineration of waste started in March 2012, the local community has organised and filed formal complaints to the local authorities and the Clean Development Mechanism for their eventual support to the project. See report by GAIA: Vargas, J.T. & Vilella, M., 2013. From Bordo Poniente to CEMEX : the CDM's support for waste incineration in cement factories. (January) in http://www.no-burn.org/downloads/From%20Bordo%20Poniente%20to%20CEMEX%20_final.pdf. See other reports about the pollution related to incineration of waste in cement kilns: Carrasco, F., Bredin, N. & Heitz, M., 1994. Atmospheric Pollutants and Trace Gases. , pp.1484–1490.; García-Pérez, J. et al., 2013. Cancer mortality in towns in the vicinity of incinerators and installations for the recovery or disposal of hazardous waste. Environment international, 51, pp.31–44. Available at: http://www.ncbi.nlm.nih.gov/pubmed/23160082 [Accessed April 16, 2013].	Accepted. The section has been revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
26933	5	54	19			Suggestion to delete the sentence: "Economic co-benefits are also reported for both of the cement plant owner and local government to treat municipality wastes in the cement kiln, while it also reduces GHG emissions (Sano et al., 2005)." The reasons is that incineration of wastes in cement kilns, both municipal solid waste and industrial waste, have been reportedly negative for the social, economical and environmental aspects of the local waste management in several towns and countries. The most remarkable examples are in Spain, where incineration of waste in cement kilns has mostly obeyed economical interests from the cement companies which are currently under much pressure due to the crisis faced in the construciton sector. The public administration does save money in the short-term sending waste to be incinerated in the cement kilns instead of paying for it to be incinerated in the conventional plants or buried in the landfills. However, incineration of waste in cement kilns is still at the bottom of the Waste Hierarchy for Waste Management options according to the European Commision Directives on Waste. The disposal of waste, whether this is in incinerators or in cement kilns, is the least preferable option in comparison to the prevention, reuse or recycling of waste, which offer much advantage in terms of mitigation of GHG emissions, benefits for the local economy through jobs creation, and sustainable development through resource efficiency. For information about Spain please see the report: Puig, I., Jofra, M. & Calaf, M., 2012. La puerta de atrás de la incineración de residuos. Other remarkable examples have been found in Mexico, where the incineration of waste from the Mexico City in cement kilns in the neighbouring state of Hidalgo has stopped after breaching the local and national law. Since the incineration of waste started in March 2012, the local community has organised and filed formal complaints to the local authorities and the Clean Development Mechanism for their eventual support to the project. See report by GAIA: Vargas, J.T. & Vilella, M., 2013. From Bordo Poniente to CEMEX : the CDM's support for waste incineration in cement factories. (January) in http://www.no-burn.org/downloads/From%20Bordo%20Poniente%20to%20CEMEX%20_final.pdf. See other reports about the pollution related to incineration of waste in cement kilns: Carrasco, F., Bredin, N. & Heitz, M., 1994. Atmospheric Pollutants and Trace Gases. , pp.1484–1490.; García-Pérez, J. et al., 2013. Cancer mortality in towns in the vicinity of incinerators and installations for the recovery or disposal of hazardous waste. Environment international, 51, pp.31–44. Available at: http://www.ncbi.nlm.nih.gov/pubmed/23160082 [Accessed April 16, 2013].	noted, text rewritten
34314	5	54	8	54	16	Please delete these sentences and cross-reference section 6.6.2.6 where the post-AR4 literature is assessed in detail.	noted, text rewritten
36590	5	54	35	54	46	It is not clear why this figure is included with the previous figure. It should be a separate figure instead of (b).	Rejected. We are sorry but we could not identify the figure to which this comment refers.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
32491	5	548				The page numbers refer to the pages of the pdf document (and do not coincide with the page numbers as printed in the bottom right of the document. Life Cycle Assessment (LCA) is standardused by ISO with that name. Therefore, it should never be referred to as Life Cycle Analysis. Furthermore, once defined, it can be referred to simply as "LCA". Many important works of Brandão et al. (e.g. 2013) and Levasseur are missing, which are particular relevant to chapters 8 and 11. These are: -Brandão M, Levasseur A, Kirschbaum M, Cowie A, Weidema B, Jørgensen SV, Hauschild M, Chomkhamsri K, Pennington D (2013) Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting. The International Journal of Life Cycle Assessment 18 (1) 230-240. DOI: 10.1007/s11367-012-0451-6. http://link.springer.com/article/10.1007%2Fs11367-012-0451-6 -Levasseur A, Lesage P, Margni M, Brandão M, Samson R (2012) Assessing temporary carbon sequestration and storage projects through land use, land-use change and forestry: comparison of dynamic life cycle assessment with ton-year approaches. Climatic Change. DOI: 10.1007/s10584-012-0473-x. http://www.springerlink.com/content/b3251u56v728m870/?MUD=MP13. -Levasseur A, Brandão M, Lesage P, Margni M, Pennington D, Clift R, Samson S (2012) Valuing temporary carbon storage. Nature Climate Change 2, 6–8. doi:10.1038/nclimate1335. http://www.nature.com/nclimate/journal/v2/n1/full/nclimate1335.html. -Brandão M, Mila i Canals L, Clift R (2011) Soil Organic Carbon changes in the cultivation of energy crops: implications for GHG balances and soil quality for use in LCA. Biomass & Bioenergy35 (6). 2323–2336. Special issue: Modelling Environmental, Economic and Social Aspects in the Assessment of Biofuels. http://www.sciencedirect.com/science/article/pii/S0961953409002402 -Brandão M, Clift R, Mila I Canals L, Basson L (2010) A Life-Cycle Approach to Characterising Environmental and Economic Impacts of Multifunctional Land-Use Systems: An Integrated Assessment in the UK. Sustainability 2(12): 3747-3776. Special issue: Life Cycle Sustainability Assessment. http://www.mdpi.com/2071-1050/2/12/3747/pdf -Mueller-Wenk R and Brandão M (2010) Climatic impact of land use in LCA - carbon transfers between vegetation/soil and air. The International Journal of Life Cycle Assessment 15(2) 172-182. http://www.springerlink.com/content/02628184t2q98051/fulltext.pdf -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. Springer. 125pp. -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. PhD thesis. Centre for Environmental Strategy (Division of Civil, Chemical and Environmental Engineering), Faculty of Engineering and Physical Sciences, University of Surrey, UK. 246 pp. Appendices 541 pp. -Mulligan D, Edwards R, Marelli L, Scarlat N, Brandão M, Monforti-Ferrario F (2010) The effects of increased demand for biofuel feedstocks on the world agricultural markets and areas. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-16220-6. http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/16193/1/en24464_iluc%20workshop.pdf -Brandão M, Levasseur A (2011) Assessing temporary carbon storage in life cycle assessment and carbon footprinting: outcomes of an expert workshop. Joint Research Centre, European Commission, Ispra, Italy	Accepted. Will use standard terms.
23909	5	55	17	55	34	This paper is relevant for this section http://www.pnas.org/content/early/2009/07/02/0905232106.abstract	Rejected. We are grateful for the reference, but consider it more appropriate for CH4.
34061	5	55	18	55	20	What is the evidence to support this statement that various large Asian countries have per capita emissions comparable to OECD countries? There is no reference citation here, and previous figures do not break down per capita emissions according to countries to support this. Figures showing average per capita emissions and GDP show emissions at much lower levels for similar per capita GDP levels in Asian countries compared to OECD countries. This statement should be removed if not supported.	Accepted. The text is revised.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
40603	5	55	30	55	34	It is sure that some part of GHG flows from developed countries to developing countries. However, the assessment should not be limited to carbon emission, but multi-facetted assessment including industrial structure, international specialization, economic effects, technology transfer, and so on.,	Noted. We could not address this comment, as were not sure in what direction the comment would like to see the text changed.
40604	5	55	46	55	51	This summery is very good. Please cite it in TS and SPM.	Noted. Thanks. Indeed part of this will feature in the TS.
40605	5	56	1	56	10	Although there is some rebound effects, in many cases the majority of studies shows 30-35% and efficiency measures achieve 65-70% of their original purposes, as shown in P51 L6-L8. This should be cite here to show that innovation can contribute to the reduction of GHG emission as well as increasing efficiency of industry and life.	Rejected. This section is about rebound. Innovation is addressed in teh following section.
36591	5	56	14	56	15	Is this sentence saying that no policies have been successful in reducing GHG emissions? Since the authors have previously cited some policies have been successful, we don't think the this it is true to say "policies have proved ineffective".	Rejected. Sorry, but we could not locate the sentence referred to. On SOD, p56, line 15, we write "A combination of strategies is generally found to be more effective than applying any one strategy", which is very different from what is cited by the comment.
33685	5	56	19			… and organizations also contribute to emissions.	Noted. Rephrased.
33686	5	56	25			… As described across the different sections of …	Noted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
32492	5	563				The page numbers refer to the pages of the pdf document (and do not coincide with the page numbers as printed in the bottom right of the document. Life Cycle Assessment (LCA) is standardused by ISO with that name. Therefore, it should never be referred to as Life Cycle Analysis. Furthermore, once defined, it can be referred to simply as "LCA". Many important works of Brandão et al. (e.g. 2013) and Levasseur are missing, which are particular relevant to chapters 8 and 11. These are: -Brandão M, Levasseur A, Kirschbaum M, Cowie A, Weidema B, Jørgensen SV, Hauschild M, Chomkhamsri K, Pennington D (2013) Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting. The International Journal of Life Cycle Assessment 18 (1) 230-240. DOI: 10.1007/s11367-012-0451-6. http://link.springer.com/article/10.1007%2Fs11367-012-0451-6 -Levasseur A, Lesage P, Margni M, Brandão M, Samson R (2012) Assessing temporary carbon sequestration and storage projects through land use, land-use change and forestry: comparison of dynamic life cycle assessment with ton-year approaches. Climatic Change. DOI: 10.1007/s10584-012-0473-x. http://www.springerlink.com/content/b3251u56v728m870/?MUD=MP13. -Levasseur A, Brandão M, Lesage P, Margni M, Pennington D, Clift R, Samson S (2012) Valuing temporary carbon storage. Nature Climate Change 2, 6–8. doi:10.1038/nclimate1335. http://www.nature.com/nclimate/journal/v2/n1/full/nclimate1335.html. -Brandão M, Mila i Canals L, Clift R (2011) Soil Organic Carbon changes in the cultivation of energy crops: implications for GHG balances and soil quality for use in LCA. Biomass & Bioenergy35 (6). 2323–2336. Special issue: Modelling Environmental, Economic and Social Aspects in the Assessment of Biofuels. http://www.sciencedirect.com/science/article/pii/S0961953409002402 -Brandão M, Clift R, Mila I Canals L, Basson L (2010) A Life-Cycle Approach to Characterising Environmental and Economic Impacts of Multifunctional Land-Use Systems: An Integrated Assessment in the UK. Sustainability 2(12): 3747-3776. Special issue: Life Cycle Sustainability Assessment. http://www.mdpi.com/2071-1050/2/12/3747/pdf -Mueller-Wenk R and Brandão M (2010) Climatic impact of land use in LCA - carbon transfers between vegetation/soil and air. The International Journal of Life Cycle Assessment 15(2) 172-182. http://www.springerlink.com/content/02628184t2q98051/fulltext.pdf -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. Springer. 125pp. -Brandão M (2012) Food, Feed, Fuel, Timber or Carbon Sink? Towards Sustainable Land Use: a consequential life cycle approach. PhD thesis. Centre for Environmental Strategy (Division of Civil, Chemical and Environmental Engineering), Faculty of Engineering and Physical Sciences, University of Surrey, UK. 246 pp. Appendices 541 pp. -Mulligan D, Edwards R, Marelli L, Scarlat N, Brandão M, Monforti-Ferrario F (2010) The effects of increased demand for biofuel feedstocks on the world agricultural markets and areas. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-16220-6. http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/16193/1/en24464_iluc%20workshop.pdf -Brandão M, Levasseur A (2011) Assessing temporary carbon storage in life cycle assessment and carbon footprinting: outcomes of an expert workshop. Joint Research Centre, European Commission, Ispra, Italy	Accepted. Will use standard terms.
24250	5	57				A driver which would deserve to be mentioned in this figure is "Investments", or perhaps conventional GDP based "Economic growth" as we know it. This would also link this chapter on drivers to a discussion on enhanced models & indicators (as suggested in No. 4 above) and to Chapter 16.	Noted. We try to include infrastructure into the figure. GDP growth is included through "Production and Consumption"
31412	5	57	1			This figure nicely puts factors, drivers and polices together and could be moved section 5.1 to lay out the framework from the beginning.	Accepted.
36592	5	57	11	57	11	This sentence is rather long. Please consider revising it.	Noted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36593	5	57	15	57	19	What is the basis for stating that "so far, policies have provide ineffective in influencing behavioural choices in a way that curb the upward GHG emissions trends? Future policies, climate or non-climate ones, will have to deal with the complexity of the drivers and their interconnection, if the aim is to change the future GHG emissions trends."? There is no discussion of what GHG emissions would have been in the absence of policies that have been put into place so what is the point of comparison used in saying that policies have not reduced GHG emissions. Emissions may still be rising, but less quickly than they otherwise would have. In addition, there is little discussion of price incentives in this chapter. There are numerous complex interactions, but a key policy driver for mitigating GHG emissions is to place a greater price incentive on lowering emissions.	Accepted. Thank you for raising this point. We have rephrased the text to reflect more accurately the trends. We substituted insufficient for ineffective, as we do not want to suggest that policies have no effect. Furthermore, we add the condition that the statement applies to most countries, not necessrally to all. Lastly, we don't write that emissions are not reduced compared to a counterfactual, but only that emissions have not gone down.
36594	5	57	16	57	17	This is not true. See section 3.9 for a description. We recommend deletion.	Noted. Thank you for raising this point. We have rephrased the text to reflect more accurately the trends. We substituted insufficient for ineffective, as we do not want to suggest that policies have no effect. Furthermore, we add the condition that the statement applies to most countries, not necessrally to all. Lastly, we don't write that emissions are not reduced compared to a counterfactual, but only that emissions have not gone down.
30850	5	57	21	57	22	The wording of this question is awkward. Suggest changing to "What considerations constrain the range of choices available to society to contribute to lower GHG emissions?". The second part of the question seems unnecessary based on the answer provided.	Accepted. Suggested change was made.
36595	5	57	21	58	13	This FAQ is a seemingly random collection of thoughts that when read over and over still doesn't add up to a coherent exposition. It needs to be improved or deleted.	Noted. The FAQ has been moved to an earlier position in the chapter. It remains as an FAQ, but its earlier positon in the chapter produces te intended result

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
36596	5	57	23	58	13	Please revisit this discussion. We recommend that it be revised to be more analytical or deleted. We also recommend that the authors break the sentences into smaller pieces. They are too long. Please also add citations.	Taken into Account. The text has been revised into a shorter FAQ with simpler sentences. It is not possibble to be more quantitative, however, for exactly the reasons given in FAQ 2. For a given option it is impossible to unambiguously attribute X % of the change to technology (say) and (100-x)% to behaviour, because the same change may appear to be a technological change to an engineer and a bavioural change to a social scientist. The FAQ focuses on the fallacy that either class of change ALONE will make a very limited contribution to reduction in GHG emissions. Rather both technological "solutions" and behavioural ones are de facto deserving some credict for any reduciton in emissions, and efforts on all fronts are useful. Which efforts are highest payoff with be extremely context specific.
33687	5	57	25			… service requires that …	Accepted. Revised in shortened version
33688	5	57	26			… that they are priced …	Accepted. Revised in shorened version
33689	5	57	28			… choice of how much to consume is …	Accepted. Text is revised.
36597	5	58	14	58	39	Please expand this section to more adequately discuss the uncertainties. More specific data is needed. Support with citations.	Accepted. New text has been added to the chapter, much of it related to and included in Section 5.2.
36598	5	58	15	58	17	The text mentions how a lot of uncertainty and variation exist with terrestrial emissions and ends. Is this due to uncertainty concerning data collection? Please explain in the discussion.	Accepted. New text has been added to the chapter, much of it related to and included in Section 5.2.
33690	5	58	2			… products and services that are desirable, …	Accepted. Revised in shortened version

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
29980	5	58	22	58	29	The discourse seems very generic and with very old references. A lot of important references on this point are not considered: as ane example, all the work made by the Inter Acadamic Council to Review of the Processes and Procedures of the IPCC (http://www.interacademycouncil.net/24026/26050.aspx) must be cited. Other fundamental works that must be cited are (as an example), Morgan et al 2009 [Morgan, M.G., H. Dowlatabadi, M. Henrion, D. Keith, R. Lempert, S. McBride, M. Small, and T. Wilbanks, eds., 2009, Best Practice Approaches for Characterizing, Communicating, and Incorporating Scientific Uncertainty in Climate Decision Making, A report by the Climate Change Science Program and the Subcommittee on Global Climate Change Research, National Oceanic and Atmospheric Administration, Washington, D.C., 96 pp]. or NAS, 2003 [NAS (U.S. National Academy of Sciences), 2003, Policy and procedures on committee composition and balance and conflicts of interest for committees used in the development of reports, available at http://www.nationalacademies.org/coi/index.html.]	Accepted. The text is revised. We use the terms 'evidence' and 'agreement' consistently with the 'best practice approaches..' suggested by the reviewer.
22574	5	58	27	58	30	Delete this paragraph as the claim that the literature does not provide a clear answer what the cause of different emissions levels are is simply wrong. The role of technologies within the energy systems and why those technologies have been chosen are very well documented e.g. from the IEA over the past 30 years. Rewrite the whole section with more detailed information from IEA, SRREN and other sources.	Accepted. The text is revised, more specific and connecting to the chapter sections.
36600	5	58	38	58	39	The authors should reconsider sentence of co-benefit discussion. See discussion in Chapter 3 and chapter 6.	Noted. The text is revised together with Section 5.7.
24251	5	58				Related to drivers it would make sense to mention the approach developed by GHG Protocol to report avoided emissions in society (Scope 3) - either from research or as a gap for further research - as stimulating and rewarding such strategies is vital for mitigating climate change.	Rejected. CH5 does not deal with mitigation instruments for future use. Let us note that a reference would have been useful! I assume the comment refers to http://www.ghgprotocol.org/files/ghgp/Corporate%20Value%20Chain%20%28Scope%203%29%20Accounting%20and%20Reporting%20Standard.pdf.
36599	5	58	15	58	19	This section is not very helpful as currently written. It would be better to include a terminal paragraph in each preceding section that draws out gaps in knowledge and data specific to the issue at hand.	Noted. The chapter structure is given and not amenable to change.
34047	5	6				GNE has not been defined in Annex 1 Glossary, GNP is defined however. There should be consistency in the use of the terminology and definitions.	Accepted. GNE will be included in the glossary.
30840	5	6	10			Suggest changing to "would need to be addressed and acted upon". There is a verb tense issue in this sentence.	Accepted: The ES was revised accordingly.
33655	5	6	10			… need to be addressed and …	Accepted: The ES was revised accordingly.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
21662	5	6	11	6	13	Please quantify the potential role of the rebound effect. Numbers are provided in the SPM that are not reflected in this chapter.	Noted. This has been done. The relevant text reads "A comprehensive review of 500 studies suggests that direct rebounds are likely to always be over 10% and could be considerably higher (i.e. 10% less savings that the projected saving from engineering principles). For household efficiency measures the majority of studies show rebounds in the region of 30-35%, meaning that efficiency measures achieve 65-70% of their original purposes (Greening et al., 2000; Bentzen, 2004; Sorrell, 2007; Sorrell et al., 2009); (Haas and Biermayr, 2000); (Berkhout et al., 2000); (Schipper and Grubb, 2000); (Freire González, 2010)."
19417	5	6	12	6	13	Thank you for qualifying the Kaya Identity's energy intensity term by noting rebound effects. Big problem with this approach.	Noted
36344	5	6	14	6	14	If behaviour change is given a low agreement, limited evidence rating but in this paragraph, it is discussed as an overarching driver. As such, it seems to deserve a higher rating. Please review and revise as necessary.	Accepted rating changed to robust evidence, high agreement
30841	5	6	15	6	17	This is quite a strong statement and implies to the reader that the entirety of all policies employed in the past need to be different. Suggest reviewing wording and increasing precision if possible.	accepted. The change above would addres this comment as wel
36345	5	6	15	6	17	Past policies may not have stopped the upward trend in GHG, but they have presumably reduced the rate of emissions growth relative to the reference case without those policies in place. Past experience does not necessarily imply different policies, but much stronger incentives for behavioral change than have been provided. This could be achieved through more stringent versions of past policies, for instance.	Accepted. We have rephrased the text to reflect more accurately the trends. We do not want to suggest that policies have no effect. Furthermore, we add the condition that the statement applies to most countries, not necessrally to all. Lastly, we don't write that emissions are not reduced compared to a counterfactual, but only that emissions have not gone down.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
29166	5	6	15	6	17	This almost appears framed as if climate policies not reducing emissions. True climate policy is not causing net reductions in global emissions but clearly there are sectors/regions where it is reducing emissions. The drivers of emission growth provide a natural upward trend (not necessarily policy driven) so better to say that current climate and energy policies are not sufficient to buck the overall trend. The past policies may be effective but need scaling up in stringency and coverage (geographical and sectoral). As drafted the text is too negative on policies.	Accepted. We have rephrased the text to reflect more accurately the trends. We do not want to suggest that policies have no effect. Furthermore, we add the condition that the statement applies to most countries, not necessrally to all. Lastly, we don't write that emissions are not reduced compared to a counterfactual, but only that emissions have not gone down.
40570	5	6	16	6	17	This part is hard to imagine. Please indicate some examples on the options which we can have.	accepted. the change above would address this comment as well.
24103	5	6	21	6	22	Isuggest to give here more elaboration on what type of land use, change in land use and forestry are major causes in emission, or that can be added in subsection5.3.1 since . Although that is in chapter 11, but I think there should be something here in this chapter, since chapter is about driving forces.	Accepted. We have included a paragraph on the drivers of emissions increase.
23589	5	6	29	6	29	GNE is not defined, including in Annex 1	Accepted. GNE will be included in the glossary.
21663	5	6	23	6	23	Neither chapter 5 nor chapter 6 gives any details on drivers on the baseline GHG emissions unerlying the RCP scenarios. This is a serious omission that need to be rectified. Similar to the SRES report, there needs to be information on the baseline assumptions of the various models used. This information needs to be comparable with the SRES report and should including GDP, population, energy demand, GHG emissions. This requires a separate section in Ch. 5 or 6.	Noted. This comment has been forwarded to CH6

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30252	5	6	15	6	17	The message that policies need to be "different" is rather simplistic and implies that nothing has been learnt in 50 years. As other chapters (e.g ch 15) aim to show, a number of policies have been effective and cost-effective, allbeit at small, e.g. national/sectoral, level. Please consider qualifying this last statement with a mention of factors influencing policy success and a cross-reference to the relevant sections in policy chapters.	accepted. Two revisions are proposed for the specified text. In the first sentence we have addeded a phrase so it reads : "Past policies, IN AGGREGATE , have not changed drivers and trends in a way that have stopped the upward GHG emissions trends. " THis small addition makes clear the reference is not to every single policy ever tried being a failure. Rather, despite what is likely to be a long list of case histories that could be presented successes, their NET EFFECT has not been a cessation in the upward trend in emissions. The second change is in the next sentence. It would now read "If future policies aim to change the trends and bring emissions down, they will have to make better use of the lessons reported in Chapter 13 regarding global and regional policies, and Chapter 15 regarding national and local policies, to create an integrated policy environment and appropriate incentives that would foster more effective and more accessable technologies, and more motivated consumers and citizens choosing among the available technologies." This now explicitly acknowledges that there have been positive lessons learned. It also makes clear that individual policies rarely result changes in trends: it takes a comprehensive policy environment and corresponding incentives. Even in the cases when there was some single policy change that made a substandial difference, Chpoaters 13 and 15 make clea that the success depended in part
27553	5	64	31	64	32	The citation "Eurostat: Climate Change, …" should be re-considered. Propose to use "Eurostat, 2011: Climate Change - Driving forces. Available at: …" as reference.	Accepted. Editorial
27554	5	65	7	65	7	The year of publication is missing.	Editorial/Accepted.
27555	5	66	35	66	36	The citation of "Greenhouse gas emissions trends and projections in Europe 2009" should be re-considered. Propose to use "EEA (2009). Greenhouse gas emissions trends and projections in Europe 2009?" as reference.	Editorial/Accepted.
27556	5	68	29	68	30	The citation of "international Energy outlook 2011" to be re-considered. Propose to use "US EEA, 2011" as reference.	Editorial/Accepted.
29347	5	69	18			JRC (2012) should be JRC/PBL (2012). And version number (4.2 FT2010) should be added. And add in reference list the full names of JRC and PBL.	Editorial/Accepted.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
19182	5	7	13	7	14	The effects of greenhouse gases are caused by atmospheric concentrations, not emissions, The relationship between these is unknown.	Rejected - It is true that changes in GHG concentrations are the proximate caused of radiative forcing changes. The WG I report describes concentrations and the relationship between emissions and concentrations. It is clear that changes in anthropogenic emissions are causing changes in concentrations, even if these relationships are uncertain. The purpose of this chapter is to describe trends and drivers related to emissions.
23852	5	7	13			"…stocks and flows…". You only look at flows in this section and so I suggest to remove "stocks".	Accepted. In this context, for CO2 "Stock" refers to cumulative CO2 emissions (for which additional discussion has been added), and for non-CO2 the closest equilvalant is radiative forcing, which is also discussed.
36346	5	7	15	8	12	There are no citations for any of this data. Citations are given for data given starting in page 9, but not in either of these pages (except for figure 5.2.1, lines 2-5, page 8)	Accepted - this data is supplied by a database provided by the WG III TZU and an appropriate citation has been added to the figure captions.
23853	5	7	16			No reference to the datasource, nor its robustness	Accepted - Regarding citation, this has been added. Discussion of uncertainty has been added to the text.
27506	5	7	16	7	16	Insert "global" in front of "greenhouse gas emissions".	Accepted - change made
30842	5	7	17			Is "important" the right word? The figure points to it being the greatest proportion of GHGs. Importance means something different and this is not explained in this paragraph.	Accepted - wording changed to "Carbon dioxide (CO2) is the largest component of anthropogenic greenhouse gas (GHG) emissions. "
36347	5	7	17	7	17	Most important', yes but why - because it represents the largest share of anthropogenic GHGs emitted. The authors need to be explicit, both here and in Executive Summary opening statement.	Accepted - wording changed to "Carbon dioxide (CO2) is the largest component of anthropogenic greenhouse gas (GHG) emissions. "
27507	5	7	19	7	19	Insert "the share of" between "… 2010," and "CO2 emissions".	Noted - wording adjusted to read "In 2010, CO2 comprised over 75% of 100-year GAP weighted anthropogenic GHG emissions"

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
33656	5	7	13			What is missing here is a graph showing the shares of GHG emissions by gas (CO2, CH4, N2O and F-gases) of the 5 main regions. In the text reference should be made to underline that when analysing shares of fossil-fuel related CO2 emissions only, the shares of Annex I countries tend to be larger, since non-Annex I countries generally have higher shares of CO2 emissions from deforestation and of CH4 and N2O emissions. This also applies to cumulative emissions.	Taken into account - Space limits preclude adding another figure, but suggest to add lighter shading in each regional area in SOD figure 5.2.1 that indicates the contribution over time of non-CO2 GHG emissions.
29350	5	7	13			What is missing here is a graph showing the shares of GHG emissions by gas (CO2, CH4, N2O and F-gases) of the 5 main regions. In the text reference should be made to underline that when analysing shares of fossil-fuel related CO2 emissions only, the shares of Annex I countries tend to be larger, since non-Annex I countries generally have higher shares of CO2 emissions from deforestation and of CH4 and N2O emissions. This also applies to cumulative emissions.	Taken into account - Comment duplicates previous comment.
32408	5	7	13	12	33	Please assure consistency with corresponding WGI Chapters and use latest availabel data in figures.	Taken into account - Figures were updated once WG I chapters were finalized.
27557	5	70	27	70	27	The placeholder should be completed.	Editorial/Accepted.
27558	5	71	19	71	19	The placeholder should be completed.	Editorial/Accepted.
27560	5	73	11	73	12	The year of publication is missing.	Editorial/Accepted.
27559	5	73	4	73	4	The placeholder should be completed.	Editorial/Accepted.
19423	5	75	35	75	36	The updated citation is: Saunders, H.D. (in press, 2013). “Historical evidence for energy consumption rebound in 30 US sectors and a toolkit for rebound analysts.” Technological Forecasting and Social Change http://dx.doi.org/10.1016/j.techfore.2012.12.007.	Editorial/Accepted.
27561	5	78	20	78	20	The citation of "UNEP 2008 Annual Report, 2009" should be re-considered. Propose to use "UNEP (2009). UNEP Annual Report 2008?" as reference	Editorial/Accepted.
33658	5	8				Recommend to remove "(territorial)" and discuss up front in the chapter that default figures refer to "production-based" or "territorial" emissions of countries and regions (cf. UNFCCC and IPCC inventory guidelines), unless stated otherwise.	Noted - while this is a good point, the chapter is space limited. We have retained this in the figure caption so that the figure is self-explanatory, but now also refer to the later section where territorial vs. consumption-based emissions are examined.
30558	5	8				The figure lacks neatness and not expressive. It could be better if it can be expressed with atractive figure.	Noted - Figures have been redrawn.
29356	5	8				Recommend to remove "(territorial)" and discuss up front in the chapter that default figures refer to "production-based" or "territorial" emissions of countries and regions (cf. UNFCCC and IPCC inventory guidelines), unless stated otherwise.	Noted - while this is a good point, the chapter is space limited. We have retained this in the figure caption so that the figure is self-explanatory, but now also refer to the later section where territorial vs. consumption-based emissions are examined.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
32160	5	8				In international transport, I think that maritime emissions are as great as flight ones. Check international transport only 2.2% ? I am sure that avation alone is 2%	Noted - Aviation is 1.6% in the EDGAR DB (which is consistent with literature estimates), however note that only 60% of this international avaiation, which is what is in this figure. EDGAR uses IEA statistics which, unforuntatley, underestimate shipping fuel use (Erying et al 2009). Re-calculation of bunker fuel use using an updated fuel time series (Klimont et al. 2013), results in international bunker fuels being 2% of total emissions by 2010, which means that international travel is 2.9% of total emissions in 2010 instead of 2.2% as estimated by EDGAR. This will be noted in the transportaiton sector section.
27508	5	8		8		Meaning of inserted table at the right bottom with headings "Sector, 70s, 80s, 90s" is unclear; there is fairly no reference in the text; propose to delete it.	Accepted - all graphs are redrafted
27509	5	8		8		nomenclature of "Economies in Transition" (EITs) or "Reformation Economies" and its abbreviation throughout the hole document is not consistent. Use one single term, such as EIT.	Accepted - EIT adopted.
19830	5	8		9		We need a list of which countries are included in OECD90 and REF (probably in an appendix). This should clarify any overlap, e.g. between OECD90 and Asia. Also we need consistency. Fig 5.2.1 uses REF whereas Fig 5.2.2 uses "Economies in Transition". Ch 6 sometimes uses the acronym EIT	Accepted. The report will contain a list of region definitions and consistency between figures. We use EIT throughout.
36348	5	8	1			Maybe this is assumed to be obvious, but it seems like this and other similar figures should specify that the values reported in the table represent average annual percentage changes by decade.	Accepted - all graphs are redrafted
24347	5	8	10	8	12	The statement should present a complete accurate picture of the situation as presented in Figure 5.2.1.It is suggested to reword it as follows: "The 1990 OECD countries contributed most to the pre-1970 emissions,and since then have continued to contribute a significant share of global emissions,with a share of 55.1% in the total cumulative emissions over 1970-2009."	Accepted - text and figure edited to be more balanced. Note that figure has a new format that more clearly shows the evolution of cumulative CO2 emissions over time.
33659	5	8	10	8	11	The OECD countries contributed most to the emissions in 1990, but..	Accepted - text and figure edited to be more balanced. Note that figure has a new format that more clearly shows the evolution of cumulative CO2 emissions over time.
22311	5	8	10	8	12	The statement should present a complete accurate picture of the situation as presented in Figure 5.2.1, by rewording it as follows: "The 1990 OECD countries contributed most to the pre-1970 emissions and since then have continued to contribute a significant share of global emissions (approximately 12-15 GTCO2e GHG emissions per year), even as, since 1970, developing countries' share of global emissions in both absolute and percentage terms have risen over time to constitute a major share of global emissions."	Accepted - text and figure edited to be more balanced. Note that figure has a new format that more clearly shows the evolution of cumulative CO2 emissions over time.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30556	5	8	11			The figures lack consistency neither they are territory based nor activity based. The Figure captions are more of text (body text)type. Comparisions and explanations are as part.	Noted - First part of this comment is not clear to us -- all these figures are territorial emissions. Figure captions have been edited to more clearly describe the figures, with some material moved into the main text.
36350	5	8	15	9		This figure reports global and regional emissions with three significant figures and no quantification or qualification of uncertainty.. Furthermore, presumably this data is presented elsewhere (e.g., WGI) and ought to be cross-referenced.	Accepted - Superfluous precision to be removed. References added and uncertainty discussed in the text.
30559	5	8	18		20	Though the amount of CFCs released to the atmosphere is minimal, the gases have strong GWP. This is not only they are potent but the dissociation and resumption of continuous ozone depleting cycles with the help of UV. I feel that the condition and the existance of the cycle need to be mentioned.	Taken into account - Note is added that CFCs are not discussed in this chapter, but instead in WG I report.
36349	5	8	2	8	2	The acronym for transitional economies used in this figure and many others is "REF" -- which should be changed because it is too easily confused with a reference case scenario (for which "REF" is commonly used).	Accepted - We use EIT in the final draft throughout WG3.
29348	5	8	4	8	5	This caption tekst should be in main text.	Accepted - text moved.
35244	5	8	6	9	8	This conclusion confuses the concepts of stock and flow. It is not appropriate to compare cumulative emissions with one year emission data in 2010. The conclusion of “The 1990 OECD countries contributed most to the pre-1970 emissions” is incomplete. In fact, OECD countries still account for most GHG emission stock. It is suggested to revise the sentence as follows, “The 1990 OECD countries contributed most to the pre-1970 emissions, and are still the main contributors to emissions up to 2010, with a share of 61.1% in the total cumulative emissions over 1750-2010". In addition, it is also recommended to add a bar within figure SPM.3, which gives the whole picture and indicates the cumulative emissions over 1750-2010. Please find the suggested revised figure 4 in the attached WORD file.	Accepted - text revised and new figure also shows cumulative emissions from 1750 - 2010 (as well as for decades leading up to this point.) and also LUC emissions in a similar figure as part b.
26314	5	8	6	8	6	Include "from fossil fuel burning" in the statement: "Figure 5.2.2 shows the growth in CO2 emissions, (…)"	Taken into account - word "fossil" inserted into caption to clarify.
33657	5	8	6			Reference is made to CO2 emissions, but refers only to fossil-fuel related emissions (should be added in line 6). If left as-is, it should be made clear that CO2 from deforestation and non-CO2 emissions are not presented, thereby showing annual and cumulative emissions of Annex I and non-Annex I regions skewed to higher Annex I shares. However, one could also show total GHG emissions, e.g. from Höhne et al. (2011) Contributions of individual countries’ emissions to climate change and their uncertainty,Climatic Change,106,359–391. The data in this paper have been recently updated through 2010 (contact Höhne or Den Elzen).	Taken into account - text revised and new figure also shows cumulative emissions from 1750 - 2010 (as well as for decades leading up to this point.) and also LUC emissions in a similar figure as part b. We only show flows of total GHG emissions (in other figures) since differing lifetimes makes it problamatic to present a simple cumulative number for non-CO2 GHGs.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
24599	5	8	6	9	4	It is important to make a distinction between changes in annual or decadal contributions to global emissions and changes in cumulative contributions (which are related but not the same), particularly as the latter is a key factor in attributing responsibility for current warming and apportioning differentiated mitigation burdens. While Asia has now overtaken other regions as the most significant contributor to annual CO2 emissions, it still accounts for only 19.2% of cumulative emissions while OECD countries account for 61.9%. For this reason, presenting a 'snapshot' of current (2010) emissions against cumulative emissions should be undertaken with caution and with appropriate explanatory text.	Taken into account - text revised and new figure also shows cumulative emissions from 1750 - 2010 (as well as for decades leading up to this point.) and also LUC emissions in a similar figure as part b.
29349	5	8	6			Reference is made to CO2 emissions, but refers only to fossil-fuel related emissions (should be added in line 6). If left as-is, it should be made clear that CO2 from deforestation and non-CO2 emissions are not presented, thereby showing annual and cumulative emissions of Annex I and non-Annex I regions skewed to higher Annex I shares. However, one could also show total GHG emissions, e.g. from Höhne et al. (2011) Contributions of individual countries' emissions to climate change and their uncertainty,Climatic Change,106,359–391. The data in this paper have been recently updated through 2010 (contact Höhne or Den Elzen).	Taken into account - text revised and new figure also shows cumulative emissions from 1750 - 2010 (as well as for decades leading up to this point.) and also LUC emissions in a similar figure as part b. We only show flows of total GHG emissions (in other figures) since differing lifetimes makes it pragmatic to present a simple cumulative number for non-CO2 GHGs.
34045	5	8	6	8	12	PL see comment 5 above on representation of cumulative emissions. An additional comment and an additional column in the related figure should be included to show cumulative emissions from 1750-2010. PL see attached calculations.	Taken into account - text revised and new figure also shows cumulative emissions from 1750 - 2010 (as well as for decades leading up to this point.) and also LUC emissions in a similar figure as part b.
23857	5	8	8			The "developing countries" is not quite true as it is actually "asia" and "asia" is actually "china". No need to blame all developing countries for the emissions growth in China?	Taken into account - text revised to note that emissions growth was not equal in all developing regions. While it is true that China dominates the ASIA region, it is also true that emissions also grew rapidly in many other developing regions over this time period. Space limitations also prohibit examine all results on a country level.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
30557	5	8	9	8	12	It would be unfair to generalize the contribution of developing countries and Asia together. Because, the share conribution is incomparable.In addition, the figure shows significant increament for ias and a decreasing trend to the rest including developing nations. Developing countries with less contribution even before 1970s and still with decreasing trend should not be generalized with Asias emission contribution.	Taken into account - text revised to note that emissions growth was not equal in all developing regions. While it is true that China dominates the ASIA region, it is also true that emissions also grew rapidly in many other developing regions over this time period. Space limitations also prohibit examine all results on a country level.
26313	5	8		8		the title of the little box, at the bottom right, is "sector". It should be better as "region".	Accepted - all graphs are redrafted
19427	5	9		9		Panels (a) and (b) are inconsistent. Economies in transition: visual integration of panel (a) over 1970-2009 gives more than 10%, rather 15%, whereas number in panel (b) is 3.8%. This means that also some other percentage in panel (b) is wrong, probably contribution of Asia, which is evidently larger than what visual integration of panel (a) provides.	Noted -- All figures have been redrafted with updated data and percentages checked.
22517	5	9				Please, as the UNFCC war adopted in 1992, show also in Figure 5.2.2 (a), the column for cumulative emissions from 1992 to 2009.	Rejected - While this would certainty be a valid choice, we have chosen to stick with presenting emissions over several decadal periods (in the new version of the figure) so that we can show the impact of changes over consistent time periods.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
39150	5	9				This figure only shows energy CO2 emissions - 60% of total GHG emissions, and even less of a percentage historically (see Fig. 1.3). It is grossly misleading to include a graphic that suggests that Annex I nations accounted for 75% of cumulative emissions from 1750-1970. Indeed, as Fig. 1.3 shows, energy CO2 in 1970 was barely 50% of the total GHG picture! In addition, an overall framework for thinking about atmospheric commitments should logically include not only past and current emissions, but also decisions that put in place infrastructure that commits a nation to future emissions (i.e., the idea of infrastructure lock-in as discussed in, e.g Davis et al., 2010: "Future CO2 Emissions and Climate Change from Existing Energy Infrastructure" Science, 329(5997). A policy-neutral presentation of cumulative emissions would not only include all gases and all sectors, but should also reflect commitments to future emissions. With respect to a source for non-energy CO2 emissions, the authors should strongly consider utilizing the MATCH database (www.match-info.net) and associated references (such as Hohne et al., 2011: Climatic Change, DOI 10.1007/s10584-010-9930-6) as they include CO2, CH4 and N2O from all major sectors for all nations from 1750-2100 under various IPCC scenarios. Additionally, literature should be cited and its underlying data employed (such as Pongratz & Caldeira, 2012: Environ. Res. Lett., doi:10.1088/1748-9326/7/3/034001) to illustrate how historic LULUCF emissions are significant and should not be ignored in discussions of historic responsibility and cumulative emissions. If retained in some heavily modified form, the panel on the right in SPM.3 is also misleading and should be shown in absolute numbers, not percentages as it will likely lead the common policymaker to make inaccurate conclusions. Finally, the panel on the right uses 1970 as a cut off year. A far more relevant year to make the cut-off would be 1990 or 1992.	Taken Into Account - LUC emissions (and their uncertainty) added as a second figure to provide better balance. Only CO2 can be delta with as cumulative emissions, as other GHGs have widely disparate lifetimes, and space prohibits yet a third figure here (however, the previous figure was modified to show the impact of non-CO2 GHGs). Infrastructure is a critical issue of course, and is dealt with in Chapter 12. Comparisons is now also made to the MATCH database (note, however, that this is not fully independent of the data used here). Cumulative emissions portion of the figure has been re-drawn as absolute values, so as to enable more accurate conclusions by policymakers. Several different years are now used in the RH panel, so as to enable trends to be seen. Uncertainty is now indicated. Detailed discussion of land-use change and associated references, however, are differed to Chapter 11.
22312	5	9		9		The arrangement of the regional bars in the columns in Figure SPM.3(b) should be similar to the arrangement of the regional groupings in Figure SPM.3(a) - i.e. from bottom to top, they should be consistently arranged as follows - OECD90, REF, ASIA, LAM, MAF. This will allow for improved cross-figure comparison of the two figures, and would also allow for easy aggregation and comparison between Annex I (OECD90, REF) and Non-Annex I (ASIA, LAM, MAF) aggregate emissions. As it is now, the columns in Figure SPM.3(b) are not consistent with the regional arrangement in Figure SPM.3(a).	Taken Into Account - We will strive for consistency as much as possible. Sometimes other reasons apply to have regions, sectors or gases in different order, though.
19687	5	9	1			Please explicitly indicate if you refer here to Gt of C or to Gt of CO2 for both panels in figure 5.2.2 (I presume the former)	Accepted - y-axis label to be changed (all are GtCO2)
27510	5	9	1	9	1	Figure 5.2.2 (b): please add vertical axis title "Cumulative Percent of CO2"	Taken Into Account - Figure actually changed so is no longer percent.
36351	5	9	2	9		The data are presented with three significant figures, no uncertainty analysis, including for cumulative figures going back to 1750. Please provide uncertainty analysis and revisit the number of significant figures.	Taken Into Account - Figure actually changed so is no longer percent.
36352	5	9	6	9	9	The caption is not descriptive of the figures.	Taken Into Account - Figure captions edited.

Comment No	Chapter	From Page	From Line	To Page	To Line	Comment	Response
34504	5	ALL				Intergenerational equity is an important part of development literature. I don't see any inclusion of a measurement technique in the Chapter. In addition, I had mentioned in the previous review about inclusion of Gini coefficient. You have not included this in the review.	Rejected: The issue of equity as well as countries domestic distribution of welfare is dealt with in Chapter 4.