Review Comments by Experts on the First Order Draft of Volume 3 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
748	3	3			It can be evaluated that the point covering a wide range of	Hideshi Iki	Noted	
1516	3	3			….and equipment leaks. In addition, users of fluorinated GHGs may return empty containers (e.g., cylinders) to the production facility for reuse; prior to reuse, the residual fluorinated GHGs may be removed from the container and, unless they are recovered and recycled or destroyed, these are also an emission source. In many cases, these "heels" are contaminated and sent for immediate destruction. Text and calculation should reflect this.	Archie McCulloch	Accepted	We agree with the commenter and have incorporated the revised text as suggested by adding the text "in many cases, these 'heels' are contaminated and sent for immediate destruction."
1518	3	3			….other fluorinated greenhouse gases. The default emission factors in Table 3.29 are expressed in terms of kg CO2e emitted/kg CO2e produced (that is, both emissions and production are GWP-weighted). [We are considering presenting default emission factors in terms of kg CO2e emitted/kg fluorinated compound produced, which would better account for the fact that high-GWP emissions may result from the production of low-GWP products.] The suggested change makes no sense. 1. This is a factor, and all that the change would do is alter the value of the factor. 2. Process vents and equipment leaks are more likely to contain the product material than anything else, so the basic premise of the proposed change is incorrect. 3. The default factor is unrealistically high; 0.1 kgCO2eq/kgCO2eq of HFC is 10% which is a factor of over 100 higher than the measured factor for ODS (which have equivalent physical & chemical properties). The default factor in the 2006 Guidelines was 0.5%, so why the change?	Archie McCulloch	Rejected	Recent publicly available data show that the emissions are higher than the previously cited default factor for fluorochemical processes. In the U.S., production and transformation facilities report their F GHG emissions from fluorinated gas production and their fluorinated GHG products to the U.S. EPA under the Greenhouse Gas Reporting Program (GHGRP). Analysis of these emissions and production data show that the actual, controlled emissions from fluorochemical processes are in the range of 0.003 to 0.008, and these emission factors align with the 0.005 factor previously cited. [Schaffner, et. al., 2018] Tier 1 default emission factors, however, should not reflect the application of abatement. Further analysis to estimate emissions on a pre-abatement basis show that the emissions from fluorochemical processes are higher than the 0.005 factor previously cited. We believe the 0.005 factor is inline with actual emissions and is not representative of pre-abatement emissions from fluorochemical processes. While the commenter notes that the accepted convention is that the type of fluorinated GHG emitted is generally expected to be similar to the product produced, the data from the GHGRP show that for some processes the type of fluorinated GHG emitted is from a byproduct reaction that produces a fluorinated GHG byproduct that is not similar to the intended product. Process vents and equipment leaks do indeed emit product materials, as the commenter cites, but reactants and byproduct compounds may also be present in these process streams. There are processes in the GHGRP data set that manufacture low GWP products, however, the byproduct reactions produce high GWP compounds that are emitted. For example, HFO products will have emissions of Saturated HFCs from the production process.

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1518 (c'd)						Archie McCulloch		The recently developed emission factors indicate that emissions following control for fluorochemical processes in the GHGRP data set range from 0.003 to 0.008. The commenter indicates that the EEA includes an emission factor of 0.06 percent (or 0.0006), 0.07 percent (or 0.0007), and 0.12 per cent (or 0.0012) for 2016 through 2014, respectively, on a controlled basis for processes that use ODS as feedstock to manufacture other fluorinated products, and this emission factor agrees readily well with the GHGRP data set. The recently developed emission factors from the GHGRP data set indicate that emissions on a pre-abatement basis from fluorochemical processes range from 0.02 to 0.05. While the recently developed emission factors are higher than the previous accepted default emission factor (0.005) in section 3.10.2 of the 2006 IPCC Guidelines, these newer data demonstrate that the emissions are higher than previously understood. The 2006 Guidelines default emission factor of 0.005 is likely underestimating the emissions from fluorochemical processes and should be revised to reflect the new understanding. [Looks like the commenter is referring to an EF from ODS feedstock use in other manufacturing processes, and this value is a value that accounts for treatment/control. See p.7 of 2016 Executive Summary. What is the measured factor for ODS? "A number of ODS serve as feedstock for the manufacture of other products such as refrigerants, foam blowing agents, polymers, pharmaceuticals and agricultural chemicals." "In 2016, the emission rate from feedstock uses amounted to 0.06 %. The fact that the 2016 average emission rate is similar to 2015 and lower than the emission rate for earlier years appears to point towards improvements in emission control by industry."]
1518 (c'd)						Archie McCulloch		U.S. EPA Greenhouse Gas Reporting Program. For reporting years 2010 through 2016. Accessed May 2018. https://www.epa.gov/ghgreporting Schaffner, K.S., D.O. Schaeffer, J.B. Coburn, B.T. Mader, and G.M. Watson. Draft Development of Default Emission Factors for Fluorochemical Production Using Data Reported through the U.S. EPA Greenhouse Gas Reporting Program. June 2018.
1348	3	3	1	1693	Storage and Transport of chemical products: All the different products in the chemical industry (Refinerys, ammonia, nitric acid, …) are transported and stored. During these processes the products emit. Where shall these emissions be reported. I think the easiest way is to add these emissions on the emissions for the different source categorys. Based on AR_produced_amounts x EF_storage_handling = EM_Storage_Handling. The EF_Storage_handling can be a Default-EF for total chemical industry as T1 method. And in future product specific EFs can be developed. The other possibility is to add storage and handling at 2B10 comparable to the NFR category 2B10b.	David Kuntze	Noted	No action can be taken because the comment is out of scope of the 2019 Refinement. However, the authors note that emissions from venting residual F-GHG products from storage cylinders are covered in the Refinement to Chapter 3.10.2, Emissions from production of fluorinated compounds (other than HFC-23 emissions from HCFC-22 production).

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8678	3	3	1	1693	The use of flaring in the chemical industry is not described very well. It would be very relevant to describe the types of chemical industry where flaring is most frequently occurring and provide guidance on how to estimate and where to report emissions. Noting that the flaring in the energy sector currently is for oil and natural gas production/treatment and hence does not necessarily covers the possible flaring associated with all types of chemical industry.	Ole-Kenneth Nielsen	Noted	No action can be taken because the comment is out of scope of the 2019 Refinement.
4510	3	3	100		HNO3, subscript	Kewei Yu	Accepted	
4518	3	3	1001		good practice in italic	Kewei Yu	Accepted	
856	3	3	1001	1001	I think it is better to delete the reference to Table 3.29 in this line, since it is adequately introuced below in the text (in lines 1012 to 1013)	Virginia Sena	Accepted	
946	3	3	1003	1003	as Box 3.18 is referred to in line 1129, and also referred to in Line 1003, consider moving the text box to the vicinity of line 1129, or in the vicinity of line 1003, where the text box is first referred to.	Robert Lanza	Accepted	Box moved to (former) line 1019.
4274	3	3	1004	1004	I suggest that the authors add "and methanol" after "a fuel cell". If my understanding is correct, Toyota's Mirai and Honda's Clarity Fuel Cell do not use methanol, so these fuel cell vehicles do not emit CO2 from tailpipes. I assume that line 1004 intends to the reforming of methanol discussed in table 3.29.	Naofumi Kosaka	Accepted	Text rewritten to clarify that the issue is relevant only if the fuel cell consumes fuels containing carbon.
4520	3	3	1006		better use %	Kewei Yu	Accepted	
948	3	3	1006	1006	"The most common [hydrogen production] methods at present …"	Robert Lanza	Accepted	
950	3	3	1009	1009	"electrolysis of water."	Robert Lanza	Accepted	
952	3	3	1011	1011	"using fossil input" -- clarify whether this is referring to "feedstock" (raw material) to the process and/or referring to "fuel" (that provides heat) to the process. Clarify throughout this section where the text is discussing "fuel" and where the text is discussing "feedstock." In Ammona Production, emissions from the "feedstock" (i.e., the raw material to the process) and emissions from the "fuel" (i.e., that provides heat to the process) are both reported under IPPU.	Robert Lanza	Accepted	Terminology made consistent throughout chapter, and definitions provided in box.
206	3	3	1012	1013	In table 3.29 many comment in sector colum like "No emission". You should explain why you use this word, because I guess you want to explain Hydrgen sector is good for technology like "Water electrolysis". I hope you to show what sector you select.	Koichi Kojima	Accepted	Explanations have been provided in footnotes to the table.
750	3	3	1012	1017	Among Table 3.29, the emission of water electrolysis seems to depend on the power supply configuration. The meaning differs from “No emissions” such as Photo catalytic splitting. It would be better to mention about that or to be allocated to the Energy sector.	Hideshi Iki	Accepted	Explanation have been provided in footnotes to the table.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
752	3	3	1012	1017	On hydrogen carriers such as organic hydride, CO2 emissions should be taken into account in total from production of carrier to generation of hydrogen. In addition, if CO2 is emitted as a result of using hydrogen carriers, it is reasonable to be allocated to the Energy Sector or users. It should be better to mention that in some way.	Hideshi Iki	Accepted with modification	The authors have made some additional comments to clarify this section: 1) Releasing hydrogen from cyclohexane etc. generates no process emissions, only emissions from fuel combustion. I.e. emissions should be allocated to Energy (stationary combustion). However, parts of the text have been re-written, as these gas stations might produce hydrogen as their main product. 2) For the reforming of methanol, the method is provided already, but Table 3.29 has also been revised to clarify.
2436	3	3	1016	1018	Organic hydride shall be added to Table 3.29 (Current Hydrogen Production Methods). Sample of description is as follows; ---------- Category | Technology |Feedstock |Status of Development |Sector ---------- Main Product hydrogen| Dehydrogenation| Organic Hydride(Note3)| Minor and increasing | No emissions(Note4) ---------- Following 2 sentences shall be added as footnotes of Table 3.29. 3 Organic Hydride is mainly used for hydrogen carrier and storage with a combination of hydrogenation and dehydrogenation. 4 If thermal sources are required in hydrogenation or dehydrogenation process, the emissions are allocated to the energy sector.	Hideaki Tazawa	Accepted with modification	The authors have made some additional comments to clarify this section: 1) Releasing hydrogen from cyclohexane etc. generates no process emissions, only emissions from fuel combustion. I.e. emissions should be allocated to Energy (stationary combustion). However, parts of the text have been re-written, as these gas stations might produce hydrogen as their main product. 2) For the reforming of methanol, the method is provided already, but Table 3.29 has also been revised to clarify.
10068	3	3	1016	1019	Summary of current hydrogen production methods and the allocation of emissions to the sector are shown in Table 3.29. Recommend inclusion of an additional column in Table 3.29 to state specifically where these emissions should be reported in order to avoid double counting.	Miriam Lev-On	Rejected	The authors consider that the extensive guidance provided is transparent.
954	3	3	1017	1018	Comments on Table 3.29	Robert Lanza	Noted	
956	3	3	1017	1018	Comments on Table 3.29 -- Under the "Category" column -- "Main Product Hydrogen" -- see comments on lines 999-1001, clarify the definition of "main product."	Robert Lanza	Accepted	
958	3	3	1017	1018	Comments on Table 3.29 -- Under the "Technology" column -- replace "Fuel Reforming" with "Steam Reforming"	Robert Lanza	Accepted	
960	3	3	1017	1018	Comments on Table 3.29 -- Under the "Feedstock" column -- does Ammonia" in this column refer to the raw material (feedstock) to the reforming process, or does "Ammonia" refer to the Ammonia Production process that produces hydrogen as an intermediate? Ammonia is also listed under "byproduct or intermediate product." Consider clarifying this difference in a footnote to the table.	Robert Lanza	Rejected	The authors consider that the extensive guidance provided is transparent.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
962	3	3	1017	1018	Comments on Table 3.29 -- Under the "Sector" column -- clarify (in a footnote) that for a waste process that involves both biogenic and non-biogenic raw material (feedstock) that for the same process biogenic emissions are reported to the IPPU Memo and non-biogenic emissions are reported to IPPU	Robert Lanza	Accepted	A footnote has been added.
964	3	3	1017	1018	Comments on Table 3.29 -- Under the "Sector" column -- include an explanation in Table 3.29 of why the Ammonia refroming process (row 4 of Table 3.29) is to be reported under Energy (stationary combustion) and not under IPPU.	Robert Lanza	Accepted with modification	The explanatory note has been rewritten to be clearer, and a new column has been added to the table, to explain the allocation principle.
966	3	3	1017	1018	Comments on Table 3.29 -- Under the "Sector" column -- clarify under water electrolysis that there are "no IPPU emissions" from the water electrolysis process (emssions related to electricity production for the process would be reported under Energy.)	Robert Lanza	Accepted	Explanations have been provided in footnotes to the table.
968	3	3	1017	1018	Comments on Table 3.29 -- Under the "Sector" column -- clarify under fermentation whether the "insignificant" emissions refer to CO2, CH4, or both; emissions of CH4 may not be "insignificant" for large-scale processes.	Robert Lanza	Accepted with modification	The supporting text for biological methods has been rewritten to reflect that the methane is part of the product and produced in an anaerobic atmosphere, and hence none of this methane will be emitted in the hydrogen production sector.
970	3	3	1017	1018	Comments on Table 3.29 -- Under the "Sector" column -- clarify under photo voltaic that there are "no IPPU emissions" from the photo voltaic process (emssions related to electricity production for the process would be reported under Energy.)	Robert Lanza	Accepted	Explanations have been provided in footnotes to the table.
972	3	3	1017	1018	Comments on Table 3.29 -- Under the "Category" column -- consider including separate subheadings for "intermediate" processes and "byproduct" processes in Table 3.29 and identiying which processes listed in the table are "intermediatel" processes and which processes listed in the table are "byproduct" processes.	Robert Lanza	Rejected	The authors consider that there is no need for a such distinction, as intermediate product and by-product emissions are treated the same way.
974	3	3	1017	1018	Comments on Table 3.29 -- Under the "Technology" column -- "refineries" is not a technology. Text box 3.18 indicates that emissions from hydrogen production in the refinery sector is to be reported under the refining subcategory of the Energy sector. Refer to the text box in Table 3.29, consider moving the text box forward to be in the vicinity of the table.	Robert Lanza	Accepted with modification	Responding to three comments in one: 1) Accepted. Refineries is not a technology. Rewritten. 2) For hydrogen production in refineries, the existing methodology in Vol. 2 Energy (Ch. 4.2) may be used, and it will be improved in the 2019 Refinement. Clarifying box will be provided in the Energy chapter. 3) Box 3.18 has been moved to (former) line 1019.
976	3	3	1017	1018	Comments on Table 3.29 -- Under the "Technology" column -- clarify whether Ammonia Production" (listed under "Byproduct or Intermediate") is a different process than "Ammonia" listed above under "Steam Reforming" and "Main Product Hydrogen"	Robert Lanza	Rejected	The authors consider that the extensive guidance provided is transparent.
978	3	3	1017	1018	Comments on Table 3.29 -- Under the "Technology" column -- Text box 3.18 indicates that emissions from hydrogen production as an intermediate product of ammonia production are to be reported under the Ammonia Production subcategory of the IPPU sector. Refer to the text box in Table 3.29, consider moving the text box forward to be in the vicinity of the table.	Robert Lanza	Accepted with modification	Addressing two comments in one: 1) Accepted. Reference to the text box has been added; 2) the text box has been moved to (former) line 1019.

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980	3	3	1017	1018	Comments on Table 3.29 -- Under the "Sector" column -- emissions from methanol and ethylene production processes are to be reported under the "Petrochemical and Carbon Black" subcategory of the IPPU Sector.	Robert Lanza	Accepted	
982	3	3	1017	1018	Comments on Table 3.29 -- Under the "Sector" column -- emissions from steel production processes are to be reported under the "Iron and Steel and Metallurgical Coke" subcategory of the IPPU Sector.	Robert Lanza	Accepted	
984	3	3	1017	1018	Comments on Table 3.29 -- Under the "Technology" column -- clarify what type of "soda" is being referred to in "soda production."	Robert Lanza	Accepted	
986	3	3	1017	1018	Comments on Table 3.29 -- Under the Table 3.29 footnote 1, note that In Ammona Production, emissions from the "feedstock" (i.e., the raw material to the process) and emissions from the "fuel" (i.e., that provides heat to the process) are both reported under IPPU, and not under tje stationary combustion subcategory of the Energy Sector.	Robert Lanza	Noted	The authors note that this does not apply to the mentioned footnote, which regards reforming of ammonia feedstock (not production of ammonia). No changes necessary.
4522	3	3	1030		production in italic?	Kewei Yu	Accepted	
988	3	3	1031	1031	"Therefore, the emissions estimates are independent of how the hydrogen is being used." Consider noting here that the sector and subcategory the hydrogen is used on does affect where the emissions are to be reported.	Robert Lanza	Accepted	A clarification has been added.
5410	3	3	1033	1042	This category includes only CO2 emissions. However, if natural gas or other fossil gas is used as a raw material, CH4 could also be emitted. It would be necessary to consider adding CH4 emissions to this category if CH4 emissions from hydrogen production is not negligible.	Takashi Morimoto	Noted	The authors note that there may be minor methane emissions, but the available literature references all indicate that methane emissions are extremely low and the dataset is also very limited. Therefore, at this time it is not possible to derive methods and EFs for methane emission estimates, which are regarded as sufficiently low to be considered insignificant.
990	3	3	1038	1040	… can be placed in either of two categories depending on the degree of conversion…" -- clarify which of the technologies in Table 3.29 fall into each of the two categories. Consider adding a column or other indicator to Table 3.29 indicating the category of each technology in the table.	Robert Lanza	Rejected	The next section of text clarifies these issues and we have a reference to Table 3.29 already in the text.
992	3	3	1042	1042	… have hydrogen as a byproduct or intermediate product" -- consider identifying separately in Table 3.29 which technologies produce hydrogen as an intermediate and which produce hydrogen as a byproduct.	Robert Lanza	Rejected	The authors consider that there is no need for a such distinction, as intermediate product and by-product emissions are treated the same way.
994	3	3	1051	1051	…and the combustion [reactions] there is an approximate…" -- clarify which combustion processes are being referred to here.	Robert Lanza	Accepted	
5314	3	3	1054	1055	IPPU memo item mentioned, but I can´t find the IPPU memo item from my CRF reporter, only memo item I can find is under Energy sector. Is there a decision to include memo items to IPPU also?	Pia-Kristiina Forsell	Accepted with modification	The authors note that there is no need at this stage to specify the type of memo item. Hence, the specification "IPPU" is removed from all text.
996	3	3	1055	1055	…the CO2 should be [reported] in the IPPU Memo Item…	Robert Lanza	Accepted	
998	3	3	1055	1055	"Waste may contain both fossil and biogenic materials" -- consider adding this statement as a footnote to Table 3.29	Robert Lanza	Accepted	A footnote has been added.
4524	3	3	1065		H2, subscript	Kewei Yu	Accepted	

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1000	3	3	1087	1088	"…details about syngas) which in most cases is the final product." -- see comments under line 984, clarify the definition of "final product;" the Ammonia Production IPPU subcategory includes emission factors for a "partial oxidation" ammonia production technology. There are also syngas processes in which the hydrogen-containing syngas is an intermediate product used to produce ammonia and for which the syngas is not a final product.	Robert Lanza	Accepted	The text has been rewritten.
1002	3	3	1101	1101	"…and other gases [including CO2 and methane.]"	Robert Lanza	Accepted	
4526	3	3	1111		better use %	Kewei Yu	Accepted	
1004	3	3	1113	1114	editing convention, using "e.g.," or "f. ex."	Robert Lanza	Accepted	
1006	3	3	1116	1116	"Biological methods [including] fermentation…"	Robert Lanza	Accepted	
1008	3	3	1118	1118	"… hydrogen containing minor amounts of CO2, methane, and other…" -- clarify here how methane emissions from biological processes are to be reported	Robert Lanza	Accepted	The authors have clarified the text; no emissions are to be reported.
1352	3	3	1120	1120	Biogenic processes to produce H2 are excluded because the CO2 emissions are not originating from fossil sources and we are not obliged to report CO2 emissions from biogenic sources. This is correct. But these biogenic processes produce also relevant amounts of CH4. In line 1120 the GLs estimate an amount of about 2%. I porpose to include the biogenic processes in the reporting but not for CO2, but for CH4 emissions.	David Kuntze	Noted	Methane is part of the product and produced in an anaerobic athmosphere, and hence none of this methane will be emitted in the hydrogen production sector. There may be minor methane emissions, but the available literature references all indicate that methane emissions are extremely low and the dataset is very limited. Therefore, at this time it is not possible to derive methods and EFs for methane emission estimates, which are regarded as sufficiently low to be considered insignificant.
1010	3	3	1120	1120	…. A maximum of 2 percent of the hydrogen production." -- clarify if this is 2 percent by weight of the hydrogen production or 2 percent by volume of the hydrogen production.	Robert Lanza	Accepted with modification	The literature source is not specific on type of percentage. The authors of the hydrogen chapter have taken it as molar percentages of the produced hydrogen gas; if we assume it to be percentage by weight, then the produced hydrogen is even purer and the methane content even lower. The text has been rewritten to reflect that the methane is part of the product and produced in an anaerobic atmosphere, and hence none of this methane will be emitted in the hydrogen production sector.
1012	3	3	1120	1120	…. A maximum of 2 percent of the hydrogen production." -- this may not be an insigificant amount of methane emissions for a large-scale biological hydrogen production process.	Robert Lanza	Noted	Methane is part of the product and produced in an anaerobic athmosphere, and hence none of this methane will be emitted in the hydrogen production sector. There may be minor methane emissions, but the available literature references all indicate that methane emissions are extremely low and the dataset is very limited. Therefore, at this time it is not possible to derive methods and EFs for methane emission estimates, which are regarded as sufficiently low to be considered insignificant.
328	3	3	1122	1123	it is stated that coal gasification for city gas should be considered in the hydrogen production sector but there is neither a method nor an emission factor provided (at least for CH4 in respect of the high methane content of town gas9	Christian Boettcher	Accepted with modification	Authors have provided clarifications in the revised text, to specify that production of hydrogen as part of mixtures is not covered by this section.

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10070	3	3	1125	1129	Propose including a citation to the 2009 API GHG Compendium, Section 5.2.2 Refinery Hydrogen Plants, for further elaboration of the methodology for estimating GHG emissions for Steam Reformers. The methodology is applicable both to refinery and stand-alone H2 manufacturing plants with applicable feedstock and CO2 capture and removal.	Miriam Lev-On	Accepted with modification	The reference has been included; no change in method description is considered necessary by the authors.
1014	3	3	1127	1127	…(i.e., raw materials and fuels data)" --- clarify that emissions resulting from raw materials use and emissions resulting from fuels use are both to be reported under IPPU. Consider providing a text box example describing the [separate] use of fuel and raw materials in hydrogen production processes, similar to the description in Ammonia Production, in which natural gas participates in the steam reforming chemical reaction as a raw material and natural gas also provides heat to the process as a fuel.	Robert Lanza	Accepted with modification	The authors have provided a clarification in a separate paragraph, rather than a textbox.
1016	3	3	1128	1129	as Box 3.18 is referred to in line 1129, and also referred to in Line 1003, consider moving the text box to the vicinity of line 1129, or in the vicinity of line 1003, where the text box is first referred to.	Robert Lanza	Accepted	Box moved to (former) line 1019.
1018	3	3	1130	1130	"…relevant data [are] available…"	Robert Lanza	Accepted	
5316	3	3	1138	1139	Using production capacity gives normally over estimation of emissions that is the reason not to suggest to use it as default method and mention that it is good practice to use it. Even in ammonia chapter capacity data has been multiplied with capacity utilisation factor, not the total capacity data used. And to think about calculation of baseline emissions of hydrogen production, this guideline (as good practice!) makes recommendation to over estimate emissions of base year!	Pia-Kristiina Forsell	Accepted with modification	Guidance has been provided in the 'activity data' section, but has been improved in both places. The authors also note that Tier methods have been changed in the updated version of the document.
1020	3	3	1153	1153	"…production data [are] not available…"	Robert Lanza	Accepted	
5318	3	3	1153	1154	The mentioning that "It is good practice to avoid double counting with other sector" is unnecessary, that is a fact.	Pia-Kristiina Forsell	Accepted	
1022	3	3	1155	1155	…(i.e., raw materials and fuels data)" --- clarify that emissions resulting from raw materials use and emissions resulting from fuels use are both to be reported under IPPU. Consider providing a text box example describing the [separate] use of fuel and raw materials in hydrogen production processes, similar to the description in Ammonia Production, in which natural gas participates in the steam reforming chemical reaction as a raw material and natural gas also provides heat to the process as a fuel.	Robert Lanza	Accepted with modification	The authors have provided a clarification in a separate paragraph, rather than a textbox.
1024	3	3	1159	1159	clarify "plastic" here -- what type(s) of plastic are being referred to?	Robert Lanza	Accepted	A footnote is provided in table 3.30 stating that the factors relate to mixed plastic. For CCF the value for "other petroleum products" in Vol.2 Ch. 1 Table 1.3 is used.
4276	3	3	1159	1159	The 2006 IPCC Guidelines (Volume 5, Tables 2.4 and 2.5) provide the fossil carbon content of plastics (75% of dry weight for municipal solid waste and 80% for industrial solid waste). However, I do not find the net calorific values of plastics in the guidelines.	Naofumi Kosaka	Accepted	All factors are now given in Table 3.30. Moreover, the NCV value is provided in a footnote.

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8652	3	3	1159	1161	It is not clear what is the assumption behind the CCF for plastic. The value of 20 kg/GJ could not be reproduced based on the cited reference. It is quite easy to estimate the CCF for different types of plastic. However, it should be stated in the GL what mix of plastics is assumed, so that users can evaluate it.	Ole-Kenneth Nielsen	Accepted	A footnote is provided in table 3.30 stating that the factors relate to mixed plastic. For CCF the value for "other petroleum products" in Vol.2 Ch. 1 Table 1.3 is used.
1026	3	3	1164	1164	"it is assumed that the same material is used for both raw material and fuel in a given production method…" -- is it necessary to make this assumption for hydrogen production? Or could the method be modified to allow for separate emissions calculations to be conducted for fuel and for raw material?	Robert Lanza	Accepted with modification	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
5304	3	3	1164	1178	These paragraphs (three altogether) are not dealing with Tier 1 method to calculate emissions, but general information of good practice. These paragraphs are better to include in 3.11.1 Introduction or 3.11.2 Methodological issues.	Pia-Kristiina Forsell	Accepted with modification	Sections of text that are not specific to Tier 1 method have been moved to the 3.11.2.1 introduction.
1028	3	3	1165	1165	"it is good practice to use the CCF for the raw material" -- can the method be modified to allow use of both the CCF for the fuel and the CCF for the raw material? Both the CCF for the raw material and the CCF for the fuel would be known, or there would be default factors for both.	Robert Lanza	Accepted with modification	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
858	3	3	1168	1168	The reference to table 3.11.2 is not correct. It may be "Table 3.30" the correct one.	Virginia Sena	Noted	The text has been rewritten in response to other comments, so this comment no longer applies.
1334	3	3	1170	1170	The IPCC GLs write that CO2 EM from biogenic sources shall be reported at IPPU Memo item. I do not know this memo item in the CRF tables. To my knowledge this memo item does not exist. But I see the necessarity to create this. But as in this process only the GLs are changed My proposal is to leave the IP memo item in the text and to add a footnote to it, that this memo item is planned to be added at the CRF tables. As long as the memo item for IP does not exist, the CO2 emissions from biogenic sources shall not be reported.	David Kuntze	Accepted with modification	The authors note that there is no need at this stage to specify the type of memo item. Hence, the specification "IPPU" is removed from all text.
1030	3	3	1171	1171	"..biogenic carbon shares [of the feedstock]" -- there is at least a theoretical possibility that the fuel could also contain a biogenic component.	Robert Lanza	Accepted	The text has been rewritten to address this.
1032	3	3	1173	1174	"…typically sold for use in other manufacturing industries…" -- CO2 recovered from ammonia production in ammonia-fertilizer plants may be used for urea production. The method should account for other production processes in which recovered CO2 may be used as a feedstock in the same facility rather than being sold or stored.	Robert Lanza	Accepted	The text has been rewritten, and text moved to introduction of Ch. 3.11.2.1.
1336	3	3	1173	1178	As for the lines 1407-1410 the following sentence should be added: If the emissions are not reported at the respective sectors, it is good practice to not subtract these recovered amounts from the CO2 emissions.	David Kuntze	Accepted	The text has been added to introduction of Ch. 3.11.2.1.
1034	3	3	1181	1181	"…or hydrogen production [are] not available."	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1344	3	3	119	119	Ammonia production and the problem of the correct allocation of the energy demand. The IPCC GLs 2006 recommend for ammonia production that all process and energy emissions from ammonia production should be allocated at 2B1. This is a very difficult recommendation, because countries are using energy balances. And in these it is not possible to identify the energy demand from ammonia production. Also it is very difficult to subtract these emissions from the emissions from CRF 1. Because then this will lead to a gap with the Refenece approach. As in the countries under the UNFCCC convention both methods exist, I propose to change the IPCC GL for 2B1 and to allow to use both methods. So it is allowed to report the energy emissions at CRF 1 and CRF 2. When the IPCC GL 2006 for ammonia production will not be changed there will be always very difficult discussions between Reviewers and Partys.	David Kuntze	Noted	No action can be taken because the comment is out of scope of the 2019 Refinement.
1036	3	3	1190	1190	Clarify the definition of the "FRF" "feedstock requirement factor." The text refers to "raw material and fuel" as comprising "feedstock" in various places; consider whether it is feasible to modify the method to allow for separate calculations for "fuel" and "raw material," as these could be two different materials that have carbon contents.	Robert Lanza	Accepted with modification	Responding to two comments in one: 1. Rejected. Clarification is already included in the second paragraph after the definition. 2. The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
6408	3	3	1194		default feedstock specific requirements are given only in table 3.30	Ekaterina Imshennik	Accepted	Cross-reference changed.
4278	3	3	1194	1195	I suggest that the authors delete "feedstock specific feedstock requirement factors (FRFj) and" because Table 1.3 in Vol.2 only include carbon content factors.	Naofumi Kosaka	Accepted	Cross-reference changed.
1338	3	3	1195	1196	"…if hydrogen production is not a key category, …." But Tier 2 is already enough for key categories. I see it not necessary to propose a method of the T2 method to be used that can be used, if it is not a key category. This is also not good as it makes the job for the reviewers more difficult. Because the partys can report a method as T2 but it is not T2. And so far a T2 method always fulfills the requirements of a Key category. This should be left like this. My proposal is to delete the methods that can be used for a T2 method if the source category is not a key category.	David Kuntze	Accepted	Paragraph deleted.
8654	3	3	1195	1198	This sentence is currently not clear. Why the reference to 5 % and how does it link to the previous sentence?	Ole-Kenneth Nielsen	Accepted	Paragraph deleted.
1038	3	3	1196	1196	"up to 5 %..." -- clarify what the basis is for this value, or for the value that would replace it based on the text note.	Robert Lanza	Accepted	Paragraph deleted.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1040	3	3	1200	1200	…(i.e., raw materials and fuels data)" --- clarify that emissions resulting from raw materials use and emissions resulting from fuels use are both to be reported under IPPU. Consider providing a text box example describing the [separate] use of fuel and raw materials in hydrogen production processes, similar to the description in Ammonia Production, in which natural gas participates in the steam reforming chemical reaction as a raw material and natural gas also provides heat to the process as a fuel.	Robert Lanza	Accepted with modification	The authors have provided a clarification in a separate paragraph, rather than a textbox.
1042	3	3	1201	1202	"it is assumed that the same material is used for both raw material and fuel in a given production method…" -- is it necessary to make this assumption for hydrogen production? Or could the method be modified to allow for separate emissions calculations to be conducted for fuel and for raw material?	Robert Lanza	Accepted with modification	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
5306	3	3	1201	1214	Same information given as in line 1164-1178 (more reasons to describe these information in Introduction or Methodological issues.	Pia-Kristiina Forsell	Accepted with modification	Sections of text that are not specific to Tier 1 method have been moved to the 3.11.2.1 introduction.
860	3	3	1205	1205	It is written "good practise" instead of "good practice".	Virginia Sena	Accepted	Text rewritten.
1044	3	3	1208	1208	"..biogenic carbon shares [of the feedstock]" -- there is at least a theoretical possibility that the fuel could also contain a biogenic component.	Robert Lanza	Accepted	
1046	3	3	1210	1211	"…typically sold for use in other manufacturing industries…" -- CO_2 recovered from ammonia production in ammonia-fertilizer plants may be used for urea production. The method should account for other production processes in which recovered CO_2 may be used as a feedstock in the same facility rather than being sold or stored.	Robert Lanza	Accepted	The text has been rewritten, and text moved to introduction of Ch. 3.11.2.1.
1048	3	3	1224	1224	refer to previous comments, define "main product"	Robert Lanza	Accepted	A new text box has been added, which also includes "main product", "feedstock", "raw material", "fuel", "pure hydrogen" and "gas mixtures".
1050	3	3	1230	1231	"…[should] be obtained from producers."	Robert Lanza	Accepted	
1354	3	3	1230	1268	In line 1230 and in line 1268 plant specific feedstock requirement factors (FRF) are mentioned. It seems that the differentiation between 3a and 3b is than not obvious. Only the decision tree shows then that in T3a no plant specific feedstock requirement factor should be used. The text should be improved.	David Kuntze	Noted	The method description has been revised to cite provision of plant specific estimation based on feedstock consumption.
1340	3	3	1232	1234	"If data on actual hydrogen production is not available for a selection of plants, it should be considered to use production capacity as an estimate of production for these plants, ..." This is a Tier 3 method. So does this sentence mean that a country can use a Tier3 method and use for this for all plants as AD the production capacity? I would think that production capacity should not be used in a Tier 3 method and my proposal is to delete the production capacity in the section for the TIER 3 method.	David Kuntze	Accepted	Paragraph deleted.
1052	3	3	1234	1234	"… or use a Tier 2 method [that uses aggregate production data.]"	Robert Lanza	Accepted	Paragraph deleted.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8656	3	3	1238	1243	Again the reference to 5 % is not clear. If using a tier 3 then the data are known. If the intention is to say that in some cases a Party may use tier 3 for a number of plants accounting for X % of the production, the Party can apply tier 1 for 100-X % of the production, then this point can be made more clearly.	Ole-Kenneth Nielsen	Accepted	Paragraph deleted.
4280	3	3	1239	1243	I suggest that the authors delete "If … CCF." because tier 3 is not applied when this category is not a key category according to Figure 3.20.	Naofumi Kosaka	Accepted	Paragraph deleted.
1054	3	3	1240	1240	"up to 5 %..." -- clarify what the basis is for this value, or for the value that would replace it based on the text note.	Robert Lanza	Accepted	Paragraph deleted.
5308	3	3	1244	1254	Some repetition of the paragraphs over mentioned.	Pia-Kristiina Forsell	Noted	
1056	3	3	1247	1247	"…typically sold for use in other manufacturing industries…" -- CO2 recovered from ammonia production in ammonia-fertilizer plants may be used for urea production. The method should account for other production processes in which recovered CO2 may be used as a feedstock in the same facility rather than being sold or stored.	Robert Lanza	Accepted	The text has been rewritten, and text moved to introduction of Ch. 3.11.2.1.
1058	3	3	1248	1248	"…storages. Stored carbon is solid carbon or coke…" -- this combination of sentences is unclear, the carbon sent to storages (presuably by underground injection) is not the same "stored carbon" as what is turned into solid carbon or coke."	Robert Lanza	Accepted	A clarification has been provided.
5320	3	3	1259	1267	Equation 3.47. There is a mistake in the equation. In the equation the consumption of feedstock are tonnes ant it should be multiplied with caloric value to get consumption as GJ (or MJ).	Pia-Kristiina Forsell	Accepted	The equation has been corrected to apply consistent units.
1060	3	3	1264	1264	refer to previous comments, define "main product"	Robert Lanza	Accepted	A new text box has been added, which also includes "main product", "feedstock", "raw material", "fuel", "pure hydrogen" and "gas mixtures".
1062	3	3	1269	1269	"…consumption data [are] not necessary…"	Robert Lanza	Accepted	
1342	3	3	1269	1271	"Note that plant specific consumption data is not necessary in the Tier 3b method, since all the feedstock is assumed to be converted to CO2 emissions or stored as solid carbon." I do not agree with this. In the IP section T3 was always plant specific. This should be left like this. With this method I also not obviously see the difference between T2 and T3. Reviewers rely on the information T3 = plant specific for IP section.	David Kuntze	Accepted	The method was proposed having steam reforming of natural gas in mind. However, the composition of coal can vary greatly, even between plants, and hence a plant specific Tier method based on consumption data is now provided, and a new Tier 2 method based on consumption data with country specific carbon content factors as well. The former Tier 3b method is now placed at the Tier 1 level. Moreover, the letters a and b are switched to allow for a new Tier 1c method based on national level activity data and at the same time have the Tier methods at a given level labelled sorted by letters according to the uncertainty. Accordingly, the former Tier 3b method is now Tier 1a, and methods labelled 'a' has the lowest uncertainty at that Tier level.
5310	3	3	1272	1282	Some repetition of the paragraphs over mentioned.	Pia-Kristiina Forsell	Noted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1064	3	3	1275	1275	"…typically sold for use in other manufacturing industries…" -- CO_2 recovered from ammonia production in ammonia-fertilizer plants may be used for urea production. The method should account for other production processes in which recovered CO_2 may be used as a feedstock in the same facility rather than being sold or stored.	Robert Lanza	Accepted	The text has been rewritten, and text moved to introduction of Ch. 3.11.2.1.
1066	3	3	1276	1276	"…storages. Stored carbon is solid carbon or coke…" -- this combination of sentences is unclear, the carbon sent to storages (presuably by underground injection) is not the same "stored carbon" as what is turned into solid carbon or coke."	Robert Lanza	Accepted	A clarification has been provided.
1068	3	3	1286	1286	CO_2 -- check subscripts throughout section	Robert Lanza	Accepted	
1070	3	3	1288	1288	consider developing a standard format for figure notes, table notes, text notes, etc.	Robert Lanza	Accepted	
1072	3	3	1298	1301	Consider whether the Tier 1 method can be modified to allow for separate calculations for different materials used for fuel and for raw material.	Robert Lanza	Accepted with modification	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
1074	3	3	1303	1305	Consider whether the Tier 2 method can be modified to allow for separate calculations for different materials used for fuel and for raw material.	Robert Lanza	Accepted with modification	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
1076	3	3	1312	1322	Consider whether the Tier 3 method can be modified to allow for separate calculations for different materials used for fuel and for raw material.	Robert Lanza	Accepted with modification	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
8658	3	3	1323	1324	The references in Table 3.30 should be assigned to the relevant technologies rather than all just listed at the bottom, i.e. it should be clear which references have been used for which process. The CCFs seems to be consistent with the CCFs reported in the 2006 GL in the energy sector, with the exception of bioethanol (biogasoline), this discrepancy should be addressed. The global average seems to be a weighted average using less than 100 %, what has been assumed in the weighting for the remaining 4 %? It would also be good, if it is stated what year the global average is representative for (i.e. 49 % natural gas, 29 % LPG/naphtha and 18 % coal), i.e. is this the average in 2017 and would this be markedly different in e.g. 1990 or 2000. How big is the potential error in applying this for a long time-series, e.g. 1990 to today.	Ole-Kenneth Nielsen	Accepted with modification	Addressing four comments in one: 1. Rejected, as most of the references are relevant to several production processes. 2: Accepted. The CCF figures are consistent with Other Liquid Biofuels in Table 1.3 (Vol. 2, Ch. 1), and Table 3.30 is changed accordingly. 3: Accepted. The remaining 4 % of the global average is electrolysis, in addition to other very minor technologies. It is added to the footnote. 4: Literature is scarce, but the global average seems to have been relatively stable over the years (see f. ex. Ogden 1999 and Speirs et al. 2017). The factor is to be used in the Tier 1c method, only, i.e. the one with the highest uncertainty.
754	3	3	1323	1324	In Table 3.30, is there a consistency in the relative order among the producing methods of FR and CCF in each manufacturing method? (e.g. Black liquor requires more raw material than waste materials and coal)	Hideshi Iki	Noted	More abundant technologies are placed higher than less abundant ones, but the sorting is not strict.
1078	3	3	1324	1324	Comments on Table 3.30	Robert Lanza	Noted	
1080	3	3	1324	1324	Comments on Table 3.30 -- Under the "Production Process" column -- replace "Fuel Reforming" with "Steam Reforming" 30	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1082	3	3	1324	1324	Comments on Table 3.30 -- For the carbon content factors in Table 3.30 provide a reference to TABLE 1.3 DEFAULT VALUES OF CARBON CONTENT in Volume 1	Robert Lanza	Accepted	
1084	3	3	1324	1324	Comments on Table 3.30 -- for note "*" clarify "plastic" -- what type(s) of plastic are being referred to?	Robert Lanza	Accepted	A footnote is provided in table 3.30 stating that the factors relate to mixed plastic. For CCF the value for "other petroleum products" in Vol.2 Ch. 1 Table 1.3 is used.
1086	3	3	1324	1324	Comments on Table 3.30 -- for note "**" -- clarify that the natural gas and LNG percentages refer to the steam reforming production process and that the coal percentage refers to the gasification process. Provide a reference for the production data referred to in the note.	Robert Lanza	Accepted	
1088	3	3	1324	1324	Comments on Table 3.30 -- for note "***" -- clarify that the natural gas and LNG percentages refer to the steam reforming production process and that the coal percentage refers to the gasification process. Provide a reference for the production data referred to in the note.	Robert Lanza	Accepted	
1090	3	3	1324	1324	Comments on Table 3.30 -- consider developing a standard format for figure notes, table notes, text notes, etc. It is not clear from the format of the notes, numbers, asterisks, etc. which reference is associated with which feedstock requirement factor. Consider reformatting the table so that each line contains the feedstock requirement factor and its associated reference.	Robert Lanza	Accepted with modification	Addressing two comments in one: 1: Accepted, a standard format has been implemented. 2: Rejected as several references are applicable to several production processes.
1092	3	3	1324	1324	Comments on Table 3.30 -- NETL 2017 included in the reference section in Line 1683, is not referenced in Table 3.30. If NETL 2017 was used in preparing the factors in Table 3.30, indicate which factors are based on NETL 2017.	Robert Lanza	Accepted	
1094	3	3	1324	1324	Comments on Table 3.30 -- NETL 2017 includes data points for each of two coal gasifier technologies, and includes data points for three different types of coal. Pitt 8 coal is a high-BTU value coal with a heat value of approx. 13,120 BTU/lb; Wyodak coal is a low-BTU value coal with a heat value of approx. 8,220 BTU/lb. The NETL 2017 data show different conversion efficiencies for the two coal types from the same gasification process. Consider whether NETL 2017 and similar data for coal gasifiers can be used to provide separate factors for lower-BTU value coals and higher BTU-value coals rather than a providing only a single factor applicable to a range of coal heat contents.	Robert Lanza	Accepted with modification	The authors have revised the uncertainty range of FRF, increased from +/- 15% to +/- 20%. After method revision this applies to Tier 1 only, while both Tier 3 methods are plant specific.
1096	3	3	1324	1324	Comments on Table 3.30 -- JRC 2014 included in Table 3.30 does not appear in the reference list for Chapter 3.11.	Robert Lanza	Accepted	
1098	3	3	1324	1324	Comments on Table 3.30 -- The full reference for GREET (2013) is Updates to Parameters of Hydrogen Production Pathways in GREET™, Amgad Elgowainy, Jeongwoo Han, and Hao Zhu, Systems Assessment Group, Energy Systems Division, Argonne National Laboratory, October 7, 2013	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1100	3	3	1324	1324	Comments on Table 3.30 -- The PNNL 2017 hydrogen production efficiency calculator for coal gasification, NETL 2017 data for coal gasification, and GREET 2013 data for coal gasification all include electricity generation. Consider in Table 3.30 including for coal gasification two separate factors for the feedstock requirement that goes to hydrogen production and the feedstock requirement that goes to electricity production (for example, GREET 2013 includes a factor for kWh generated/mmBtu hydrogen produced for coal gasification). It could be the case that if only the feedstock requirement that goes to hydrogen production is included in the table, the feedstock requirement that goes to electricity productio could be misreported. In incorporating the two separate feedstock requirement factors indicate that the feedstock use for hydrogen production and the feedstock use for electricity production are to be reported separately if the electricity is exported.	Robert Lanza	Accepted	The authors have reviewed the literature sources and revised the factors accordingly, to remove any energy use not being a direct part of the hydrogen production process. Changes are minor, as in hydrogen production the amount of electricity being used in the production process is small.
1102	3	3	1324	1324	Comments on Table 3.30 -- The PNNL 2017 hydrogen production efficiency calculator for central biomass gasification and the GREET 2013 data for biomass gasification both include values for the amount of biomass consumption and the amount of natural gas consumption for the gasification process. Consider in Table 3.30 including for biomass gasification separate factors for the natural gas feedstock requirement of the biomass gasification process and the biomass feedstock requirement of the biomass gasification process, considering that the CO2 emissions from the biomass feedstock to the process and the CO2 emissions from the natural gas feedstock to the process are to be reported separately. Including only a single factor for the combined natural gas consumption and biomass consumption could result in the natural gas component of the feedstock and the biomass component of the feedstock being misreported.	Robert Lanza	Accepted with modification	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
1104	3	3	1333	1333	For "national production data" clarify whether this refers to data only for the amount of hydrogen produced as a "main product" only? Or would this refer also to data for intermediate and byproduct hydrogen production?	Robert Lanza	Accepted	Clarification has been added by cross-reference to box 3.16 on double counting.
207	3	3	1336	1336	Why you select 80 percent?	Koichi Kojima	Noted	This is the percentage used in Ch. 3.2 Ammonia production.
4512	3	3	135		N2O, subscritp, check other places	Kewei Yu	Accepted	
894	3	3	135	141	N2O -- check subscripts throughout section	Robert Lanza	Accepted	
4528	3	3	1351		CO2, subscript, good practice in italic	Kewei Yu	Accepted	
1106	3	3	1351	1352	CO2 -- check subscripts throughout section	Robert Lanza	Accepted	
4530	3	3	1352		CO2 subscript	Kewei Yu	Accepted	
1108	3	3	1360	1361	"up to 5 %..." -- clarify what the basis is for this value, or for the value that would replace it based on the text note.	Robert Lanza	Accepted	Paragraph deleted.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8660	3	3	1384	1410	Considering that the guidance on hydrogen production is new and that it could be significant in many countries, it is very important that this new guidance is tied in with the existing guidance on feedstocks and non-energy use of fuels, i.e. it is necessary that Chapters 1.3-1.5 of Volume 3 are updated to reflect this new significant source that will affect the completeness checks and verification approaches outlined as good practice.	Ole-Kenneth Nielsen	Accepted	A row has been added to table 1.2 in Vol. 3 Ch. 1 with the following information: Type of use = Feedstock; Example of fuel types = natural gas, oils, coal; Product/process = hydrogen; Chapter = 3.11.
862	3	3	1388	1388	It is written "good practise" instead of "good practice".	Virginia Sena	Accepted	
1110	3	3	1391	1392	"… other sectors, including Ammonia Production (IPPU) and Petroleum Refining (Energy) must be excluded from…"	Robert Lanza	Accepted	
1112	3	3	1395	1395	as Box 3.18 is referred to in line 1129, and also referred to in Line 1003, consider moving the text box to the vicinity of line 1129, or in the vicinity of line 1003, where the text box is first referred to.	Robert Lanza	Accepted	Box moved to (former) line 1019.
5322	3	3	1395	1410	Box 3.18, Double counting. Should it be possible to not to subtract the recovered CO2 which is going to be used immediately after recovering? Like CO2 in soft drink industry.	Pia-Kristiina Forsell	Accepted	Text has been revised, notably to alert users to the risk of double counting emissions, as it might be a difficult task for the hydrogen producers to document reporting in the downstream sectors (data availability, etc.).
5102	3	3	1397	1397	…When hydrogen is a by-product or intermediate product, its good practice to report the CO2 emissions in the sector of the main product.… In the categories where refineries have to be reported (1.A.1.b and 1.B.2.aiii) is no methodical description available. Combustion related emissions from hydrogen production are automatically included in 1.A.1.b. But process related emissions from hydrogen production are not mentioned in 1.A.1.b and 1.B.2.aiii. This is a dead link.	Kristina Juhrich	Noted	The existing methodology in Vol. 2 Energy (Ch. 4.2) may be used, and it will be improved in the 2019 Refinement. Clarifying box will be provided in the Energy chapter.
1330	3	3	1397	1410	If only H2 production as main product is reported at this category I see here the danger of missing emissions. There is then always a high possibility that there is a gap.	David Kuntze	Accepted	Authors have added text clarifications to address this comment.
60	3	3	1399	1403	"Emissions from production of hydrogen reported in the Energy Sector and IPPU sectors other than hydrogen production must be excluded from the hydrogen production sector" seems to indicate that hydrogen production is not a process in IPPU but a 3rd sector. If hydrogen production is not a process in IPPU it is better to design a seperate Vollume for it.	Mingshan Su	Rejected	The authors consider that the extensive guidance provided is transparent.
1114	3	3	1400	1401	"… these sectors include Petroleum Refining (Energy, Oil and Natural Gas Systems) and Ammonia Production (IPPU, Chemical Industry)."	Robert Lanza	Accepted with modification	Reference to the aggregate sector is now provided.
1116	3	3	1404	1405	Fuel consumed as part of the [hydrogen] production process (e.g., fuel combusted directly to provide process heat to the production process) should be reported in the Hydrogen Production sector. Fuel consumed for other purposes should be reported in other sectors..."	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
5104	3	3	1404	1406	This sentence should remain unchanged. It gives scope of interpretation. Strict rules regarding allocation issues are not useful. National circumstances should be considered. It should be possible for a country to follow the structure of their energy statistic (including the IEA questionnaire) which has a clear definition on energetic and non-energetic use. The Guidelines deviate from this definition in several cases which causes problems.	Kristina Juhrich	Noted	
1332	3	3	1407	1410	All CO2 recovered and used somewhere else, should be reported there. Ok, but then it should be said, that only CO2 recovered can be subtracted, that is reported elsewhere, to avoid a gap in the reporting of emissions. It is the same disucussion as for ammonia. The easiest way is to report all CO2 emissions at the H2 production and to not subtract the recovered CO2. I propose the follwing sentence: If the emissions are not reported at the respective sectors, it is good practice to not subtract these recovered amounts from the CO2 emissions.	David Kuntze	Accepted	Text has been revised, notably to alert users to the risk of double counting emissions, as it might be a difficult task for the hydrogen producers to document reporting in the downstream sectors (data availability, etc.).
1118	3	3	1407	1410	CO2 recovered from ammonia production in ammonia-fertilizer plants may be used for urea production. The method should account for other production processes in which recovered CO2 may be used as a feedstock in the same facility rather than being sold or stored.	Robert Lanza	Accepted with modification	The authors note that the bullet point does not mention selling or storing. The text has been revised from "manufacturing industries" to "production processes".
8662	3	3	1407	1410	In order to ensure transparency, it would be good, if it was described as good practice to report on the downstream uses, so that it is possible to verify that they have been correctly accounted for in the relevant sectors.	Ole-Kenneth Nielsen	Accepted	Guidance with reference to the NIR has been included.
4532	3	3	1409		hydrogen? Letter case	Kewei Yu	Rejected	Proper noun for the sector.
5440	3	3	141	151	The default factors as given in Table 3.3 are considered as being reasonable.	Tiffanie Stephani	Accepted	
4534	3	3	1412		avoid starting a sentence with an abbreviation	Kewei Yu	Accepted	
844	3	3	142	143	The parenthesis "(listed in Table 3.3)" is not correct. It will be correct to only write: "The five production processes types are distinguished according to the pressures applied in the oxidation and absorption stage as presented in Table 3.3.A.". And the "A" for Table 3.3.A, in capital letter.	Virginia Sena	Accepted with modification	The sentence (listed in Table 3.3) has been deleted, however, we still prefer to use “a” instead of “A” because Table 3.3.a is an additional information (sub-section) of Table 3.3. If we name the table as Table 3.3.A then the next table must be named as Table 3.3.B.
1120	3	3	1426	1426	"Fuel requirement factors" -- edit -- these are referred to elsewhere in the section as "Feedstock requirement factors."	Robert Lanza	Accepted	
1122	3	3	1426	1426	"[Feedstock] requirement factors (FRFs): Uncertainty in the default [feedstock] requirement factors …"	Robert Lanza	Accepted	
1124	3	3	1428	1428	"i.e., how much feedstock [(fuel) is combusted for process heat] per tonne of…"	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1126	3	3	1428	1430	Consider whether the method can be modified to allow for separate calculations for fuel and raw material, as it is possible that the fuel and raw material to a hydrogen production process could be different materials with different heat contents and carbon contents. PNNL 2017 and GREET 2013 (referenced in Table 3.30) show data for biomass gasification in which the raw material is biomass and the fuel is natural gas.	Robert Lanza	Accepted with modification	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."
8664	3	3	1433	1433	The use of the Latin phrase seems unnecessary.	Ole-Kenneth Nielsen	Rejected	
4536	3	3	1443		replae "percentage points" with "%"	Kewei Yu	Rejected	To make that change would alter the meaning.
1128	3	3	1443	1443	"An increase of +/- 10 percentage points…" -- clarify -- an "increase" isn't "+/-" which could be an +10 percentage point increase or a - 10 percentage point decrease.	Robert Lanza	Rejected	The authors consider that the text is appropriate for the description of uncertainty.
208	3	3	1443	1443	Why you select 10 percent? I find 15 percent is most common value in table 3.30. And compared with table 3.29 and table 3.30 I find major technologies uncertainty is 10 or 15, but 15 is three times and 10 is two times.	Koichi Kojima	Noted	The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock." Therefore this comment is no longer relevant.
4282	3	3	1446	1446	I suggest that the authors replace "member state" by "country with similar circumstances".	Naofumi Kosaka	Accepted	
8666	3	3	1446	1446	The use of the term 'Member State' should be avoided.	Ole-Kenneth Nielsen	Accepted	
1130	3	3	1447	1447	"An increase of 20 percentage point…" See comment on Line 1443, does this mean a "+/-" or just a "+?"	Robert Lanza	Accepted	The sign can be +/-
1132	3	3	1448	1448	"A default increase in the downward uncertainty" -- clarify, it is unclear what the downward uncertainty refers to here.	Robert Lanza	Accepted	
1134	3	3	1449	1449	Clarify -- "biogenic share" of what?	Robert Lanza	Accepted	Rewritten and moved to "Activity data uncertainties".
1136	3	3	1449	1449	Clarify -- "low value" -- what value is it? Low compared to what value?	Robert Lanza	Accepted	Rewritten and moved to "Activity data uncertainties".
1138	3	3	1449	1449	Clarify -- "reported data" -- based on what reported data?	Robert Lanza	Accepted	Phrase removed.
209	3	3	1458	1458	Why you select 5 percent?	Koichi Kojima	Noted	Same as Ch. 3.2 Ammonia production.
210	3	3	1462	1462	Why you select 20 percent? Default value in table 3.30 is 30 percent.	Koichi Kojima	Noted	There is not a default value for this in Table 3.30. The uncertainty is considered medium sized, based on expert judgement. A plant will probably not change production technology over the years, and hence a big variation in factors is not expected.
1140	3	3	1474	1475	CO2 and H2 -- check subscripts throughout section	Robert Lanza	Accepted	
1142	3	3	1476	1476	"no fossil fuel use or loss" -- clarify - this refers to no fossil fuel use to provide process heat to the production process and that only raw material, and no fuel, is used in the process?	Robert Lanza	Noted	The authors have revised the text to clarify this point.
1346	3	3	151	152	Table 3.3: For nitric acid production Germany proposes a further category: Plants with two catalysts. This reduces the EF even more. The main reason for the further reduction is because when one catalyst is cleaned the other one is still working.	David Kuntze	Noted	This category could be added if enough information is available by technology and using 2 catalysts. However, there are very few plants and all in Europe using this abatement and as European plants are using T3 as measurement is mandatory under the ETS and what we are updating is T2 it migth be no relevant to include it as there will be a risk of countries using an EF which is lower than in reality.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8644	3	3	151	152	Table 3.3 presents an EF for 'Old' production process defined as pre-1975. It is not clear what this EF is intended to be used for, e.g. is it applicable until a certain year and if so what year. Many inventories estimate emissions back to 1990, should this EF be used for all processes in 1990? More guidance should be provided on the applicability of this EF.	Ole-Kenneth Nielsen	Accepted	The word "Old (pre-1975) plants" means that the EF is to be used for the technology that was built before 1975 and it is still operating (this situation still exist in some countries). An explanatory footnote has been added.
8646	3	3	151	152	Footnote b and d to Table 3.3 both mentions 2017 submissions by Annex 1 Parties as reference for several EFs. It is not clear whether the Parties using default EFs from the 2006 IPCC GL have been taken out of the dataset. Also, several of the data points referenced from the BREF document are significantly outside of the range of the EFs provided considering the uncertainty listed. It seems that either the EFs of the uncertainty ranges should be updated. An example: Dual pressure (L/M) default EF is 7 with an uncertainty of 10 %. The only plant of this type in the BREF is reported with an emission level of 3.4-4.9, i.e. considerably outside the range of the default EF.	Ole-Kenneth Nielsen	Accepted	Parties using default EFs from the 2006 IPCC GL have been taken out of the dataset. Concerning the EF presented in the BREF for Dual L/M pressure plants the data comes from N2O emission levels of the Austrian nitric acid plants relating to catalytic ammonia combustion of the Austrian nitric acid plants (with abatement). The data source in the BREF is the report called STATE-OF-THE-ART FOR THE PRODUCTION OF NITRIC ACID WITH REGARD TO THE IPPC DIRECTIVE, Herbert WIESENBERGER, 2001, and IPCC data 20 years ago was not very realiable. Even this report also indicates that discrepancies might be caused by analytical problems with measurements. Nowadays, N2O concentrations are measured continuously, which is the more reliable method. Some more recent data can be found in UNFCCC NIRs submissions of Canada, Croatia and Italy for this technology (the results show higher values). In addition, the BREF indicates for EU designed dual plants a EF range of 8 - 10 (although it is not specified if it is L/M or M/H). Nevertheless, the uncertainty range has been updated to take into account the data source for the Austrian plants.
896	3	3	152	152	Comments on Table 3.3	Robert Lanza	Noted	
898	3	3	152	152	Comments on Table 3.3 -- N2O -- check subscripts throughout section	Robert Lanza	Accepted	
900	3	3	152	152	Comments on Table 3.3 -- For Single Low Pressure Plants -- provide a reference for the 5 kg/tonne emission factor-- there are no source notes for this line in the table	Robert Lanza	Noted	This EF was not updated, it is default IPCC2006 GLs. Based on the IPCC2006 GLs, the source of EF is Van Balken (2005) and European Fertilizer Manufacturrers Association. Therefore we did not put the sources. It is coherent with the information presented by the Parties in their GHG inventory submissions and based on measurements.
902	3	3	152	152	Comments on Table 3.3 -- For Single High Pressure Plants -- provide a reference for the 9 kg/tonne emission factor -- there are no source notes for this line in the table	Robert Lanza	Noted	This EF was not updated, it is default IPCC2006 GLs. Based on the IPCC2006 GLs, the source of EF is Van Balken (2005) and European Fertilizer Manufacturrers Association. Therefore we did not put the sources. It is coherent with the information presented by the Parties in their GHG inventory submissions and based on measurements.
904	3	3	152	152	Comments on Table 3.3 -- The "*" note does not appear to be associated with any "*" in the table itself; consider establishing a standard convention for notes and sources in tables throughout the document.	Robert Lanza	Accepted	Notes are indicated with * and sources with letters

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
906	3	3	152	152	Comments on Table 3.3 -- It is not clear from the "*" note how (whether) tailgas destruction technologies are being distinguished from NSCR technologies or other abatement technologies in the single pressure emission factors referred to in the "*" note. In the 2006 Guidelines for Nitric Acid Production, TABLE 3.2 N2O ABATEMENT APPROACHES AND ABATEMENT MEASURES. shows four levels of abatement, primary, secondary, tertiary, and quaternary.	Robert Lanza	Accepted	EF from plants with tail gas destruction technologies are not being distinguished from NSCR or other abatement technologies in the single pressure because the EF is almost the same for all types of abatement, i.e. 2.5. (Sources: IPCC2006 and 2017 Annex I Party GHG Inventory Submissions available at http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php). For instance, the EF with NSCR in USA is 3.3 while the 2006 IPCC GLs provided an EF of 2 for NSCR and 2.5 for tailgas destruction. Having a look to EF measurements for all levels of abatement technologies it was possible to regroup the EF with abatement in a single one representative for all single pressures processes and all levels of abatement. Nevertheless, the note has been redrafted for providing more clarity.
908	3	3	152	152	Comments on Table 3.3 -- Provide a basis and explanaton for the uncertainty estimates for each of the emission factors	Robert Lanza	Noted	The uncertainty levels are estimated from the range of EF found from measurements in the references. It is planned to obtain a wider range of measurements from the bigger producer countries to estimate and confirme the uncertainty values proposed using the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories of the 2006 IPCC Guidelines.
910	3	3	152	152	Comments on Table 3.3 -- Provide for footnote (b) an explanation of which national inventory submittals included N2O emission factors for nitric acid production and how the emission factors reported in the national inventories were translated into the 8 kg/tonne emission factor.	Robert Lanza	Rejected	For this case the EF published in the CRF tables and NIR submitted to the UNFCCC by Finland, Italy and Slovakia were used. From the group of countries using each technology an EF range is established for the technology without abatement measures and then the average proposed and the range taken into account in the uncertainty levels proposed. We do not think we should mention countries or plants due to confidentiality issues (even if the GHG inventories are publicly available and the BREF document published data by plant from EU plants). The number of plants by country is usually very small and we think there could be an issue if we provide the name of the countries and/or plants.
912	3	3	152	152	Comments on Table 3.3 -- Provide for footnote (d) an explaination of which national inventory submittals included N2O emissions and how these were used with emission factors from the other sources cited in footnote (d) to estimate the emission factors for the various various dual pressure processes.	Robert Lanza	Rejected	The EF published in the bibliography together with the EF reported in the CRF tables and NIR submitted to the UNFCCC are used all together. From the group of countries and plants using each technology an EF range is established for the technology without abatement measures and then the average proposed. We do not think we should mention countries due to confidentiality issues (even if the GHG inventories are publicly available) and also due to the changes of technologies in time in all countries. The number of plants by country is usually very small and we think there could be an issue if we provide the name of the countries.
914	3	3	152	152	Comments on Table 3.3 -- for example, Germany and Australia report Tier 3 plant-specific emission factors for N2O emissions from nitric acid production	Robert Lanza	Noted	Data from these two countries could not be used because they publish only the IEF for all plants and with abatement so these countries were taken out of the dataset. However, the biggest HNO3 producers in the EU are being contacted to validate the EF proposed and Germany is one of the countries that confirmed the realibility of the updated EF proposed.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
916	3	3	152	152	Comments on Table 3.3 -- Provide for footnote (c) a basis and explanaton for the conservativeness factor for NSCR	Robert Lanza	Accepted with modification	The explanation was wrong in indicating that a conservativeness factor has been applied for NSCR. This has been corrected. EF from plants with tail gas destruction technologies are not being distinguished from NSCR or other abatement technologies in the single pressure technologies because the EF is almost the same for all types of abatement, i.e. 2.5. (Sources: IPCC2006 and 2017 Annex I Party GHG Inventory Submissions available at http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php). For instance, the EF with NSCR in USA is 3.3 while the 2006 IPCC GLs provided an EF of 2 for NSCR and 2.5 for tailgas destruction. Having a look to EF measurements for all levels of abatement technologies it was possible to regroup the EF with abatement in a single one representative for all single, all M/H dual and all L/H pressures processes and all levels of abatement. Nevertheless, the note has been redrafted for providing more clarity.
918	3	3	152	152	Comments on Table 3.3 -- Some other chemical industry subcategories, e.g., petrochemical (ethylene) production, include geographic adjustment factors, see e.g., 2006 Guidelines TABLE 3.15 DEFAULT GEOGRAPHIC ADJUSTMENT FACTORS FOR TIER 1 CO2 EMISSION FACTORS FOR STEAM CRACKING ETHYLENE PRODUCTION. Consider using geographic adjustment factors in a similar manner to the national inventory data for N2O emissions from nitric acid production, rather than having one set of world-wide emission factors, as some national inventories are reporting plant-specific emission factors?	Robert Lanza	Rejected	The geografic differences can be easily figured out when looking at the GHG inventories of all countries. In fact, EU plants have the lowest EF and they are all using T3 due to the fact that the ETS make measurements mandatory. This table is going to be used by non EU countries as it provides T2 EF. There are few plants producing HNO3 worldwide and, out of EU there are no geographic differences, but emissions depend on the technology. Geographic differences have been also taken into account by proposing EF by technology and EF for outdated or old plants (pre-1975).
920	3	3	152	152	Comments on Table 3.3 -- In the 2006 Guidelines TABLE 3.3 DEFAULT FACTORS FOR NITRIC ACID PRODUCTION includes a separate default factor for plants with NSCR. Consider including a similar "plants with NSCR" factor in the revised table of default factors.	Robert Lanza	Rejected	EF from plants with tail gas destruction technologies are not being distinguished from NSCR or other abatement technologies in the single pressure technologies because the EF is almost the same for all types of abatement, i.e. 2.5. (Sources: IPCC2006 and 2017 Annex I Party GHG Inventory Submissions available at http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php). For instance, the EF with NSCR in USA is 3.3 while the 2006 IPCC GLs provided an EF of 2 for NSCR and 2.5 for tailgas destruction. Having a look to EF measurements for all levels of abatement technologies it was possible to regroup the EF with abatement in a single one representative for all single, all M/H dual and all L/H pressures processes and all levels of abatement. Nevertheless, the note has been redrafted for providing more clarity.
5442	3	3	153	153	Fertilizers Europe agrees to the comments made for Tier 3 and notes that for most nitric acid plants in Europe detailed plant data are available and thus the tier 3 method will be the most appropriate.	Tiffanie Stephani	Noted	
1520	3	3	1627	1627	change to ……. Fluorocarbons Environmental Acceptability Study, Arlington, U.S.A., 2004. Available at http://agage.mit.edu/data/afeas-data Out of date website	Archie McCulloch	Noted	The final list of references is subject to change and will be formatted in the final draft

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1144	3	3	1660	1660	The full reference for GREET (2013) is Updates to Parameters of Hydrogen Production Pathways in GREET™, Amgad Elgowainy, Jeongwoo Han, and Hao Zhu, Systems Assessment Group, Energy Systems Division, Argonne National Laboratory, October 7, 2013	Robert Lanza	Accepted	
4284	3	3	1660	1660	I suggest that the authors check the citation again. The number of authors is not two but three. The document name ends at not Patyways but GREET.	Naofumi Kosaka	Accepted	
1146	3	3	1683	1683	The National Energy Technology Laboratory (2017). The National Energy Technology Laboratory -- provide the title of this reference	Robert Lanza	Accepted	
1148	3	3	1683	1683	NETL 2017 is not referenced in Table 3.30. If NETL 2017 was used in preparing the factors in Table 3.30, indicate which factors are based on NETL 2017.	Robert Lanza	Accepted	Reference has been added to Table 3.30.
1150	3	3	1686	1687	The URL for the Pacific Northwest Laboratories Hydrogen Production Energy Conversion Efficiencies is: https://www.h2tools.org/hyarc/hydrogen-data/hydrogen-production-energy-conversion-efficiencies	Robert Lanza	Accepted	
6314	3	3	204	594	Excellent and comprehensive HFC-23 emissions methodology, no changes recommended.	Anny Huang	Noted	Thank you for your comment.
4582	3	3	2293		CO2 emission	Kewei Yu	Accepted	
6316	3	3	665	667	Strongly recommend that the final Guidelines version does include default emission factors currently described in the draft text "We are considering presenting defaul emission factors……which would better account for the fact that high-GWP emissions may result from the production of low-GWP products."	Anny Huang	Accepted	[See response to comment #1518.]
6402	3	3	698		Mij instead of Mijk	Ekaterina Imshennik	Accepted	We agree with the commenter and have corrected the typographical error as suggested.
846	3	3	698	698	The comma before the word "plants" has to be moved to after the word "plants". It has to be: "Mijk = mass emitted from j streams in each plant over all i plants, as determined from a mass balance."	Virginia Sena	Accepted	We agree with the commenter and have corrected the typographical error as suggested.
848	3	3	699	699	The parenthesis at the end of the line has to be deleted. The parenthesis is closed in the next line.	Virginia Sena	Accepted	We agree with the commenter and have corrected the typographical error as suggested.
4508	3	3	75	81	leter case issues	Kewei Yu	Accepted	
850	3	3	858	858	The reference to the Table should be "Table 3.29A" instead of "Table 3.29".	Virginia Sena	Accepted	We agree with the commenter and have corrected the typographical error as suggested.
852	3	3	867	867	The reference to the Table should be "Table 3.29A" instead of "Table 3.29".	Virginia Sena	Accepted	We agree with the commenter and have corrected the typographical error as suggested.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6828	3	3	876	882	In Germany, the SF6 emitted during the production of SF6 is not reported to UBA (German environmental agency) because there is only one SF6 manufacturer (compliance). The emission factor for returned and reused gas is 0.005.	Edgar Dullni	Accepted with modification	We are unable to find the Preisegger reference to help provide any additional context for the selection of the original value 0.002 or the commenter's suggested value of 0.005. It is also not clear if the 0.002 value represents a controlled or uncontrolled number. The expert reviewer does not provide documentation of the suggested 0.005 value, so we are not able to revise the value without including a reference in the 2019 Refinement section 3.10. Therefore, we will retain the original 0.002 value as is listed in the orginal 2006 guideline, as this value successfully completed the peer review process at that time. We included a note in the 2019 Refinement to clarify we do not know if this value represents emissions from a controlled or uncontrolled process .
4514	3	3	895		good practice in italic	Kewei Yu	Accepted	We agree with the commenter and have corrected the typographical error as suggested.
854	3	3	895	895	The reference to the Table should be "Table 3.29A" instead of "Table 3.29".	Virginia Sena	Accepted	We agree with the commenter and have corrected the typographical error as suggested.
6404	3	3	921		The decision tree should be refined. After "Are detailed data available jn plant-specific estimates?" "No" and "yes" are confused.	Ekaterina Imshennik	Accepted with modification	We agree with the commenter that the revised version of Figure 3.17 in the FOD of section 3.10 that was available under the Expert Review beginning in December 2017 had an error. Based on further review of the figure, we determined that Figure 3.17 should not be modified under the refinement. We reverted back to the original Figure 3.17 from the 2006 Guidelines. Another comment received on Figure 3.17, see below, resulted in a revision to Footnote 2 to the Figure 3.17.
6406	3	3	921		Emission estimates from key category can be made using Tier2 methodology. It is not mandatory to use Tier 3.	Ekaterina Imshennik	Accepted	We believe the commenter refers to Footnote 2 to Figure 3.17 that indicates Tier 2 may only be used for key category determination and is not useful for emission estimations for the inventory. We agree with the commenter that there may be instances where Tier 2 would be an appropriate methodology. The original footnote makes reference to the fact that HCFC-22 production is a relatively simple reaction process with two reactants and one by-product (HFC-23) that accounts for the majority of the total byproducts. Because there is one significant byproduct, the mass balance approach in Tier 2 is relatively straightforward. For fluorochemical processes covered under section 3.10.2, there tend to be more complex processes with multiple reactants and multiple by-products, which are perhaps too complicated for the mass balance methodology under Tier 2. However, in instances where a fluorochemical process under section 3.10.2 is a relatively simple process, i.e., few reactants and one product, Tier 2 could be appropriately applied. The Footnote 2 to Figure 3.17 has been refined to indicate that Tier 2 would be appropriate only for certain simple processes. The text in section 3.10.2.2 has not been refined.
6312	3	3	977	1495	Although the method for hydrogen production is defined in detail, it seems that there is no definition on the purity of hydrogen. It is necessary to define the purity of hydrogen. Because hydrogen to be supplied to a fuel cell is required to have high purity, and generation of CO 2 due to energy required for the purification process should be taken into consideration.	Ryo Nakajima	Noted	The authors note that impurities are removed in a separate step using energy from electricity or stationary combustion on site (i.e. sector 1 Energy). Hence, no change is needed.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
922	3	3	984	984	delete "methanol" -- Table 3.29 indicates that methanol is an "experimental" process	Robert Lanza	Accepted with modification	Table 3.29 has been revised to reflect that methanol reforming is not "experimental" but "minor and increasing".
924	3	3	984	984	"final product" -- clarify the defintiion of "final product," consider adding a text box describing the definitions of "final product" intermediate" and "byproduct"	Robert Lanza	Accepted	A new text box has been added, which also includes "main product", "feedstock", "raw material", "fuel", "pure hydrogen" and "gas mixtures".
926	3	3	984	984	"final product" -- defined as a) the hydrogen is exported offsite to a separate facility; b) the hydrogen is sold as a commercial product; c) similar definition	Robert Lanza	Accepted	A new text box has been added, which also includes "main product", "feedstock", "raw material", "fuel", "pure hydrogen" and "gas mixtures".
4516	3	3	988		CO2, subscript	Kewei Yu	Accepted	
928	3	3	988	988	CO2 -- check subscripts throughout section	Robert Lanza	Accepted	
930	3	3	989	989	"maximum of 2 % is normal" -- specify 2 percent of what… e.g., 2 percent by weight of the total amount of hydrogen produced?	Robert Lanza	Accepted with modification	The literature source is not specific on type of percentage. The authors of the hydrogen chapter have taken it as molar percentages of the produced hydrogen gas; if we assume it to be percentage by weight, then the produced hydrogen is even purer and the methane content even lower. The text has been rewritten to reflect that the methane is part of the product and produced in an anaerobic atmosphere, and hence none of this methane will be emitted in the hydrogen production sector. The term "normal" has been changed to "reported", as literature is scarce.
932	3	3	989	989	"minor" -- 2 percent may not be a "minor" amount of CH4 emissions from large-scale processes, considering that the emissions are methane, not CO2.	Robert Lanza	Accepted with modification	The text has been rewritten to reflect that the methane is part of the product and produced in an anaerobic atmosphere, and hence none of this methane will be emitted in the hydrogen production sector. The term "normal" has been changed to "reported", as literature is scarce.
8648	3	3	989	989	It is stated that biological technologies might generate minor amounts of CH4 and that at present a maximum of 2 % is normal. It is not clear what the 2 % refer to. Is the CH4 emission 2 % of the hydrogen produced? If so, this would seem like a significant emission. This would be elaborated further.	Ole-Kenneth Nielsen	Accepted with modification	The literature source is not specific on type of percentage. The authors of the hydrogen chapter have taken it as molar percentages of the produced hydrogen gas; if we assume it to be percentage by weight, then the produced hydrogen is even purer and the methane content even lower. The text has been rewritten to reflect that the methane is part of the product and produced in an anaerobic atmosphere, and hence none of this methane will be emitted in the hydrogen production sector. The term "normal" has been changed to "reported", as literature is scarce.
934	3	3	990	990	"combustion of fossil fuels" -- would this combustion of fossil fuels be reported under "energy" or under "IPPU?" In Ammona Production, emissions from the "feedstock" (i.e., the raw material to the process) and emissions from the "fuel" (i.e., that provides heat to the process) are both reported under IPPU.	Robert Lanza	Accepted	A clarification has been provided.
936	3	3	992	992	CO2 -- check subscripts throughout section	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8650	3	3	993	994	The statement that only GHG emissions from fossil feedstocks should be included in the inventory seems inaccurate. If there were CH4 emissions from biological processes (see also comment to Volume 3, Chapter 3, Line 989) they should be included in the inventory. If they are insignificant that could be stated and no methodology be provided, but stating that the inventory should only include emissions from processes using fossil fuels seems inaccurate.	Ole-Kenneth Nielsen	Accepted	The text has been rewritten to address this comment.
938	3	3	994	994	CO2 -- check subscripts throughout section	Robert Lanza	Accepted	
4884	3	3	994	995	What does 'the IPPU memo item' refer to? Is it a memo item that needs to newly be included in the IPCC Reporting tables (in Vol.1)?)	Elsa Hatanaka	Accepted with modification	The authors note that there is no need at this stage to specify the type of memo item. Hence, the specification "IPPU" is removed from all text.
940	3	3	995	996	"negligible" -- 2 percent may not be a "minor" amount of CH4 emissions from large-scale processes, considering that the emissions are methane, not CO2.	Robert Lanza	Accepted with modification	The text has been rewritten to reflect that the methane is part of the product and produced in an anaerobic atmosphere, and hence none of this methane will be emitted in the hydrogen production sector. The term "normal" has been changed to "reported", as literature is scarce.
942	3	3	999	1001	"main product" -- Clarify the definition of "main product." See comments to line 984, consider a text box to clarify the definition of "main product."	Robert Lanza	Accepted	A new text box has been added, which also includes "main product", "feedstock", "raw material", "fuel", "pure hydrogen" and "gas mixtures".
944	3	3	999	1001	"byproduct" and "intermediate product" -- consider adding a text box describing the definitions of "main product" "intermediate product" and "byproduct."	Robert Lanza	Accepted	A new text box has been added, which also includes "main product", "feedstock", "raw material", "fuel", "pure hydrogen" and "gas mixtures".
5100	3	3	999	1003	…When hydrogen is a by-product or intermediate product, its good practice to report the CO2 emissions in the sector of the main product. For instance…in refineries… In the categories where refineries have to be reported (1.A.1.b and 1.B.2.aiii 4) is no methodical description available. Combustion related emissions from hydrogen production are automatically included in 1.A.1.b. But process related emissions from hydrogen production are not described in 1.A.1.b and 1.B.2.aiii. This is a dead link.	Kristina Juhrich	Noted	The existing methodology in Vol. 2 Energy (Ch. 4.2) may be used, and it will be improved in the 2019 Refinement. Clarifying box will be provided in the Energy chapter.
5522	3	4			Section 4.4 Primary Aluminium Production - General information: Many countries proposed CO2 reduction for years to come and are placing or had placed regulations about GHG emissions and requirements (for example taxes and cap and trade). Year baselines are different and reduction objectives could be different too. There could free allowance given by government based on regulated targets. The change proposed could impact the compliance of those regulations and free allowance. We welcomed the proposition to develop a consistent time series but the method must be accurate to avoid any uncertainty increasing.	Christine Dubois	Noted	No action needed
2514	3	4			Proof reading is needed	Anna Mikis	Accepted	
5084	3	4	1004	1004	insert comma after "ratio"	Christopher Bayliss	Accepted	Edited text

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
5404	3	4	1004	1014	Based on the numbers in Table 1 in (Marks and Nunez 2018) it would make more sense to report LVAE emissions based on CF4/ton Al for both Tier 2 and Tier 3 as well as for Tier 1. These numbers seem to be very consistent around 0.015 to 0.018 kg CF4/ton Al for all PB technologies, while the HVAE numbers improves a lot due to the different design and control improvements from the old legacy PB cells to the new modern PB cells. This indicates that LVAE and HVAE does not have a direct relationship, and hence it only introduces additional uncertainties to report LVAE as a function of HVAE. The reduction in HVAE is to a large degree due to improvements in automated anode effect termination and avoidance systems. These systems might prevent an HVAE, but are not very efficient in avoiding the LVAE preceding the HVAE, and fair to say these systems are not designed to do so either. Therefore, it is difficult to see why a reduction in HVAE should automatically lead to a reduction in LVAE which would be the case if LVAE is reported as a factor of HVAE. Reporting LVAE as a function of produced metal, but preferably with Tier 3 type factors calculated for each plant makes much more sense and will probably give equal or better accuracy while maintaining a simpler and more transparent approach.	Ole Kjos	Rejected	The consistency of the numbers across facilities would argue to justify suggested approach. However, there is evidence in repeat measurements at individual facilities that when HVAE emissions are reduced LVAE emissions are also reduced which would favor a ratio approach in any time series approach. Many of the factors involved in reducing HVAE emissions also reduce the propensity for LVAE emissions to occur. We agree with the reviewer that the best way to establish a LVAE and HVAE emissions factor is using the T3 approach.
5550	3	4	1012	1014	The decision not to consider C2F6 emissions from LVAE is welcomed	Christine Dubois	Accepted	No action needed
1708	3	4	1015	1027	There are inconsistencies related to Equation 4.26B. As it is developed, "LVAE_E CF4" units will be "square Kg" instead of "Kg". I think the "MPi" term of the equation has to be deleted, and also that the "Ratio" has no units (instead of kg CF4/tonne Al as it is written in line 1026).	Virginia Sena	Accepted	Edited text
4540	3	4	102	103	Tier 2, a space	Kewei Yu	Accepted	Typo corrected in the text
5086	3	4	1024	1024	replace "ECF4" with "ECF4,i"	Christopher Bayliss	Accepted	Edited text
5088	3	4	1025	1025	subscript 4 in CF4	Christopher Bayliss	Accepted	Corrected
9546	3	4	1026	1027	No units for the LVAE/HVAE ratio.	Nadia Morais	Accepted	Edited text
5540	3	4	1037	1038	In the title, HAVE should be HVAE EF CF4 and EF C2F6, units should be (kg/tonne Al)/(min/celldays)	Christine Dubois	Accepted	Edited text
5090	3	4	1037	1043	spelling of HVAE incorrect in tables 4.15 and 4.16 (HAVE)	Christopher Bayliss	Accepted	Edited text
8680	3	4	1037	1043	There is no references cited for the default EFs presented in Table 4.15 and Table 4.16. The references used should be provided for each of the technologies listed.	Ole-Kenneth Nielsen	Accepted	Edited tables and reference added
5544	3	4	1037	1048	Table 4,15 indicates slope term for Tier 1 EFCF4 for HVAE and LVAE is lower than EFC Tier 2 shown in table 4,16 (HVAE) for different technology PFPB. The units should be (kgCF4/mt Al)/(Min/cellday). Should explain why is Tier 1 lower than Tier 2. We know Tier 1 uncetanties are higher but perhaps a comment or explanation should be included.	Christine Dubois	Rejected	Heading incorrect in first draft - values are not comparable as suggested

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
9548	3	4	1042	1043	Table 4.16 : not the good units for the tier 2 Slope Coefficient and the note «b» does not appear at the bottom of the table.	Nadia Morais	Accepted with modification	Removed footnote - previous heading for CF4 was incorrect and has now been amended so units are correct
5542	3	4	1042	1043	In the title, HAVE should be HVAE EF CF4, units should be (kg/tonne Al)/(min/celldays)	Christine Dubois	Accepted	Edited text
5092	3	4	1042	1043	second column in table 4.16 mislabelled - should read SCF4 (kg/tonne Al/AE-mins/cell-day	Christopher Bayliss	Accepted	Edited text
5094	3	4	1042	1043	no footnote 'b' to accompany reference in Uncertainty Range column of table 4.16	Christopher Bayliss	Accepted	Edited text
9550	3	4	1047	1048	Uncertainty of the LVAE/HVAE ratio must be specified.	Nadia Morais	Accepted	Uncertainties included
1350	3	4	1049	1056	The EF under Tier 3 for PFC emissions from aluminium production is requested to be measured. But in the old IPCC GLs 2006 there was the collection efficiency to be accounted (see old IPCC GLs 2006, p. 4.54, table 4.16, note C. I propose to add the information Collection efficiency = CWPB 98%, SWPB 90%, VSS 85%, HSS 90% in the text for the developement of a Tier 3 EF.	David Kuntze	Rejected	The updated factors don't necessarily reflect the percentage collection efficiencies noted in comment. While those percentage are typical for the technologies mentioned the updated emission factors and slope factors are calculated based on actual measurements and the measured fluoride collection efficiencies for the measured facilities (using the fluoride collection efficiency as a proxy for PFC collection efficiency). Therefore a T3 EF would have efficiency related to individual site.
5548	3	4	1086	1139	For GHG regulation, taxes and cap and trade system, the government choice year baseline to calculate the CO2 reduction. Changing the historical result is important but it must be accurate as it is impact the regulation compliance	Christine Dubois	Accepted	Modifications were applied to the time-consistency section to ensure consistency through time for historical data.
9552	3	4	1101	1102	Last sentence : specify that this methodology concerns the Tier 2 method. Because I understand that the 2007 and up backcast data concerns the users of the tier 2 method and not the users of tier 3 overvoltage method (no good practice specified in the document to backcast the HVEA emissions for the users of tier 3 overvoltage method).	Nadia Morais	Accepted with modification	Edited text accordingly for Tier 2. There was no modification regarding tier 3 due to the fact the such coefficients are based on smelter data. For this reason, backcasting using tier 3 should still use the specific factor defined during that specific period.
6128	3	4	1119	1121	The IAI is referenced two times in lines 1119 and 1120 but noted as if they were different entities with differing references?	Jooil Kim	Accepted	Edited text
5546	3	4	1123	1139	Section 4.4.2.7 developing a consistent time series : for aluminium smelters using Tier 1 or Tier 2, the proposition for HVAE is to backcast calculation for PFC emission from 2007. It is not clear for LVAE if we have to backcast emission from 2007 or not. And if we are using Tier 3 factor, could we use Tier 2 factor for LVAE PFC emissions?	Christine Dubois	Accepted	Section on time consistency was edited accordingly.
4552	3	4	1125		Xiping is given name, check the reference	Kewei Yu	Accepted	Edited text
9554	3	4	1128	1139	I found some contradictions in these lines. The impact of the LVEA emissions backcast on the cap and trade regementation should be considered. I understand that the backcast with tier 2 is interresting to understand the level of LVEA PFC in the atmosphere but not enough acurate for facilities regulation at this time.	Nadia Morais	Accepted	Added some words to add precision regarding the "national level"

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
4176	3	4	1133	1139	For backcasting purposes, it may be more accurate to assume a minimum LVAE emission factor instead of omitting the LVAE emissions entirely. However, I haven't had the opportunity to review the data in the cited paper.	Stephanie Bogle	Rejected	There was no observation of LVAE in the past (2006 and less) due to the change in technologies and increasing amperage. For this reason, there is only a minimal error in omitting LVAE prior to a certain date in time (2006). For the period between 2006 and 2019, there is too much uncertainty and variations associated to the LVAE EF to allow its usage for individual smelters backcasting.
6130	3	4	1145	1147	Past IAI reports have found and used different emission factors specific to China, so there exists instances of regional differences. Perhaps the authors would clasify this as a difference in "work practices in use in the country or region"? In it's current form, this sentence gives the impression that there aren't significant differences in emissions between countries and regions, and I think that could be misleading.	Jooil Kim	Rejected	Differences are in work practices and tech not country specific
5406	3	4	1225	1226	A good methodology for measurement and quantification of LVAE is essential, and needs to be specified either in the document or with a reference. Especially the level of quantification (LOQ) is important as a higher LOQ will detect a lower share of the total LVAE emissions, and hence give a lower reported value. On the other hand, it is essential not to analyse below LOQ, as it will then include noise in the dataset, which will lead to a substantial over-estimation of the emissions. To have comparable measurements across facilities it is essential to have the same LOQ when estimating LVAE. Ideally LOQ for LVAE should be defined as a fraction of the produced gases to be independent of suction rates, i.e. LOQ CF4 could be 1/1000000 of the CO2 level. Figure 3 from Aarhaug et.al, Light metals 2018 compares two instruments with different sensitivity, and how that affect the instruments actual ability to estimate emissions. If none, or too low LOQ were to be used then one would potentially report the integrated noise area, as seen in "ProtIR" data before 12:00. Also, if using IUPAC defined LOQ on both ProtIR and Bomem results, they would give significant different reported values due to lower noise and higher sensitivity of the Bomem. A consensus for the required detection level to establish LVAE quantification needs to be outlined, there should be a requirement that all measurements are proven to conform with this detection limit, and too report uncertainty budgets as well.	Ole Kjos	Accepted with modification	Edited text to clarify - reviewers notes are mostly out of scope of GL but should be considered for future protocols to support new GL.
8682	3	4	1225	1226	Not sure that it is the role of inventory compilers to encourage industry how to do estimates. It seems that role would fit better with regulatory authorities or the international branch association. This sentence should be deleted or reformulated.	Ole-Kenneth Nielsen	Accepted	Text removed
6132	3	4	1258	1258	Table 4.17: Include separate reporting of CF4 and C2F6 emissions in the table, as suggested in line 1250.	Jooil Kim	Rejected	Method adopted is the same for both gases so no need to separate
4554	3	4	1276		5%, remove a space	Kewei Yu	Accepted	Text has been removed.
4556	3	4	1287	1289	parallel and sequential, in italic or not?	Kewei Yu	Rejected	Not in italic. Text has been corrected.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6418	3	4	1314	1320	The text is the same as in lines 1307 - 1313	Ekaterina Imshennik	Accepted	Doubled text has been removed.
1710	3	4	1314	1320	These 2 parapraphs are the same as the 2 paragraphs above (lines 1307 to 1313).	Virginia Sena	Accepted	Doubled text has been removed.
8684	3	4	1335	1336	If the sources are negligible then they are presumably <1 % and not >1 %. The same goes for line 1349-1350.	Ole-Kenneth Nielsen	Accepted	>1% has been replaced by <1%.
6422	3	4	1336	1336	Should be < 1%	Ekaterina Imshennik	Accepted	>1% has been replaced by <1%.
6420	3	4	1350	1350	Should be < 1%	Ekaterina Imshennik	Accepted	>1% has been replaced by <1%.
1712	3	4	1376	1382	Please review the punctuation (dots at the end of the sentences) in this paragraph. Also, in line 1382, it is written "...m the presence..." instead of "...in the presence..." The paragraph may be: "The first stage of carbonization ends at concentrations of 3-4 g/l of Al2O3. Alumina hydrate is then separated and the second stage of carbonization is carried on to sodium hydrocarbonate concentrations of 10-15 g/l of NaHCO3. The precipitate is sodium hydroalumocarbonate as mentioned above. Since the carbonate-containing solutions are further processed to yield sodium carbonate and potassium carbonate, they must not contain more than 0.1-0.15 g/l of Al2O3. It is for this reason that carbonization must be carried on up to 10-15 g/l of NaHCO3 concentrations since the solubility of the alumocarbonate is sharply reduced in the presence of substantial amounts of hydrocarbonate."	Virginia Sena	Accepted	The text has been corrected.
4558	3	4	1381		m?	Kewei Yu	Accepted	The text has been corrected.
6424	3	4	1385	1399	Lime is used in numerous industrial processes. It will be better to estmate this CO2 sink in individual sink category on the base of total amount of lime used in all industrial processes, in order not to make this methodology too complicated.	Ekaterina Imshennik	Noted	Cross cutting issue - may need input from CLAs for next draft
4560	3	4	1405		is very depends on, grammar	Kewei Yu	Accepted	The text has been corrected.
1714	3	4	1405	1405	It is written "… capture is very depends on…" instead of "… capture is very dependent on …"	Virginia Sena	Accepted	The text has been corrected.
4542	3	4	141		Tier 2, letter case	Kewei Yu	Accepted	Edited text
4562	3	4	1426		replace carbon dioxide or methane with ""CO2 and CH4"	Kewei Yu	Accepted	The text which contains the appropriate phrases has been corrected.
4564	3	4	1454		lime production in bold?	Kewei Yu	Accepted	The text has been corrected. The text is normal
6426	3	4	1454	1456	Emissions from lime production are accounted for in category 2.A.2 Lime production. The estimation of CO2 emission from lime production in alluminium industry will cause double counting. Moreover, this text is not in line with the Equation 4.27A for Tier 1.	Ekaterina Imshennik	Accepted	Additional clarification has been added. Equation 4.27A for Tier 1 has been corrected .
4566	3	4	1458		sintering process in bold?	Kewei Yu	Accepted	The text has been corrected. The text is normal
8686	3	4	1477	1478	A tier 1 EF is referenced to section 4.4.5.3. However, in this section on tier 1 EF is provided.	Ole-Kenneth Nielsen	Accepted	The table with Tier 1 EF is provided in section 4.4.5.3.
4568	3	4	1483		better use %	Kewei Yu	Accepted	The text has been corrected.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6428	3	4	1496	1497	It is not necessary to mention lime calcination in this decision tree. CO2 emissions from lime production should be accounted for in 2.A.2 source category Lime production according to IPCC Guidlines. It should not be accounted for in this category.	Ekaterina Imshennik	Rejected	Appropriate description has been added to Chapter 4.4.5.2. Tier 1 Method: If lime production process at alumina plants has not been considered at national level, this process shall be considered as source related to alumina production emission and shall be mentioned in decision tree. It is necessary to check prior collecting data for national inventory.
6430	3	4	1509	1509	If Tier 2 method makes use of typical industry values for impurities this values should be provided in the 4.4.5.3 Subsection. Otherwise, the terminology shall correspond with terminology of Equations, where word "impurity" is not used.	Ekaterina Imshennik	Accepted	Tier 2 method has bee removed.
6432	3	4	1509	1511	Too little information about Tier 2 methodology which usually becomes more in demand for inventory compilers than Tier 3.	Ekaterina Imshennik	Accepted	Tier 2 method has bee removed.
4570	3	4	1526		better use 5%	Kewei Yu	Accepted	The text has been corrected.
6440	3	4	1545	1549	Is it possible to use data on amount of carbonates consumed and corresponding carbon content or carbonate consumption rate per 1 tonne of alumina produced?	Ekaterina Imshennik	Rejected	it is not possible to use data on amount of carbonates consumed and corresponding carbon content or carbonate consumption rate per 1 tonne of alumina produced.
6434	3	4	1550	1551	It has already been accounted for in the category 2.A.2. It is double counting	Ekaterina Imshennik	Accepted	An appropriate comment is added to avoid double counting.
6436	3	4	1553	1563	CO2 emissions from soda ash use are accounted for in category 2.A.4b. If soda ash is generated in the production process it is necessary to know how it is used at the plant and how it is accounted for by national statistics to avoid double counting.	Ekaterina Imshennik	Accepted	An appropriate comment is added to avoid double counting.
4572	3	4	1557	1560	CNa2Ok? CNa2O?	Kewei Yu	Accepted	The text has been corrected.
68	3	4	1613	1613	Please check the page note 2.	Mingshan Su	Accepted	The text has been corrected.
8688	3	4	1622	1628	There is no tier 1 EF available, which is highly unusual as this would be perhaps the only source covered by the IPCC GL, where a tier 1 EF is not provided. As this is unlikely to be a KC, most countries would look to apply a tier 1. Therefore, it is necessary to present a default tier 1 EF. Also, how would users assess whether this would be a KC without having a default EF. Furthermore, the tier 1 methodology as presented in equation 4.27a requires a tier 1 EF.	Ole-Kenneth Nielsen	Accepted	The table with Tier 1 EF is provided.
6438	3	4	1623	1628	The default emission factors must be provided for Tier 1 (see Instructions to Experts and Authors, para 25, 26 and 41)	Ekaterina Imshennik	Accepted	The table with Tier 1 EF is provided.
6442	3	4	1674	1691	It is proposed to inventory compilers to collect plant level data for implementation of Tier 1 methodology. It seems rather like plant-level Tier 3 approach.	Ekaterina Imshennik	Accepted	The table with Tier 1 EF is provided.
6444	3	4	1693	1720	It is unlikely that the detailed sintering process data are collected by national statistics. Consequently, there is no practical difference between Tier 2 and Tier 3 methodologies. It means that all inventory compilers have to use Tier 3 methodology and plant-level data or the Tier 1 methodology (if the default emission factors are provided).	Ekaterina Imshennik	Accepted	Tier 2 method has bee removed.
4574	3	4	1716		better use 5%	Kewei Yu	Accepted	The text has been corrected.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8690	3	4	1811	1817	Currently, it doesn't make sense to ask inventory compilers to compare with IPCC default EFs, when no default EFs are provided!	Ole-Kenneth Nielsen	Accepted	The table with Tier 1 EF is provided in section 4.4.5.3.
8692	3	4	1835	1836	The reference to section 4.4.3.2 seems to be incorrect.	Ole-Kenneth Nielsen	Accepted	The reference has been replaced to Section 4.4.5.3.
4576	3	4	1946		,as follows:?	Kewei Yu	Accepted	Typo corrected in the text
4578	3	4	1951		replace carbon dioxide with ""CO2"	Kewei Yu	Accepted	Typo corrected in the text
1716	3	4	1986	1991	The term MPi for Equation 4.35 is not defined. It may be: Total metal production for RE metal/alloy type i (tonnes RE metal).	Virginia Sena	Accepted	Added defition of "MPi"
69	3	4	1986	1992	Please define MPi.	Mingshan Su	Accepted	Added defition of "MPi"
6134	3	4	1990	1991	MPi not defined.	Jooil Kim	Accepted	Added defition of "MPi"
1718	3	4	1994	1994	It is written "...the lack of published data means that than individual.." instead of "...the lack of published data means that individual…".	Virginia Sena	Accepted	Typo corrected in the text
61	3	4	206	335	It is better to put this section in Vollume 3(Energy Sector) to avoid reporting CO2 emssion from coke production in IPPU sector.	Mingshan Su	Rejected	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines. The only difference is related with the allocation of the fugitive emissions.
1720	3	4	2060	2061	At least one quotation mark is missing in the sentence: "...facilities can refer to this as ‘net anode or net carbon consumption."	Virginia Sena	Accepted	Typo corrected in the text
5868	3	4	207	207	Following line 207, suggest inclusion of information discussing off-site coke production CO2 emissions. 2006 Guidelines are very explicit between on- and off-site emissions and this chapter would benefit from inclusion	Vincent Camobreco	Accepted	The detailed explanation of the offsite and insite processes will be privided.
9598	3	4	208	208	Change "should" to "shall" Where it says "The emissions should be reported". It will then read as "The emissions shall be reported under the…"	Raul Salas Reyes	Noted	
1152	3	4	208	208	Line 208 and Line 324 read "Energy Sector Category Acii" Line 267, Line 280, and Line 295 read "Energy Sector Category 1.A.1c" Check for consistency	Robert Lanza	Accepted	The crosscheck of the categories numeration will be provided.
4286	3	4	208	208	I suggest that the authors replace "1Acii" by "1A1ci" to be consistent with Table 8.2 in Volume 1.	Naofumi Kosaka	Accepted	The crosscheck of the categories numeration will be provided.
1154	3	4	208	209	edit -- "The CO2 emissions should be reported under the Energy Sector Category 1.A.1c. Manufacture of Solid Fuels, and the CH4 emissions should be reported under Category 1.B.1d "Fugitive Emissions	Robert Lanza	Accepted	The crosscheck of the categories numeration will be provided.
4886	3	4	2095	2095	Is it normal to use 'recommend' in IPCC Guidelines?	Elsa Hatanaka	Rejected	There is similar wording in the existing 2006 IPCC GL's for Primary Aluminium GHG emissions
6136	3	4	2096	2097	"these are to rare earth industry are currently unavailable," revise english	Jooil Kim	Accepted	Wording adjusted
1722	3	4	2113	2113	It is written "perfromance" instead of "performance".	Virginia Sena	Accepted	Typo corrected in the text
4888	3	4	2115	2115	This line does not connect to the previous or latter line. (editorial)	Elsa Hatanaka	Accepted	Typo, line has been deleted
1724	3	4	2115	2115	The line has neither start nor end and is not connected with other lines.	Virginia Sena	Accepted	Typo, line has been deleted

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6138	3	4	2115	2115	Shown in error, erase line?	Jooil Kim	Accepted	Typo, line has been deleted
4998	3	4	2119	2120	In this decision tree one no should be yes: Is this a key category -> yes (not no) -> collect process data…	Päivi Lindh	Accepted	Decision tree updated
4580	3	4	2224		replace carbon dioxide with ""CO2"	Kewei Yu	Accepted	Change made
6144	3	4	2238	2238	"aluminium" production? Did the authors mean "rare earth metall/alloy" production instead?	Jooil Kim	Accepted	Change made
6146	3	4	2239	2239	As the authors acknowledge, there is a severe lack of measurements regarding emissions in the rare earth industry, making it difficult to provide clear guidelines for estimating GHG emissions from these processes. On the other hand, and as with the LVAE emissions in the aluminum industry, I believe these IPCC guidelines can provide an important first step. As such, I would stress that future efforts are necessary to improve these methods as more data becomes available.	Jooil Kim	Noted	Comment only, no changes made since none requested
1698	3	4	227	227	Reference to Table 4.1 is not correct. The correct one is Table 4.3.	Virginia Sena	Accepted	
1726	3	4	2293	2293	It is written "...facility CO⁻2 emission factors..." instead of "… facility CO2 emission factors…".	Virginia Sena	Accepted	Change made
6140	3	4	2293	2293	Correct "CO-2" with proper subscript	Jooil Kim	Accepted	Change made
6142	3	4	2331	2332	Table 4.30: Include separate reporting of CF4 and C2F6 emissions in the table, as suggested in lines 2324-2325.	Jooil Kim	Accepted	This comment was already addressed in the FOD text, however, the Table now has some adjusted wording to clarify this
3332	3	4	235	236	Table 4.1A Tiers 1b, 2 and 3 are not consistent with Energy Sector. Methodology provided in energy sector is based on the amount of COG combusted as fuel. Use of simplified coke balance approach will lead to high uncertainties, because amount of coal consumed for coke production is usually not included in statistics and could be only roughly evaluated. In additional, carbon content in coal as well as in coke could vary for different coal types.	Veronika Ginzburg	Accepted with modification	The Tiers 1b, 2 and 3 approaches will be revised.
9600	3	4	235	236	Is it possible to elaborate under Tier 3, what does "quality of carbonaceuous materials" means in this case? Also, an equation supporting the Tier 3 method would increase the clarity of this Tier.	Raul Salas Reyes	Accepted with modification	The detailed explanation will be provided.
1318	3	4	2351	2352	For EEA 2016 clarify in the citation which section(s) of the guidebook were used.	Robert Lanza	Noted	The list of literature is subject to change and will be formatted in the final draft
1320	3	4	2357	2358	The full reference for the JRC 2013 document is: JRC Reference Report:Best Available Techniques (BAT) Reference Document for Iron and Steel Production, Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control), Rainer Remus, Miguel A. Aguado-Monsonet. Serge Roudier, Luis Delgado Sancho, 2013	Robert Lanza	Noted	The list of literature is subject to change and will be formatted in the final draft

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1322	3	4	2359	2360	The full reference for EPA Office of Air and Radiation (OAR) 2008 document is: TECHNICAL SUPPORT DOCUMENT FOR THE IRON AND STEEL SECTOR: PROPOSED RULE FOR MANDATORY REPORTING OF GREENHOUSE GASES Office of Air and Radiation U.S. Environmental Protection Agency September 9, 2008	Robert Lanza	Noted	The list of literature is subject to change and will be formatted in the final draft
1324	3	4	2364	2365	The full reference for EPA Office of Air Quality Planning and Standards (OAQPS) 2012 document is: Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Iron and Steel Industry Prepared by the Sector Policies and Programs Division. Office of Air Quality Planning and Standards. U.S. Environmental Protection Agency. September 2012.	Robert Lanza	Noted	The list of literature is subject to change and will be formatted in the final draft
1326	3	4	2367	2367	There are several PDF documents on the ThyssenKrupp Industrial Solutions coke plant technologies website; clarify which documents were used.	Robert Lanza	Noted	The list of literature is subject to change and will be formatted in the final draft
1156	3	4	239	239	Footnote "1" is inherent to the text description and should not be a footnote; incorporate footnote text into the main text; check spelling of "coqueification"	Robert Lanza	Noted	
62	3	4	241	241	repeated comma.	Mingshan Su	Noted	
1700	3	4	241	241	Typing error: "coke, , ascension pipes, coke pushing…" instead of "coke, ascension pipes, coke pushing…"	Virginia Sena	Noted	
8670	3	4	241	241	Footnote 2 references IPPC 2013. However, this is referenced differently in the list of references.	Ole-Kenneth Nielsen	Accepted	The list of literature is subject to change and will be formatted in the final draft
1158	3	4	242	242	delete "difficult to quantfy" -- Line 551 refers to fugitive CH4 emissions data from coke production stacks and coke oven quenching towers; indicate here that emission factors for coke oven fugitive CH4 emissions have been developed based on direct measurement data.	Robert Lanza	Accepted with modification	The detailed explanation will be provided.
1160	3	4	242	242	"coke , ascension" -- missing word here? Or close up comma spacing.	Robert Lanza	Noted	
9616	3	4	249	249	I suggest that the authors replace "4.3.3" with "4.3.2.2".	Naofumi Kosaka	Noted	
8668	3	4	251	255	A reference is made that methodologies for estimating flaring from metal production are included in Volume 2 Chapter 2. This does not seem to be correct. This should be clarified.	Ole-Kenneth Nielsen	Accepted with modification	The clarification between Energy and IPPU sectors required.
1164	3	4	254	254	[check "Volume 2 Chapter 2"	Robert Lanza	Accepted with modification	The fugutive emissions concidered as a part of Volume 2. Methodology for the flaring process emissions will be provided in the Volume 3.
3334	3	4	254	255	Emissions from flaring process considered as fugitive. The methodology should be provided in Volume 2 chapter 4 (see Vol2_Ch4_FOD table 4.3.4)	Veronika Ginzburg	Noted	
5184	3	4	257	258	footnote 1: …recovery technology…	Kari Grönfors	Noted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
3336	3	4	258	335	Production based method can be used only as verification approach to ensure that carbon balance is kept. While methodology provided in the Energy sector (vol.2 ch.2) should be used to estimate the corresponding GHGs emissions. See also comments for lines 235-236, table 4.1A. The same is for Tier 2 and Tier 3.	Veronika Ginzburg	Rejected	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines.
4538	3	4	26	27	CO2 subscript, check other places	Kewei Yu	Accepted	Edited text
1702	3	4	261	261	The reference to Table 4.1 is not enough, since Table 4.1 contains only default emission factors for CO2. Reference to Table 4.2 (containing CH4 default emission factors) is also needed.	Virginia Sena	Accepted with modification	The CH4 default emission factors will be reviewed.
63	3	4	262	269	It is better to describe the two equations in 2 separate paragraphs. For example Equation 4.1(a) and Equation 4.1(b).	Mingshan Su	Noted	
1704	3	4	266	266	Taking into account the units for the default emission factors in Table 4.1 (tonnes CO2/ tonnes coke production) the unit for CO2 emissions should be "tonnes" instead of "kg".	Virginia Sena	Accepted	
6410	3	4	266	269	Units for emissions, emission factors and activity data should correspond each other	Ekaterina Imshennik	Accepted	
3338	3	4	267	267	It is not right. COG could be combusted in different categories of A1 (1A1a - energy industry, main heat and electricity production; 1A1cii - manufacture of solid fuels; 1A2c - chemical industry; 1A2a - iron and steel; and other industries, etc.) and accordingly emissions also could be reported in different categories	Veronika Ginzburg	Rejected	The equation 4.1 refers to the Tier 1, where it is considered that all COG is burned in the coke ovens.
1166	3	4	267	267	Line 208 and Line 324 read "Energy Sector Category Acii" Line 267, Line 280, and Line 295 read "Energy Sector Category 1.A.1c" Check for consistency	Robert Lanza	Accepted	
1706	3	4	269	269	The units and the reference Table for CH4 emission factor are incorrect. The line should be: " EF = emission factor, tonnes CO2 / tonne coke production (Table 4.1) or kg CH4/ tonne coke prodcution (Table 4.2).	Virginia Sena	Accepted with modification	CO2 t/t, ch4 g/t, because of the small amount of ch4 emissions comparing to the CO2.
6414	3	4	271	309	There is an inconsistency between Tier1b and Tier2. Using Tier1b we account for all coke oven gas and all coke oven by-products combusted. No other fuels used for coke production are accounted for. Using Tier2 we account only for coke oven gas combusted in coke production process. We consider that coke oven by-products are transferred offsite and are not combusted in the process. We also account for some other fuels consumed (combusted) such as natural gas, blast furnace gas and so on. It meens that we estimate different emission sources using these two methodologies. In my opinion, it may cause doublecounting or omission of CO2 emissions.	Ekaterina Imshennik	Accepted with modification	
1168	3	4	272	272	Edit to "…all of the recovered coke oven byproducts…"	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6412	3	4	272	273	According to equation 4.1A, all coke oven gas and all coke oven by-products are combusted. Only metallurgical coke is not combusted. The amount of carbon contained in this by-products is not deducted Only metallurgical coke is not combusted. The amount of carbon contained in this by-products is not deducted from the amount of carbon in raw material. There is a contradiction between the equation 4.1.A and the phrase " Tier 1b assumes that all of coke oven by-products are transferred off site"!	Ekaterina Imshennik	Rejected	The Tier 1b assumes that the by-products are not burnt at the coke plant which is consistent with the equation 4.1A.
1170	3	4	295	295	Line 208 and Line 324 read "Energy Sector Category Acii" Line 267, Line 280, and Line 295 read "Energy Sector Category 1.A.1c" Check for consistency	Robert Lanza	Accepted	
1172	3	4	297	298	Clarify definition of PM(a) = "quantity of other process material (a) not listed as a separate term in Equation 4.2A, consumed in the country for metallurgical coke production (kg); other process materials used may include natural gas, fuel oil, and converter gas."	Robert Lanza	Accepted with modification	To be rewrite with more clarifications.
1174	3	4	303	303	Consider including separate variables in Equation 4.2A for discrete coke oven byproducts, e.g., one variable for coal tar, a second variable for light oil, etc., rather than having only one variable [COB(b)] in summation; cosider including a separate variable in Equation 4.2A for flaring.	Robert Lanza	Accepted with modification	The equation has been change, dividing byproducts and emissions from flaring. However, the COB(b) per byproduct were not separated. In addition, in the caption of the equation, the place where the emissions from flaring are estimated (the chapter from fugitives from fuel transformation in the energy chapter,is also indicated).
1176	3	4	305	305	Identify here the table where the the default carbon contents of material inputs can be found.	Robert Lanza	Noted	
4544	3	4	307		Chapter 2, letter case	Kewei Yu	Noted	
5186	3	4	307	307	should be: …Volume 4 chapter 2...	Kari Grönfors	Noted	
1178	3	4	315	315	"CH4" check subscripts	Robert Lanza	Noted	
1180	3	4	324	324	Line 208 and Line 324 read "Energy Sector Category Acii" Line 267, Line 280, and Line 295 read "Energy Sector Category 1.A.1c" Check for consistency	Robert Lanza	Accepted	
1182	3	4	325	325	Identify in Line 208 that only direct emissions are to be reported in Energy Sector Category 1.A.1c and that fugitive emissions are to be reported in Category 1.B.1d "Fugitive Emissions from Fuel Transformation:	Robert Lanza	Accepted	
1184	3	4	331	331	"CO2" check subscripts	Robert Lanza	Noted	
9602	3	4	332	333	The Figure 4.6 only gives the option to proceed with a Tier 2 method if the category is key. Nevertheless, above in lines 212 and 213, it guides the user to chose between a Tier 2 or Tier 3 method if the category is key. I suggest revising the flowchart so that the question on the key category gives both the options to proceed with a Tier 3 or Tier 2 method, and describe what can assist the user in deciding which method to use.	Raul Salas Reyes	Accepted with modification	
1186	3	4	345	345	Delete comma	Robert Lanza	Noted	
1188	3	4	347	347	Clarify what "industry-wide data" are being referred to here	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1190	3	4	372	372	edit "national sinter production and national pellet production..."	Robert Lanza	Noted	
1192	3	4	374	374	edit "if the process materials used are known…"	Robert Lanza	Noted	
1194	3	4	411	412	edit …"considered under Tier 2, including [provide examples from Section 4.2.2.5 of what other process inputs and outputs are being referred to here]	Robert Lanza	Noted	
1196	3	4	415	416	This sentence is unclear, either clarify what "other methodologies" are being referred to, or delete the sentence.	Robert Lanza	Accepted	
5870	3	4	415	416	Suggested rewrite of sentence to: "In calculating pellet production emissions, energy consumption and heating value and carbon content of the fuel can be used similarly to the other methodologies."	Vincent Camobreco	Accepted with modification	The authors have reviewed this section of text and deleted this sentence as the rest of the guidance presents the method options; this sentence is not needed.
271	3	4	421	455	In figure 4.8A it is seen that there is LDG from steel making process. However the equation 4.9 does not refer to the LDG.	Fehmi Par Bekci	Accepted	
1198	3	4	435	435	Consider for this variable deleting the "m3" units and casting all of the equations in units of GJ and/or tonnes consistent with the units in the carbon content and heat content tables (e.g., Volume 2 Chapter 1 TABLE 1.3 DEFAULT VALUES OF CARBON CONTENT); or consider including a table of default values to convert m3 units to tonnes or GJ units.	Robert Lanza	Accepted with modification	
1200	3	4	439	439	Consider for this variable deleting the "m3" units and casting all of the equations in units of GJ and/or tonnes consistent with the units in the carbon content and heat content tables (e.g., Volume 2 Chapter 1 TABLE 1.3 DEFAULT VALUES OF CARBON CONTENT); or consider including a table of default values to convert m3 units to tonnes or GJ units.	Robert Lanza	Accepted with modification	
1202	3	4	445	445	Consider for this variable deleting the "m3" units and casting all of the equations in units of GJ and/or tonnes consistent with the units in the carbon content and heat content tables (e.g., Volume 2 Chapter 1 TABLE 1.3 DEFAULT VALUES OF CARBON CONTENT); or consider including a table of default values to convert m3 units to tonnes or GJ units.	Robert Lanza	Accepted with modification	
1204	3	4	447	447	Consider for this variable deleting the "m3" units and casting all of the equations in units of GJ and/or tonnes consistent with the units in the carbon content and heat content tables (e.g., Volume 2 Chapter 1 TABLE 1.3 DEFAULT VALUES OF CARBON CONTENT); or consider including a table of default values to convert m3 units to tonnes or GJ units.	Robert Lanza	Accepted with modification	
1206	3	4	449	450	Clarify definition of PM(a) = "quantity of other process material (a) not listed as a separate term in Equation 4.10, consumed for metallurgical coke and sinter production in integrated coke production and iron and steel production facilities (tonnes); other process materials used may include natural gas and fuel oil."	Robert Lanza	Accepted with modification	To be rewrited and clarified.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
64	3	4	457	460	Since electricity generation is a typical energy sector activity the "emissions from the combustion of blast furnace gas, coke oven gas and converter gas" "to produce electricity in an internal power plant to cover the internal needs" is better to be reported under Ehergy Sector.	Mingshan Su	Accepted	
1208	3	4	460	460	Clarify "the methodology for that corresponds to…" Clarify what specific method in Volume 2 Chapter 2 is being referred to here	Robert Lanza	Accepted	
4546	3	4	461		Chapter 2, letter case	Kewei Yu	Noted	
1210	3	4	463	463	Edit -- "combusting fuel (e.g., natural gas)…"	Robert Lanza	Noted	
1212	3	4	484	484	Edit -- "Equations 4.9 through 4.11 (Tier 2) also describe…"	Robert Lanza	Noted	
1214	3	4	491	491	Edot -- "furnace charge"	Robert Lanza	Noted	
1216	3	4	495	495	Edit -- "for CH4 emissions…"	Robert Lanza	Noted	
1218	3	4	497	497	Edit -- "There is no Tier 2 method for estimating fugitive CH4 emissions."	Robert Lanza	Accepted	
1220	3	4	500	500	Edit -- "The Tier 1 method for estimating CH4 emissions (Tables 4.12 through 4.14) is based on emission factors and national production statistics."	Robert Lanza	Noted	
1222	3	4	523	524	Edit -- ""This section provides default emssion factors for estimating CO2 and CH4 emissions in the Tier 1a method and also discusses carbon contents to be used in carbon mass balances in the Tier 2 and Tier 3 methods."	Robert Lanza	Accepted with modification	Accepted but made a different change.The difference is related with the wording. As as suggested, the paragrph was eddited and the following phrase was included: This section provides default emission factors for CO2 and CH4 to be used in Tier 1a for coke production and Tier 1 for iron and steel production, and provides a discussion on carbon contents to be used in carbon balances approaches at higher tiers.
1224	3	4	530	530	Edit -- "typical processes for the BOF, EAF, and OHF steelmaking methods…"	Robert Lanza	Noted	
1226	3	4	531	532	Edit -- "There are two types of cokemaking processes: the byproduct recovery process and the non-recovery process. The byproduct recovery process recovers the numerous chemical byproducts of the coke making process. In the non-recovery process, all of the coke oven gas produced by the process is burned for energy recovery and no byproducts are recovered. ; instead of recovery this process offers the potential for heat recovery and cogeneration of electricity."	Robert Lanza	Accepted with modification	Accepted but made a different change.
1228	3	4	534	534	Edit -- "Consequently, the non-recovery ovens do not leak…"	Robert Lanza	Noted	
1230	3	4	539	539	Edit -- "only about one-third of the coke oven gas is consumed…"	Robert Lanza	Noted	
1232	3	4	540	541	Edit-- "stacks and quenching towers from non-recovery and byproduct recovery processes as well as data from the wide range of European and Chinese coke ovens whose variability…"	Robert Lanza	Accepted	Accepted . We decided to accept this suggestion, without changes

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6416	3	4	544	545	Table 4.1. First two lines. Why is so great difference between Tier1 emission factors Coke oven Non recovery of byproducts - USA 1.23 and Coke oven Byproduct recovery-USA 0.21. The products' output from coke oven is Coke -73 - 77%, dry coke oven gas - 15 - 18%, by-products - 5 - 6.5%.	Ekaterina Imshennik	Accepted with modification	Default values are re-evalueted for setting a most appropritate one number with some technical description in the range of values. A produxction process with implementing a full set of energy-saving technologies is lowest value in the number.
8672	3	4	544	545	In several cases the process description in Table 4.1 mentions either USA, China or European Countries. It should be elaborated further what EFs should be considered the default for countries outside these specified countries. For 'Coke Oven: … European Countries' there is no reference provided, this should be corrected. In addition, the range is very narrow and it seems pointless to have an EF of 0.5103 for plants less than 20 years old and an EF of 0.5170 for older plants. Surely, this difference would be within the uncertainty range. For iron production, DRI production and pellet production the EFs are referenced to the 2001 BREF document. However, a revised version was adopted in 2013. Why has this not been reflected? Users of the Guidelines would no longer be able to find the 2001 BREF document online.	Ole-Kenneth Nielsen	Rejected	Due to availability of published references, at this momment three countries/region have published appropirate information.
7162	3	4	544	547	In Table 4.1, the most emission factors are smaller than the actual typical practice (global average level) except the first line (1.23 tonne CO2 per tonne coke produced). We should refer to Fruehan et al. (2000), which provides the actual levels of energy intensity and CO2 intensity.	Junichiro Oda	Accepted with modification	Fruehan et al. (2000) "Theoretical Minimum Energies To Produce Steel for Selected Conditions" js added to the valid reference for discussing dafault value for coking porcess and sitering process. (The reference to be submitted to TSU.)
1234	3	4	545	546	Edits to Table 4.1 -- First row -- EPA 2008a is "Compilation of Emission Factors in AP42"; clarify in the wording of Table 4-1 and in the Section 4.2 reference section that EPA 2012 is the actual referenced document, not EPA 2008a.	Robert Lanza	Accepted	Source of data is clearly presented by modification of original descriptions.
1236	3	4	545	546	Edits to Table 4-1 -- First row -- "Section D.2.5 GHG Emissions from Coke Plants (EPA, 2008a)" of the EPA 2012 reference document is on Page D-9 of the reference document; clarify in the wording of Table 4-1 and in the Section 4.2 reference section that EPA 2012 is the actual referenced document, not EPA 2008a.	Robert Lanza	Accepted	Source of data and information are clearly presented by modification of original descriptions, including correction of published year. (The reference to be submitted to TSU.)
1238	3	4	545	546	Edits to Table 4-1 -- Second row -- "Section D.2.5 GHG Emissions from Coke Plants (EPA, 2008a)" of the EPA 2012 reference document is on Page D-9 of the reference document; clarify in the wording of Table 4-1 and in the Section 4.2 reference section that EPA 2012 is the actual referenced document, not EPA 2008a.	Robert Lanza	Accepted	Source of data and information are clearly presented by modification of original descriptions, including correction of published year. (The reference to be submitted to TSU.)
5188	3	4	545	547	Table 4.1 includes probably emission factors for both energy based emissions (coke ovens) and non-energy emissions (other processes). This is slightly confusing, please clarify reporting categories in table.	Kari Grönfors	Accepted with modification	Additional information is described in the box for understanding emissions source and reporting categories, such as IPPU and Energy.
1240	3	4	547	547	Edits to Table 4.1 -- Fourth row -- identify the reference for the values in the Fourth Row	Robert Lanza	Accepted	A reference is clearly identified for the source of data and information.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1242	3	4	547	547	Edits to Table 4-1 -- Fourth row -- the values in the fourth row have commas (EU style), other values in this table have decimal points (U.S. style); what is the style convention for commas vs. decimal points?	Robert Lanza	Accepted	A consistent characters are used with necessary revision.
1244	3	4	547	547	Edits to Table 4-1 -- Fifth row -- the footnote in Table 3.4 Page 96 of the IPPC BAT 2013 reference document reads "Where carbonate iron ores are used, the concentration of CO2 in the waste gas is increased so that the application of EOS may strongly inhibit the sinter process. The CO2 emissions in plants which do not use carbonate ores average from 161 to 368 kg/t sinter whereas in plants which do use carbonate ores the average can be up to twice as high." Consider including two separate default factor entries in Table 4-1 for sinter production, one default factor entry for carbonate ores and one default factor entry for non-carbonate ores, rather than including a range of default factors in one table entry.	Robert Lanza	Accepted with modification	One number is set for a default value by getting a representing value through averaging values in literatures, including EU, USA and China. A default value is for non-carbonate iron ores case with adding technical information for cabonate iron ores case. (The reference to be submitted to TSU.)
1246	3	4	547	547	Edits to Table 4-1 -- Twelfth row -- the footnote notation * 1 is out of place, there is no corresponding footnote in the list of footnotes at the end of Table 4-1.	Robert Lanza	Accepted	
1248	3	4	547	547	Edits to Table 4-1 -- Twelfth row and fiftteenth row -- both the twelfth row (BOF factor) and the fifteenth row (global average factor) have an asterisk [*] footnote; the text in the asterisk footnote at the bottom of the table appears to refer to the global average factor, not the BOF factor.	Robert Lanza	Accepted	
1250	3	4	547	547	Edits to Table 4-1 -- footnotes -- the (4) value in the footnotes has no text associated with it	Robert Lanza	Accepted	Corrected for a consistent description.
1252	3	4	547	547	Edits to Table 4-1 -- footnotes -- Table 4-1 row four and Table 4-1 row five both have the (2) value in the footnotes; there is no footnote (1) in Table 4-1 row one through row three; it appears from the text of footnote (1) that footnote (1) is associated with Table 4-1 row four.	Robert Lanza	Accepted	Corrected for a consistent description.
1254	3	4	547	547	Edits to Table 4-1 -- footnotes -- the values in footnote (1) (0,510) and footnote (3) (0,265) at the end of Table 4-1 have commas (EU style), other values in this table have decimal points (U.S. style).	Robert Lanza	Accepted	A consistent characters are used with necessary revision.
1256	3	4	547	547	Edits to Table 4-1 -- footnotes -- there are three different notations for footnotes in Table 4-1: numbers (1); asterisks **; and "notes." Consider using a single style for all footnotes in Table 4-1.	Robert Lanza	Accepted	Corrected for a consistent description.
1258	3	4	547	547	Edits to Table 4-1 -- footnotes -- for "not applicable to EAFs that use pig iron as a raw material" consider describing what Emission Factors would apply in this situation; the Emission Factors for pig iron production could be applied to this situation.	Robert Lanza	Accepted	Corrected for a consistent description.
1260	3	4	556	556	Edit -- "pelletizing"	Robert Lanza	Noted	
1262	3	4	557	557	Edit -- "per MJ of Coke Breeze"	Robert Lanza	Noted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8674	3	4	565	566	It is not helpful to have a default EF listed as a range of 1-80 g/tonnes. Without any further guidance, what is the user supposed to do with this? If no better knowledge is available the geometric mean could be listed as the default EF and the uncertainty would then reflect the large range.	Ole-Kenneth Nielsen	Accepted	
1264	3	4	566	566	Edits to Table 4-2 -- First Row -- 1 - 80 is a very wide range for a default factor. The JRC BAT reference document Table 5.2 footnote (13) indicates that this range of 1 - 80 is derived from data for a single coke plant in the EU. Consider using additional references or at minimum footnoting the 1 - 80 range to indicate that the range is derived from data for a single plant.	Robert Lanza	Accepted with modification	
1266	3	4	589	589	Edits to Table 4-3 -- footnotes -- there are three different notations for footnotes in Table 4-3 numbers (1); asterisks **; and "notes." Consider using a single style for all footnotes in Table 4-3.	Robert Lanza	Accepted	Corrected for a consistent description.
1268	3	4	589	589	Edits to Table 4-3 -- footnotes -- in citing ISO Standards include the year of publication (edition) of the ISO standard, e.g., ISO 14404-1 (2013); ISO 14404-2 (2013).	Robert Lanza	Accepted	
1270	3	4	595	595	Edits-- "coke produced is assumed to be…"	Robert Lanza	Accepted	
1272	3	4	599	599	Edits -- "usable ingots"	Robert Lanza	Accepted	
1274	3	4	603	603	Edits -- "in addition to the amounts of on-site (in integrated iron and steel plants) and off-site (in merchant coke plants) metallurgical coke produced in the country."	Robert Lanza	Accepted	
5914	3	4	625	651	Due to many countries having different national circumstances regarding their allocation of fuel data and statistics between the energy and industrial sector (some data may not be dissagregated enough to distinguish or allocation fuel data to a specific industrial category/sector) more discussion should occur in this section to allow for countries to choose country specific approaches that make sense for their specific circumstances. Deviating too much from the 2006 GLs could result in many countries having to redo their fuel and emissions relationships between IPPU and Energy, taking up significant resources that could be used to improve other categories. If a country can justify their country-specific approach for allocating certain emissions between IPPU and Energy, and transparently reports this information, some issues may still occur in terms of comparability but overall adjustment could be avoided that would reduce the overall accuracy of emissions. This could be a point across more of the IPPU chapter, rather than specific to the Iron and Steel chapter.	Vincent Camobreco	Rejected	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines. The only difference is related with the allocation of the fugitive emissions.
1276	3	4	627	627	Edits -- "in integrated iron and steel plants, these processes may be connected to each other…" [for merchant plants these processes would not necessarily be connected to each other.]	Robert Lanza	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1278	3	4	629	629	Edits -- "risk of double counting of emissions or omission of emissions."	Robert Lanza	Accepted	Accepted . We decided to accept this suggestion, without changes
65	3	4	639	640	Combustion of blast furnace gas, coke oven gas and converter gas for sintering is mainly for energy purpose and it is better to be reported in Energy sector.	Mingshan Su	Rejected	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines. The only difference is related with the allocation of the fugitive emissions.
1282	3	4	639	651	Clarify that these bullet points refer to CO2 emissions; as does the introductory paragraph above; add a paragraph clarifying how CH4 emissions are to be reported.	Robert Lanza	Accepted	
66	3	4	644	648	The emissions from the combustion of blast furnace gas, coke oven gas and converter gas to produce electricity in an internal power plant should be reported in Energy sector even if the electricity is produced to cover the internal needs since producing electricity is for energy purpose and it is a typical energy sector activity.	Mingshan Su	Rejected	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines. The only difference is related with the allocation of the fugitive emissions.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
5106	3	4	644	648	The sentence: "…The emissions from the combustion of blast furnace gas, coke oven gas and converter gas to produce electricity in an internal power plant should be reported under…" should be changed into: "…The emissions from the combustion of blast furnace gas, coke oven gas and converter gas to produce electricity in an internal power plant can be reported under Energy." The line 646 - 648 should be deleted. It's not practical to distinguish between public and industrial electricity generation. Most of the industrial plants feed into the public network. Several public power plants provide industrial plants with electricity and heat. Besides the ownership of the plants changes regularly. Usually a mix of derived gases and natural gas is used for power plants and boilers. The natural gas used in the same plant has to be reported in the Energy sector. According to the Guidelines the use of derived gases of a refinery is considered as combustion; the use of derived gases in an iron and steel power plant is considered as a process. This is too confusing. It would be more practical to follow the structure of the national and the IEA energy balance were derived gases are considered as a secondary fuel that is used for energy purposes. A power plant is a power plant. For the calculation of other greenhouse gases and precursors it is necessary to consider the power plant as a unit in order to calculate fuel related emission factors. A different calculation method for CO2 increases the complexity of the inventory, which is always a source of errors. Emissions are not comparable. Fuel related implied emission factors are comparable. For the review process a carbon balance is necessary. It's not a problem to summarize 1.A.2.a and 2.C.1 emissions for the review processes. The complete allocation to IPPU is useful for some countries depending on the data availability and structure. For other countries it's more practical to allocate emissions to the energy sector. The increase of flexibility regarding the allocation methods of the Guidelines does not harm. It would facilitate the work of inventory compilers and review experts. Moreover, it would make sense to reflect reality in the Guidelines (see attached file).	Kristina Juhrich	Rejected	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines. The only difference is related with the allocation of the fugitive emissions.
1280	3	4	648	648	Addition -- "in situations where some of the electric power produced is used within the plant to meet plant needs and some of the electric power produced is exported to the grid or other facilities, emissions would be reported separtely in IPPU and in Energy based on the amount of electricity used within the plant and the amount of electricty exported.	Robert Lanza	Rejected	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines. The only difference is related with the allocation of the fugitive emissions.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8676	3	4	651	651	It is stated that emissions from flaring should be reported under energy. However, currently the guidance in the energy sector is for 'fugitive emissions from oil and natural gas systems'. Therefore, more guidance should be provided on specifically where the emissions should be reported (considering that only oil and natural gas is used in the energy sector) and also what methodology should be used, i.e. what EFs should be used.	Ole-Kenneth Nielsen	Accepted with modification	The section on "Relationship to the Energy Sector" has been revised to explain more clearly that the flaring emissions associated with coke production should be reported under Energy (with a cross-reference to the new Energy-fugitives guidance in Volume 2), whilst the emissions of flaring of other process gases in I&S production should be reported in IPPU. In both the Energy and IPPU volumes, the appropriate methodologies and EFs are presented.
5872	3	4	653	654	Recommend providing greater discussion or at least a footnote/description that better explains Figure 4.8A, as it is somewhat confusing, even with the text provided between lines 632 and 651	Vincent Camobreco	Accepted with modification	The Figure 4.8A has been revised to provide a clearer graphic to explain good practice reporting allocations, and further the LAs have provided references to the figure within the surrounding explanatory text.
9618	3	4	656	681	I understand that ISO 14404 does not distinguish the emissions between energy and IPPU sectors. However, I read the description of lines 678 through 681 as if ISO 14404 distinguishes the sectors. I understand that ISO 14404 also take into account the emissions from generation of electricity and heat purchased from outside the iron and steel industry while the IPCC Guidelines deal with the emissions under energy sector. As I am not familiar with the ISO, I suggest that the authors recheck facts. It is important to show how the boundaries are different between the IPCC Guidelines and ISO 14404.	Naofumi Kosaka	Accepted	
1284	3	4	659	660	Edits -- "The World Steel Association established such a method in 2007"	Robert Lanza	Noted	
1286	3	4	665	665	Edits -- in citing ISO Standards include the year of publication (edition) of the ISO standard, e.g., ISO 14404-1 (2013); ISO 14404-2 (2013).	Robert Lanza	Accepted	
1288	3	4	669	669	Clarify -- "basic imports and exports" means "primary inputs to the plant and primary outputs from the plant?"	Robert Lanza	Accepted	Accepted . We decided to accept this suggestion, without changes
1290	3	4	676	676	Clarify -- meaning of "free allocation"	Robert Lanza	Accepted	
1292	3	4	678	678	Edits -- in citing ISO Standards include the year of publication (edition) of the ISO standard, e.g., ISO 14404-1 (2013); ISO 14404-2 (2013). Also indicate whether this refers to ISO 14404-1 (2013) and/or ISO 14404-2 (2013); they are two separate standards.	Robert Lanza	Accepted	
5408	3	4	678	679	On line 678, it is written that "There is a difference between 2019 Guidelines Refinement and ISO 14404, related with CO2 emissions allocation between IPPU and Energy sectors". The ISO 14404 methodology is being used in many countries and it seems to be more appropriate for CO2 and energy management in the iron and steel industry. Taking it into account, the ISO 14404 methodology should also be applicable for national GHG inventory if the explanation that the methodology applied is scientifically reasonable and double counting or omission has not occurred is provided in the NIR.	Takashi Morimoto	Accepted with modification	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1294	3	4	678	680	related to the allocation of CO2 emissions to the IPPU and Energy sectors. According to the ISO Standards CO2 emissions from metallurgical coke producrtion, sintering, blast furnace, direct produced iron production, steel production, and reheating furnaces and rolling are all reported under Energy, and only the CO2 emissions from limestone and dolomite use are reported under IPPU.	Robert Lanza	Accepted with modification	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines and could not be changed in the Refiniment (there is no mandate).
5874	3	4	679	679	It is unclear to me what this sentence means, specificall "as in the last one"	Vincent Camobreco	Noted	
1296	3	4	688	688	Edits -- "from any general energy statistics (e.g., natural gas consumption for iron and steel production) if they are included there.	Robert Lanza	Noted	
1298	3	4	688	689	Edits -- "Iron can also be produced in other types of iron-making processes besides blast furnaces, such as direct reduced iron processes…"	Robert Lanza	Accepted	Accepted . We decided to accept this suggestion, without changes
1300	3	4	694	695	Consider expanding this discussion to indicate that it is desirable to report use of limestone and dolomite in iron and steel making under iron and steel, and not under the minerals sector, if sufficient data are available to report limestone and dolomite use under iron and steel making.	Robert Lanza	Rejected	This is out of the IPCC Refinement Authors Mandate.
1302	3	4	707	708	Edits -- "Process emissions should include all carbon inputs to the blast furnace.In a typical integrated iron and steel plant adjustiments may need to be made…"	Robert Lanza	Accepted with modification	The emissions calculation for the typical integrated iron and steel plant will be reviewed.
1304	3	4	713	713	Edits -- "assumes an average mix of fuels use, including coke oven gas, blast furnace gas…"	Robert Lanza	Noted	
1306	3	4	714	714	Edits -- "On the other hand, Tier 2 and Tier 3, which are based on the carbon balance approach..."	Robert Lanza	Noted	
5876	3	4	715	715	Believe this meant to say "combined use"	Vincent Camobreco	Noted	
5878	3	4	717	717	Believe this meant to say "combined use"	Vincent Camobreco	Noted	
1308	3	4	720	720	Consider adding a more explict recommendation not to mix tiers unless necessary.	Robert Lanza	Accepted	
1310	3	4	733	733	Consider adding here that emissions from electricity generation and consumption are treated as part of the Energy sector, not IPPU.	Robert Lanza	Accepted with modification	The allocation of the emissions between IPPU and Energy has been agreed and in general terms are consistent with 2006 IPCC Guidelines. The only difference is related with the allocation of the fugitive emissions.
1312	3	4	735	735	Edits -- "Although the OHF process…"	Robert Lanza	Noted	
9620	3	4	747	748	The uncertainty of tier 1 default emission factor is 25% in the 2006 IPCC Guidelines but 40% in the 2019 Refinement. It means the 2006 IPCC Guidelines underestimate the uncertainty. It is desirable to describe reasons of the change.	Naofumi Kosaka	Accepted	
1314	3	4	749	749	Edits -- "+/- 10 percent"	Robert Lanza	Noted	
1316	3	4	752	752	Edits -- Table 4.4 -- provide references / sources for uncertainties in Table 4.4.	Robert Lanza	Noted	The list of literature is subject to change and will be formatted in the final draft.
9594	3	4	766		In Section 4.3 (Ferroalloy production), it is recommended that IPCC provides methodologies to account for relevant GHG emissions from production of Fe-Vanadium, Fe- Molybdenum and Fe-Titanium alloys.	Mingming Wang	Noted	No action can be taken because comment is out of scope of the 2019 Refinement.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
5000	3	4	774	774	replace with "This section covers emissions from primary aluminium production processes, including..."	Christopher Bayliss	Accepted	Edited text
5002	3	4	775	775	replace "ore" with "refining"	Christopher Bayliss	Accepted	Edited text
5004	3	4	777	778	replace with "Primary aluminium production typically begins with the mining of aluminium containing ores (bauxites). Most bauxite is refined through the Bayer Process, which thermo-chemically extracts aluminium oxide (alumina) from the ore."	Christopher Bayliss	Accepted	Edited text
5006	3	4	785	785	replace with " Alumina is reduced to molten aluminium metal via the electrolytic Hall-Héroult Process."	Christopher Bayliss	Accepted	Edited text
5008	3	4	786	786	insert "can" between "cells" and "differ"	Christopher Bayliss	Accepted	Edited text
5010	3	4	787	791	would be interesting and useful to include the (current) global production split between technologies (%), but also what this looks like compared to 2006	Christopher Bayliss	Accepted with modification	Included some comments on noteworthy changes in production in text
5012	3	4	792	792	delete "lines operating with"	Christopher Bayliss	Accepted	Edited text
9542	3	4	792	800	New technologies types : The definitions must be precise because they will eventually be included in the regulations. Is the term «anode» refer to the anode block or the anodic set ?	Nadia Morais	Accepted with modification	Decision to remove reference to anodes as decided not best defining factor. Focus to remain on amperage.
5524	3	4	792	803	The technology named CWPB Centre-worked Prebake is proposed to be divided in 3 technologies: PFPB L, PFPB M, PFPB MW. It is not clear which category will it be for older cell desings originally for line current around 300KA (<350KA) when they were started and are operating now or in the near future with line current over 350KA and for some of them over 400KA. It is the same situation for AP18 technology which was operated at 180KA and can be operate now at more than 230KA. The definition must include those cell operation. Free allowance calculation are based on technology performance and it is important to cover all technology in operation at this moment. CO2 free allowance is based on technology for some countries. The new categories must be well defined to avoid any confusion on a regulation compliance perspective.	Christine Dubois	Accepted with modification	The comment was not adressed directly but there was a redefinition of the PFPB L, PFPB M, and PFPB MW definition which should reduce the confusion. Additionnally, there was modifications in the time consistency section which should minimize confusion to evaluate 2017 and back emissions.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6106	3	4	792	803	For Cap-and-Trade System for greenhouse gas emission allowances - Amendment in Québec, the CO2 free allowance will be given based on SWPB and CWBP from 2021. Between 2013 and 2020, the free allowance is given based on prebake (CWBP and SWPB) and based on Söderberg. Until 2021, there is no difference of free allowance given no matter the prebake CWPB. Specifying three prebake technology CWPB, the aluminium sector will need precised definition as it could be considered by governement in future modification in their carbon regulation. The data available need to demonstrate there is difference between CWPB L and M. The regulation for 2021-2023 free allowance is "Order in Council 1125-2017" is attached. At page 75/117 of this document, the free allowance to establishment covered prior to 2021 that is not considered on a sectoral basis or establishment producing lime or liquid aluminum using a side-worked prebaked anode technology indicaes the rules to calculate the free allowance . Free allowance for prebaked CWPB is indicated at page 88/117. Splitting the CWPB technology could have an impact on further regulation and definition must represent the actual operation.	Christine Dubois	Noted	No action needed
5014	3	4	794	796	replace with "...new cell technologies that operate at line currents in excess of 350kA and/or with 24 or more anodes per cell (including: AP3x, AP4x, APXe/AP60, EGA DX and DX+);"	Christopher Bayliss	Accepted	Edited text
5016	3	4	810	810	replace "re-establish" with "increase rapidly"	Christopher Bayliss	Accepted	Edited text
5018	3	4	814	815	replace with "...where anode effects are terminated primarily through manual operator intervention, which can result in higher PFC emissions."	Christopher Bayliss	Accepted	Edited text
5020	3	4	821	822	replace with "Emissions of the perfluorocarbons (PFCs) tetrafluoromethane (CF4) and hexafluoroethane (C2F6) during process upset conditions known as "anode effects" (for which..."	Christopher Bayliss	Accepted	Edited text
4548	3	4	824		SO2, subscript	Kewei Yu	Accepted	Edited text
67	3	4	824	824	2 and 6 in SO2 and SF6 should be in subscript.	Mingshan Su	Accepted	Edited text
5022	3	4	824	824	quantify - possibly using 2015 LCI data from IAI	Christopher Bayliss	Rejected	Volumes are greater than PFC but impact is lower - have modified text to make this clear. Including quantities could cause confusion.
5024	3	4	824	824	replace with "Also emitted are smaller amounts of carbon monoxide (CO), sulfur dioxide (SO2) and non-methane volatile organic compounds (NMVOC)."	Christopher Bayliss	Accepted	Edited text
5026	3	4	824	824	...and throughout, ensure numeric subscripts for molecules	Christopher Bayliss	Accepted	Edited text
6118	3	4	824	824	Subscripts for "SO2" and "SF6"	Jooil Kim	Accepted	Edited text
5028	3	4	824	826	replace with "Sulfur hexafluoride (SF6) is not emitted during the electrolytic process and is only rarely used when fluxing specialized, high magnesium aluminium alloys, from which small quantities can be released as fugitive emissions."	Christopher Bayliss	Accepted	Edited text
5030	3	4	830	830	delete "at a minimum level"	Christopher Bayliss	Accepted	Edited text

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6120	3	4	837	837	subscript "CO2"	Jooil Kim	Accepted	Edited text
5526	3	4	837	839	Section 4,4,2,1: there is no refinement proposed. For the anode consumption calculation, To apply Equation 4,21, we need the sulphur and ash analized to calculate the CO2 emissions coming from the anode consumption. For Europe primary aluminum smelters, they have to comply with the COMMISSION REGULATION (EU) No 601/2012 (21 June 2012), in this regulation, for calculation they used the carbon content for mass balance methodology as required for the CO2 coming from anode consumption. Could it be considered to add a second formula for this section for the site that have to take the carbon content instead of sulphur and ash content?	Christine Dubois	Noted	No action can be taken because the comment is out of scope of the 2019 IPCC Refinement.
6122	3	4	841	841	subscript "CO2"	Jooil Kim	Accepted	Edited text
5032	3	4	849	849	insert "cell" between "causes" and "voltage"	Christopher Bayliss	Accepted	Edited text
5034	3	4	850	850	replace with "...operating range. However, PFC gases..."	Christopher Bayliss	Accepted	Edited text
5528	3	4	851	856	section 4,4,2,3 - General comment: HVAE is defined when the voltage is higher than 8 volts and LVAE is when the voltage is lower than 8 volts. There is no indication from when AE should be measured specifically for pot start. Some primary aluminium smelters is measuring AE from the moment the pot has power (without any bath or alumina), some when bath is added in the pot, some when alumina is added in the pot as example. This difference could be important when we calculate the annual AE (min/cellday).	Christine Dubois	Accepted	An additionnal section was included in the SOD specifically to discuss the best practices regarding HVAE from pot start-up
5036	3	4	855	855	replace "and" with "with consequent"	Christopher Bayliss	Rejected	Edited text in response to another comment and removed 'and'
5402	3	4	855	856	Needs rewriting, as it is now it is a bit confusing	Ole Kjos	Accepted	Edited text
4550	3	4	857		80% by weight	Kewei Yu	Accepted	Edited text
5038	3	4	861	861	replace "identified based on" with "characterised as"	Christopher Bayliss	Accepted	Edited text
5040	3	4	861	861	delete "of"	Christopher Bayliss	Accepted	Edited text
5042	3	4	862	862	replace "similar" with "more"	Christopher Bayliss	Accepted	Edited text
5044	3	4	865	865	replace "were" with "have been"	Christopher Bayliss	Accepted	Edited text
5530	3	4	866	868	It is written "These LVAE emissions have been largely omitted from inventories to date but are nonetheless likely to be widespread and as such, methodologies are now included as to ensure GHG inventories are as complete as possible". Since we have gotten more information with PFC sampling measurements since 2010, we would suggest changing the wording to: "LVAE emissions have not been considered from the inventories to date, because the information was not available, but should now be included to ensure GHG inventories are as complete as possible"	Christine Dubois	Accepted	Edited text
5046	3	4	875	875	insert "emissions" between "PFC" and "should"	Christopher Bayliss	Accepted	Edited text
5048	3	4	878	878	delete "in turn"	Christopher Bayliss	Accepted	Edited text

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
5536	3	4	881	884	4.4.2.3 CHOICE OF METHOD FOR PFCS: it is written "In the 2006 IPCC Guidelines, two methods for calculating coefficients for HVAE PFCs were outlined: slope and overvoltage. The overvoltage method is not widely used anymore so this update will cover the methods with reference to the slope model only. If the overvoltage method is still used, it should be adopted at the Tier 3 level only". It will be difficult to backcast the emission from 2007 if there is no tier 2 factor for overvoltage. We may have historical data updated with LVAE CO2 emissions and some not as the Tier 2 factor won't be available.	Christine Dubois	Accepted	Edited text to reflect that if T2 overvoltage was being used, then best practice is to switch to slope
5538	3	4	885	894	It is said that there is currently no generally recognized means to calculate LVAE CF4 emissions from the process control data and that the most accurate approach to date is to continuously measure both LVAE and HAVE emissions, which are not practiced regularly. It should be emphasized that the initial approach to calculate LVAE from HVAE is a first attempt to estimate total emissions to include LVAE in national inventories. However, further work is needed to standarize the measurement, estimate the frequency of measurements and calculation of the LVAE emissions, which can be very low for measurement technologies and can introduces inaccuracies if guidelines are not followed. In addition installation of measurement technologies can also be very expensive.	Christine Dubois	Accepted	Edited text
5050	3	4	886	886	insert comma after "factor"	Christopher Bayliss	Accepted	Edited text
5052	3	4	886	887	sentence unclear - suggest remove "respectively"	Christopher Bayliss	Accepted	Edited text
5054	3	4	890	890	"to measure continuously"	Christopher Bayliss	Accepted	Edited text
5056	3	4	891	892	replace with "Moreover, there is currently no official methodology to standardise the measurement of LVAE PFC emissions at this time."	Christopher Bayliss	Accepted	Edited text
6124	3	4	892	894	Comment: I support the authors' comments regarding our current limited understanding of LVAE PFC emissions, and that research has shown the emissions are important enough to warrant at least some "first step" efforts. It is highly recommended that this subject is revisited in the near future, when more data becomes available and these processes are better understood.	Jooil Kim	Accepted	Edited text
5532	3	4	902	903	It is indicated that high performing facilities are those that operate with less than 0,02min/cellday which is very low. Because AE may not be measured exactly based on the same parameters (including pot start and from when) and since aluminium smelter may not have the same constraint like curtailment and power modulation period from power supplier, a suggestion would be to indicate the 20percentile on annual result.	Christine Dubois	Rejected	A percentile approach would involve annual recalculation and change of the definition
6126	3	4	903	911	Question: Do regulations or specific guidelines exist to ensure that the coefficients are robust? Perhaps they should be reiterated here?	Jooil Kim	Rejected	Relates to wider discussion on IPCC coefficient determination and not sector specific

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
5058	3	4	907	907	delete comma after "or", insert comma after "curtailments"	Christopher Bayliss	Accepted	Edited text
5060	3	4	914	914	lowercase "method" to replace "Method"	Christopher Bayliss	Accepted	Edited text
5062	3	4	923	923	replace "are" with "is"	Christopher Bayliss	Accepted	Edited text
5064	3	4	928	996	should ECF4 be written HVAE ECF4 to remain consistent with labelling or LVAE ECF4 in, for instance, line 952	Christopher Bayliss	Accepted	Edited text
5066	3	4	938	938	replace "types" with "type i" (as 936 and 937)	Christopher Bayliss	Accepted	Edited text
5068	3	4	942	943	use acronyms for SWPB, HSS and VSS (also maintain consistency in order - here and line 920 swaps VSS and HSS from the order they are listed in lines 802-803)	Christopher Bayliss	Accepted	Edited text
5070	3	4	945	945	replace "are" with "is"	Christopher Bayliss	Accepted	Edited text
5072	3	4	964	964	insert "emissions" between "effect" and "and"	Christopher Bayliss	Accepted	Edited text
5534	3	4	971	972	It is written: "Equation 4.27 should be used when anode effect minutes per cell day are recorded". It refers to Equation 4.27 but this equation is missing in the revised document Chapter 4 Metal industry emissions (IPCC2019 refinement). In the actual document (IPCC 2006), Equation 4,27 refer to the PFC emission by overvoltage method. (Tier 2 and Tier3 method).	Christine Dubois	Accepted	Edited text
5074	3	4	974	974	remove "Then"	Christopher Bayliss	Accepted	Edited text
5076	3	4	979	979	is "represents" the right word?	Christopher Bayliss	Accepted	Edited text
5078	3	4	991	992	"HVAE emissions of..."	Christopher Bayliss	Accepted	Edited text
5080	3	4	993	993	Tier 2 would use SCF4,i - slop coefficient by cell type i for CF4, though the same calculation (without i) would be used for Tier 3...i dont know if this might confuse reader...way through might be similar as expressed in 1025-1026	Christopher Bayliss	Accepted	Edited text
5082	3	4	996	996	"weight fraction of HVAE C2F6/HVAE CF4..."	Christopher Bayliss	Accepted	Edited text
9544	3	4	997	998	Add the Overvoltage Coefficient equations (Équation 4.27 from the IPCC 2006) for the Tier 3 overvoltage users.	Nadia Morais	Accepted	Edited text
2516	3	6			Chapter needs proof-reading.	Anna Mikis	Accepted	
7448	3	6	104	107	The pretense of this text in yellow seems ambiguous. Conditions for formation of NH3 should be linked to the input chemistry as in all other condtions manufacturer should certify that they are setup to not emit N2O. Formation of CF4 should be only from input chemicals and not as a function of how the device is setup. the manufacturer should be including this in the certification process. If device is setup for example to abate N2O at the expense of forming CF4 than facility should establish site specific factors. Developing language or calculationson speicfic fuel/O2 ratios seems onerous and would be dependent on every use case.	Jennifer Politsch	Rejected	Agree that clarification is needed and that a suitable reporting approach still must be devised.
10172	3	6	104	107	Greenhouse gas combustion emissions factors are define in 40CFR98 Subpart C. The IPCC volume 2 has a combustion section.	Tina Gilliland	Noted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
7450	3	6	117	117	Is any country using Tier 1 calculation? If not it should be removed from chapter as an option. Obtaining production figures is not easy or readily shared by companies (CBI) so it would seem to be difficult to complete this inaccurate calculation. If it is being used should it be adjusted to account for device complexity	Jennifer Politsch	Rejected	Even though no country is using the Tier 1 approach, the methodology will still be useful in the case of a new country developing new electronic device manufacturing facilities. TSU's recommendation is that we keep the Tier 1 approach even though it may not be currently used.
7452	3	6	117	121	Recommend adding language calling out how inaccurate Tier 1 emissions are	Jennifer Politsch	Rejected	Comment is unclear; did the commenter mean "how much" inaccurate? It is not possible to quantify the inaccuracy of the Tier 1 method because this will be facility-dependent.
10174	3	6	117	121	Tier 1 method is stated as the least accurate. Is their supporting data that the Tier 1 method is being used by the industry subsectors in any country?	Tina Gilliland	Noted	To the best of the authors' knowledge there is no evidence that the Tier 1 method is used by any country, but for the reasons discussed in the answer to comment # 7450, the decision is to keep the Tier 1 method as an applicable approach.
7454	3	6	124	124	See comment for Volume 3, Chapter 6, Start line 89, end line 89. Replace CVD with thin-film	Jennifer Politsch	Rejected	Line 124 of the FOD refers to the process categories of the Tier 2b method of the 2006 Guidelines, which were defined as 1) etch and 2) CVD cleaning. Thus "CVD" on line 124 of the FOD will be replaced by "CVD cleaning" but not by "thin film". The new process types for the 2019 Refinement are defined on lines 127-128.
10176	3	6	124	124	Same comment as line 97.	Tina Gilliland	Noted	The numbering of equations will be finalized once the Tier 3 methodologies will be finalized.
7456	3	6	128	128	recommend removing CVD as the other cleaning types listed include CVD processes	Jennifer Politsch	Rejected	Comment is unclear: "Other" refers to processes using N2O that are not CVD processes. However, to remove any possible ambiguity, the process denomination will be changed from "CVD" to "TFD (Thin Film Deposition)" in the text (line 128) and in the EF tables of the Tier 2c method (Tables 6.3h and 6.3i). Include definition of TFD where appropriate in the document and double check for consistency througout. Then, remove one of the two N2O columns (just have one N2O column).
7458	3	6	130	130	Will the apportioning guidance include language similar to the EPA reporting rule text? For the purposes of this chapter it is likely not necessary to get to the nuance of different fabs on each site. However the ability to model chemical usage of largest used gases to 20% provides more certainty on the appportioning calculations. calculations should include facility heel factors of containers instead of a default 10% or the apportioning calculation checks will not be as accurate	Jennifer Politsch	Accepted	Regarding apportioning, the general agreement is that Subpart I apportioning rules should be the starting point. A separate discussion will be held to review possible simplifications. Regarding heel factors, there will be a 10% default and guidance to develop facility-specific heel factors.
7460	3	6	140	140	Methodlogical in title is misspelled. Should be Methodoligical	Jennifer Politsch	Accepted	
10178	3	6	140	140	Methodological is misspelled.	Tina Gilliland	Accepted	
7462	3	6	145	145	Recommend replacing "the brand of process tools," to "manufacturing process types and subtypes,"	Jennifer Politsch	Accepted with modification	Modify sentence to read: "...vary according to the gases and process types and subtypes used in manufacturing, as well as the brand...".
10180	3	6	145	145	Replace "brand of process tool" with "manufacturing process types and subtypes".	Tina Gilliland	Accepted with modification	Same answer as for comment ID 7462
10182	3	6	159	159	Utilization is misspelled.	Tina Gilliland	Rejected	British spelling is used in IPCC/UN documents.
10184	3	6	159	166	In the 40CFR98 Subpart I petition for rulemaking docket, the demonstrated data indicated that the emissions factors cover a range of parameters.	Tina Gilliland	Noted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
7464	3	6	159	169	many of the processing conditions have been studied and identified as not having a significant impact reference. Please consider reference below. https://www.semiconductors.org/clientuploads/directory/DocumentSIA/SIA%20Climate%20Negotiations/SIA%20Climate%20Negotiations_copy/120228%20etch%20report%20to%20EPA.pdf	Jennifer Politsch	Noted	The link refered to by the commenter is broken. The language of the first sentence of the paragraph (lines 159-162) is hypothetical ("…emission factors can be strongly affected… and... can differ…"). The second sentence of the paragraph (line 162-166) was modified to use "can be affected" instead of "are affected" and "can substantially fluctuate" instead of "will substantially fluctuate". Regarding the third sentence of the paragraph, it is well known that the efficacy of FC emission control equipment depends on operating and maintaining the equipment according to the manufacturer's specifications and that increased gas flows, improper temperature settings, and failure to perform required maintenance can individually and collectively negatively impact performance; nevertheless, taking into account the commenter's opinion, the verb "will" in this sentence was replaced by "can".
7466	3	6	166	166	recommend changing "In addition, the efficacy of FC emission control equipment depends" to "In addition, the efficacy of FC emission control equipment depends on whether it is designed to abated fluorinated GHGs or N2O, "	Jennifer Politsch	Accepted with modification	Sentence has been changed to "the efficacy of greenhouse gas emission control equipment depends on whether it is designed to abate the target gas and on operating and maintaining the equipment according to the manufacturer's specifications..."
10186	3	6	166	169	Run on sentence. End the sentence on line 167 after manufacturer's specification. Delete the rest of the line 167 through 169. Add that this sentence: "FC emissions control equipment must be designed to abate fluorinated greenhouse gases and must be operated and maintained properly to acheive expected performance.	Tina Gilliland	Accepted	The suggestion offered by the commenter is addressed in the modification agreed to in the answer to comment ID 7466.
6830	3	6	170	171	Delete line break	Edgar Dullni	Accepted	
7468	3	6	178	181	difficult to fully comment without table 6.9. in the following reference uncertainty or relative errors were not aligned with statement of >100% if sample size was large enough and reflective of process: https://www.semiconductors.org/clientuploads/directory/DocumentSIA/SIA%20Climate%20Negotiations/SIA%20Climate%20Negotiations_copy/120228%20etch%20report%20to%20EPA.pdf	Jennifer Politsch	Noted	
10188	3	6	182	182	To improve the accuracy of Tier 1 if needed, could purchase data be used instead of FC usage data?	Tina Gilliland	Rejected	Tier 1 does not use FC usage data, but surface area of substrate used during production.
7472	3	6	182	187	Is any country using Tier 1 calculation? If not it should be removed from chapter as an option. Obtaining production figures is not easy or readily shared by companies (CBI) so it would seem to be difficult to complete this inaccurate calculation. If it is being used should it be adjusted to account for device complexity	Jennifer Politsch	Rejected	See response to comment ID10174 regarding the use of the Tier 1 method. It is not deemed feasible to adjust the Tier 1 method based on device complexity. A sentence will be added after the sented ending on line 185: "... Data are not available. It should also be noted that the accuracy of the Tier 1 default factors is expected to decrease as the complexity of the devices manufactured increases. Further, the Tier 1 method...
7470	3	6	184	184	replace "are not" with "is not"	Jennifer Politsch	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
7474	3	6	188	191	Tier 2a and 2b require distinguishing between NF3 and NF3 in other processes. If this is possible why would it not be possible to distinguish or apportion between 200mm and 300mm use. Also this distinction would be needed to apportion to abatement device installation. Also apportioning between CVD (thin-films) and other processes.	Jennifer Politsch	Noted	The reason for the distinction between the Tier 2a and Tier 2b methods is that some facilities have multiple wafer size tools served by a single gas distribution system and do not measure gas consumption separately by wafer size. Yet, in devising the Tier 2a method, the consensus is that making no distinction by process type (in particular not making the distinction between NF3 remote cleaning and other NF3-using processes) would result in significant inaccuracies in emissions estimates; therefore, limited apportioning is indeed required when using the Tier 2a method to distinguish between NF3 and/or C3F8 remote cleaning versus 'other' NF3 and/or C3F8 process types and to distinguish between N2O TFD and 'other' N2O-using processes. The authors acknowledge that this approach also requires apportioning to abatement device installation and such issue will be addressed in the Second Order Draft.
10190	3	6	188	200	Should Tier 2a and 2b be combined to not distinguish wafer sizes but rather process type. 40CFR98 Subpart I docket indicated process type dominates accuracy.	Tina Gilliland	Rejected	See answer to comment ID 7474. When possible, distinguishing emission factors by wafer size is an important element of ensuring greater accuracy. The purpose of the Tier 2a and 2b methodologies is to provide a simplified approach to avoid complex apportioning of gas usage among process types and subtypes (except, e.g., for distinguishing between NF3 remote cleaning and other NF3-using processes). Greater sophistication in terms of process distinction is achieved by using the Tier 2c method.
7476	3	6	204	204	See comment for Volume 3, Chapter 6, Start line 89, end line 89. Replace CVD with thin-film	Jennifer Politsch	Accepted with modification	See answer to comment 7456.
10192	3	6	204	204	CVD comments same as line 97.	Tina Gilliland	Accepted with modification	See answer to comment 7456.
7478	3	6	209	210	Further guidance on apportioning is necessary. Is the intent to provide guidance and list a single method or list uncertainties with various methods?	Jennifer Politsch	Accepted	Apportioning guidance is necessary. It is not yet clear whether different apportioning approaches will be required for the Tier 2a, 2b, and 2c methodololologies. With respect to the uncertainty of apportioning methods, the current requirements of the US Subpart I will be reviewed to determine whether they can applied to the IPCC Refinement.
10194	3	6	209	210	Need to provide further guidance on apportioning. Also, is the intent to list a single method or list uncertainties with various methods?	Tina Gilliland	Accepted	Further guidance on apportioning will be provided as part of the SOD. See answer to comment ID 7478 for the second part of the comment.
7480	3	6	214	226	Recommend less focus on FC byproducts formed during plasma etching of c-containing Layers. The thickness of the layers makes it difficult to obtain detectable amounts formed with an input chemical does not contain carbon.	Jennifer Politsch	Rejected	Data suggest it is not an insignificant source.
10196	3	6	216	230	This discussion assumes that the carbon containing films are tracked separately from other films. By-products formation should be inclusive of all films.	Tina Gilliland	Rejected	The discussion does not assume that the carbon containing films are tracked separately from other films. While such possibility is considered (option 1, lines 227-228), option 2) (lines 229-230) considers the case where carbon containing films are not tracked. See also response to comment ID 7480.
7482	3	6	227	230	if option 2 is possible than use of any calculation method less than Tier 2c should not be an option. Default should be option 2 if there is any uncertainty. This will better align emission inventories between IPCC and US EPA	Jennifer Politsch	Rejected	The issue of CF4 origination from the cleaning of carbon-containing films will be taken into account in the Tier 2a and 2b methods.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
10198	3	6	227	230	Requiring any film containing carbon to apply by-product formation does not appear to improve accuracy of the method and will likely over estimate emissions.	Tina Gilliland	Rejected	While option 2 as described in lines 229-230 of the FOD could lead to oversetimating emissions in cases when only a small fraction of the films actually being cleaned contain carbon, the determining factor is that NOT taking into account byproducts formation during the cleaning of carbon-containing films would lead to an underestimation of emissions. Option 1 as described in lines 227-228 of the FOD provides an approach to improve reporting accuracy in such case.
4584	3	6	23	24	QA/QC, letter case	Kewei Yu	Accepted	Checked text throughout to ensure consistency.
7486	3	6	239	242	data submitted over last 10 years to IPCC, EPA shows that the cetnreline process conditions can be very forgiving. The emissions collect by IPCC and for US EPA show that across a wide range of technolgoy nodes, factory locations, and equipment types that the measured EFs are not widely variable for same input chemicals and process categories	Jennifer Politsch	Rejected	This is not what the data show if you look at the distribution functions of Efs, which often have standards variations exceeding 100%.
7484	3	6	240	241	recommend centreline discussion or site specific Efs be based on testing frequency requirements (not too onerous or costly but more frequent than one time).	Jennifer Politsch	Rejected	Emission factors are very stable so long as the process conditions are fixed. A detailed discussion about "similarity" between recipes will be included in SOD.
7488	3	6	265	265	Table 6.1 - Cannot fully review. Should this be updated to reference process and subprocess types (different types of chamber clean for example).	Jennifer Politsch	Rejected	The table provides a summary of the information necessary to apply the various tiered method. The table is not about making distinctions by process or type or sub-type. The table will be finalized as part of the SOD submission.
7490	3	6	270	272	should a component of the decision tree include what to do if no published GWP or reference to a EPA table A-1 if not included in IPCC	Jennifer Politsch	Rejected	No GWP values are required to report emissions pertinent to Figure 6.1
7492	3	6	270	272	Tier 1 decision tree. If production data is not available should calculators be directed to Tier 2a or to not use Tier 1?	Jennifer Politsch	Rejected	This scenario is not reasonable. If production data is not available, it is not likely that gas consumption data would be available.
7494	3	6	276	276	Is any country using Tier 1 calculation? If not it should be removed from chapter as an option. Obtaining production figures is not easy or readily shared by companies (CBI) so it would seem to be difficult to complete this inaccurate calculation. If it is being used should it be adjusted to account for device complexity	Jennifer Politsch	Rejected	See discussion in the response to comment ID 7450.
7496	3	6	276	276	Is table 6.2 going to include a reference to use an EF of 1 for any non-listed gases?	Jennifer Politsch	Rejected	Table 6.2 is relevant to the Tier 1 method, which is based on substrate prodcution and not gas consumption.
8098	3	6	289	289	What is PV?, Does this represent all areas which may use Tier 1, if any?	Jennifer Politsch	Noted	PV = Photovoltaic (defined on line 80).
8096	3	6	307	307	What is PV?, Does this represent all areas which may use Tier 1, if any?	Jennifer Politsch	Noted	PV = Photovoltaic (defined on line 80).
864	3	6	321	321	It is written "used" instead of "use" at the end of the line, and the quotation marks for letter i at the end of the line are not necessary. The line should be: "...used in manufacturing processes (Ui) and the formation of by-products during the use of each input gas i (... "	Virginia Sena	Accepted	The second "used" on line 321 should be changed to "use" (the first "used" at the beginning of the line is correct)

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
7502	3	6	322	322	Tables 6.3A, 6.3B, 6.3C, and 6.3D could not be reviewed since not included in draft. However if facility cannot distinguish between wafer size or process subtypes suggest that Default Efs for 2a and 2b be weighted for NF3 based on average NF3 apportioning between chamber clean non-RPC and other uses.	Jennifer Politsch	Noted	With respect to the comment about Tables 6.3A-D; such tables will be developed as part of the SOD. Apportioning guidelines will also be developed as part of the SOD, but in any case, the approach will not be based on a weighting of emission factors but on an apportioning of consumption.
7500	3	6	324	326	This sentence is repetitve with that before it in the paragraph. Could instead say "Hence Tier 2b, 2c, and Tier 3 do not take into account substrate size..."	Jennifer Politsch	Accepted	The sentence on lines 320-322 will be changed to read: "The Tier 2a method is based on default emission factors calculated over all processes and substrate sizes, representing average utilization efficiencies of the gases used in manufacturing processes (Ui) and the formation of by-products during the used of each input gas ‘i' (BCF4,i , 321 BC2F6,i, BC3F8,i, BC4F6,i, BC4F8,i, BC5F8,i, BCH3F,i, BCH2F2,i, or BCHF3,i)."
10200	3	6	324	327	Statement is repetitive. See comments above for lines 188 through 200.	Tina Gilliland	Accepted	See proposed changed in the answer to comment ID 7500.
7510	3	6	344	346	Ei and BEi - Equation calculates to kg. Kg of each species should not be added to get final emission inventory as each chemical should be weighted to its specfic published GWP. Within chapter there is inconsistent direction for summing emissions and units. Sum should only be for when k= i and	Jennifer Politsch	Rejected	Emissions are not reported on the basis of CO2 equivalents but on a mass basis for each compound and GWPs are not to be taken into account as part of the methodology.
7512	3	6	344	346	Sum of all by-products k without use of GWP will lead to incorrect emissions in CO2e	Jennifer Politsch	Rejected	Emissions are not reported on the basis of CO2 equivalents but on a mass basis for each compound and GWPs are not to be taken into account as part of the methodology.
10202	3	6	344	346	Is the intent to report kilograms emitted without multiplying by the Global Warming Potential?	Tina Gilliland	Accepted	Answer: Yes. See also answers to comments ID 7510 and 7512.
7498	3	6	352	352	Ei - Equation calculates to kg. Kg of each species should not be added to get final emission inventory as each chemical should be weighted to its specfic published GWP. Within chapter there is inconsistent direction for summing emissions and units	Jennifer Politsch	Rejected	Emissions are not reported on the basis of CO2 equivalents but on a mass basis for each compound and GWPs are not to be taken into account as part of the methodology.
8000	3	6	353	353	Heel should be container specific and not a default value	Jennifer Politsch	Rejected	An option has been added to calculate facility-specific heels values, but no container-specific value is envisioned or seemingly necessary.
7504	3	6	354	355	This list is not inclusive of all gases or for future new gases. Tables 6.3A, 6.3B, 6.3C, and 6.3D should reflect direction to use utilisation = 1 for any non-listed gases unless Tier 3 EF is developed	Jennifer Politsch	Accepted with modification	The current list of gases 'i' is based on a comprehensive review of the litterature and on a global survey of the different gases currently used in production. Nevetheless, the authors agree that it is possible that new chemicals might be used in the future, for which emission factors are not currently available. Guidance will be added to specify that -- when no default EFs are available -- reporters might either 1) use a Tier 3a approach whereby facility-specific emission factors would be measured, OR 2) assume that emissions equal consumption (i.e. that the utilization efficiency of the chemical is ZERO). The authors assume that the commenter meant to suggest to use utilization = 0 (or (1-U=1)), not utilization =1 as stated in the comment. See lines 318-322 in SOD.
7508	3	6	354	355	What is the definition of variable Fci? The listed gases now include F2 and N2O. Should it be changed to GHG?	Jennifer Politsch	Accepted with modification	The authors will consider changing the denomination for consumption data to "C" across all tiered methods.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
7522	3	6	354	355	Should N2O EF = 1 for Tier 2a because reporter is not able to apportion to different processes or wafer size?	Jennifer Politsch	Rejected	Default emission factors have been provided for the N2O CVD category (denomination to be changed to N2O TFD) and for the "other" N2O category. Reporters will be required to apportion consumption between the two N2O categories and guidance will be provided as part of the SOD to such effect.
8002	3	6	363	363	Heel should be container specific and not a default value	Jennifer Politsch	Rejected	An option has been added to calculate facility-specific heels values, but no container-specific value is envisionned or seemingly necessary.
70	3	6	365	365	Please give the unit of FCi.	Mingshan Su	Accepted	Unit of FCi (to be changed to Ci) shall be kg.
8004	3	6	366	366	this should not include a list or it should align with all default EF table Byproduct options	Jennifer Politsch	Noted	The list of by-products was removed from the definition of Bk,i. Instead, a reference to Table 6.3 was included in the text.
8006	3	6	368	368	Equation 6.3b referencse input gas and not byproduct formed. Please make sure it is clear how to determine byproduct DRE vs. input chemical DRE	Jennifer Politsch	Rejected	Definition of Dk on line 368 refers to equation 6.3a (not 6.3b) concerning the abatement of by-product k.
8078	3	6	376	377	Reduction is site and process specific	Jennifer Politsch	Noted	Definition of ai has been finalized as part of the SOD.
8008	3	6	379	379	tit should b	Jennifer Politsch	Rejected	Comment not understood.
8012	3	6	381	396	Where is variable "a" in na or ma defined?	Jennifer Politsch	Noted	The 'a' index refers to the number of tools (n or m) abated. The method of equation 6.3c will be finalized as part of the SOD.
7514	3	6	385	385	The resolution of equation is difficult to read	Jennifer Politsch	Noted	
7516	3	6	388	388	should include references to requirements that equipment that is designed, maintained, and certified to achive the DRE.	Jennifer Politsch	Accepted	An explanation of what constitutes a "suitable emissions control technology" was added to the text, refering to section 6.2.2.1 for more details.
8014	3	6	389	390	What does suitable mean? Please include references to appropriate language in chapter.	Jennifer Politsch	Accepted	Same comment as comment ID 7516. An explanation of what constitutes a "suitable emissions control technology" was added to the text, refering to section 6.2.2.1 for more details.
8016	3	6	389	393	# of tools may not define # of abatement. Recommend changing to # of abatement for thin-film and etch/wafer cleaning equipment	Jennifer Politsch	Rejected	While the number of tools may not indeed equal the number of abatement systems, the purpose of equation 6.3c is to estimate the fraction of gas i volume fed into tools equiped with emission control technologies capable of abating gas i.
8010	3	6	390	390	See comment for Volume 3, Chapter 6, Start line 89, end line 89. Replace CVD with thin-film	Jennifer Politsch	Accepted	See answer to comment ID 7456.
7518	3	6	390	390	why does it list CVD specifically?	Jennifer Politsch	Noted	Changing 'CVD' to 'TFD' removes the ambiguity.
8022	3	6	392	392	See comment for Volume 3, Chapter 6, Start line 89, end line 89. Replace CVD with thin-film	Jennifer Politsch	Accepted	See answer to comment ID 7456 and 7518.
7520	3	6	392	392	why does it list CVD specifically?	Jennifer Politsch	Noted	Changing 'CVD' to 'TFD' removes the ambiguity.
8018	3	6	393	396	what does "SOD" mean?	Jennifer Politsch	Noted	Second Order Draft.
8020	3	6	393	396	Is the intent of gamma to weight thin-films vs. plasma etch/wafer cleaning fraction abated? In order to know if this default fraction is representative of a facility emissions they would need to be able to apportion to this level. If so what is the need for Tier 2a?	Jennifer Politsch	Noted	The intent of gamma is to reflect the difference in typical average flows between etch and CVD; a default gamma value will be provided based on best-available information to be derived as part of the SOD. The authors agree that if the gamma factor is not representative of a particular facility, apportioning will be required to derive a facility-specific gamma value. Guidance will be provided as part of the SOD. Need further discussion as to whether gamma needs to be gas-i-specific.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8024	3	6	415	417	Only if backup is 100% fool proof should this be an option. Interlocking is likely to result in close to 100% uptime but should not result in an 100% uptime. Most facilities will allow for operation to complete if possible safely even if abatement faults so some gases may run unabated	Jennifer Politsch	Rejected	The authors feel that the current language of lines 415-417 is adequate.
8028	3	6	426	426	Variable B_BP,I is not consistent nomenclature with equation on row 361 . B_PEk	Jennifer Politsch	Accepted	The text should be changed to Bk,i (B sub k sub i). Also note that the equation numbering on line 421 is incorrect and will be changed.
8026	3	6	429	431	Ei and BEi - Equation calculates to kg. Kg of each species should not be added to get final emission inventory as each chemical should be weighted to its specfic published GWP. Within chapter there is inconsistent direction for summing emissions and units. Sum should only be for when k= i and	Jennifer Politsch	Rejected	See answer to comment ID 7510.
10204	3	6	429	432	Same comment as line 344 through 346.	Tina Gilliland	Rejected	See answer to comment ID 7510.
8030	3	6	448	451	Ei and BEi - Equation calculates to kg. Kg of each species should not be added to get final emission inventory as each chemical should be weighted to its specfic published GWP. Within chapter there is inconsistent direction for summing emissions and units. Sum should only be for when k= i and	Jennifer Politsch	Rejected	See answer to comment ID 7510.
866	3	6	468	475	Description for parameter "FC i,p" (as it is described in lines 459 to 460) is missing for Equation 6.8A.	Virginia Sena	Accepted	Description for parameter FCi,p (to be changed to Ci,p) has been added below the box of equation 6.8a, as defined on line 459.
4586	3	6	469	489	gas I, type p, letter case and italic, and other places	Kewei Yu	Accepted	
8032	3	6	483	488	Comments in yellow describe intent of variable but this level of detail ideally will not be in final chapter	Jennifer Politsch	Noted	This section is still work in progress but the authors believe that sufficient detail/guidance will be required for the user to understand that the ai,p factor calculation approach will be different for the Tier2a/2b methods and the Tier 2c method.
8034	3	6	512	513	Only if backup is 100% fool proof should this be an option. Interlocking is likely to result in close to 100% uptime but should not result in an 100% uptime. Most facilities will allow for operation to complete if possible safely even if abatement faults so some gases may run unabated	Jennifer Politsch	Rejected	The authors feel that the current language of lines 415-417 is adequate.
8036	3	6	517	625	Difficult to provide comments on entire sections that are still in progress	Jennifer Politsch	Noted	
8038	3	6	517	625	Preliminarily looks like equations will yield emissions in metric tons which is different from results from Tier 1, 2a-c	Jennifer Politsch	Rejected	Preliminary estimate of emissions is in MTCO2e to determine which stacks must be tested. Clarified in Second Order Draft.
7506	3	6	528	550	tier 3b - any purchase of gas which is not detectable or included in Default Efs should be included in inventory with utilisation = 1	Jennifer Politsch	Rejected	Assuming 100% utilization efficiency is not a suitable solution. The provision of Subpart I for low use gases will be reviewed to determine if they can used for IPCC purposes.
8042	3	6	549	559	Ideally would provide references to Tier 2b equations necessary in preliminary calculation checks	Jennifer Politsch	Accepted with modification	Revised draft guidance allows facilities to use either Tier 2a or Tier 2b to develop a preliminary estimate, depending on whether multiple wafer sizes are used at the fab. A preliminary estimate of emissions is required to imprement the stack test method. A faciliy would use Tier 3 if they want a more accurate emissions estimate reflective of facility emissions rather than industry defaults.
8040	3	6	550	551	How can consumpton be a ratio? If a ratio than doesn't seem correct to yield emissions in metric tons	Jennifer Politsch	Accepted	The definition of Cij was revised and an explanation of how to determine consumption for stack systems was added.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8044	3	6	589	589	no equations yield calculations in CO2e so requires additional equations or direction to complete this portion of the process	Jennifer Politsch	Accepted	Guidance has been provided to require use of the same conversion factors used for key category analysis. Note that the purpose of the threshold defined on lines 590-591 is only to select which stacks should be tested, not for reporting final emissions, which will not be expressed in CO2e but on a mass basis for each coumpound emitted.
8052	3	6	605	605	Stack testing protocols for other species (HF, HCl, etc) are based on concentration measurements normalized to production output or converted to lb/hr (for example). They are not linked to input chemical use nor are do they require creating an EF based on POU % uptime/DRE. The beginning of the section references other stack testing requirements so this section should be more aligned to other stack testing protocols.	Jennifer Politsch	Rejected	The stack testing method proposed here is different from established air pollutant stack testing methods. Further detailed comments will be added, in part based on the history of the stack testing method development for the US GHGRP (Subpart I).
8046	3	6	605	606	References for EPA method 1 or 2 should be provided	Jennifer Politsch	Accepted	References added.
8048	3	6	611	611	Define or references for GD-043	Jennifer Politsch	Accepted	References added.
8050	3	6	619	621	Why would stack testing be used if entire calculation method for Tier 2b are required for stack testing process?	Jennifer Politsch	Accepted	Revised draft guidance allows facilities to use either Tier 2a or Tier 2b to develop a preliminary estimate, depending on whether multiple wafer sizes are used at the fab. A preliminary estimate of emissions is required to imprement the stack test method. A faciliy would use Tier 3 if they want a more accurate emissions estimate reflective of facility emissions rather than industry defaults. (Same as answer to comment ID 8042.)
8064	3	6	639	691	It should be noted that lower GWP HTF materials being marketed are not always the best environmental choice. Some or many are regulated VOC pollutants and not ideal materials to switch to. This should be highlighted as a potential side effect or negative consequence to lower GWP emissions.	Jennifer Politsch	Accepted	A sentence was added noting that low-GWP HTFs may be regulated (e.g., as VOCs) in some regions.
8062	3	6	646	646	It doesn't show in equation 6.12A that the FC is assumed to be C6F14. Is this the default for all HTFs to assume they are C6F14? If lower GWP materials are identified this will not allow facilities to take credit for the lower emissions. How should HTF GWPs be based? Are additional GWPs to be added to bring IPCC in line with EPA GHG MRR Table A-1 (default GWP section based on stoichiometry?)	Jennifer Politsch	Rejected	The Tier 1 method has been revised to provide default Tier 1 emission factors in kg/m2 for three HTFs that represent the three main types of compounds used as HTFs globally: HFE-449sl, C6F14, and PFPMIE. These compounds and their Tier 1 default emission factors are presented in Table 6.9 under "Choice of Emission Factors;" it would be redundant to present them in Equation 6.12A as well. The Fifth Assessment Report GWPs for these compounds range from 421 to 9710. To take credit for transitioning to a lower-GWP mix of HTFs, reporters should use the Tier 2 HTF reporting method. Regarding the addition of GWPs, the comment is rejected as IPCC-based methodologies are to be based on reporting emissions on a mass basis for each compound emitted.
868	3	6	646	650	Please check the Equation number for Equation 6.12A (in line 646 and in line 650), once the yellow lines are ready, since the last Equation above is Equation number 6.8E, and the Equations from 6.9 to 6.11 are missing in this FOD.	Virginia Sena	Noted	The numbering of equations will be finalized once the Tier 3 methodologies have been finalised.
8054	3	6	650	659	This section is confusing. What is Ei? How is it defined? This section results in emissions of Mt-CO2 but there is not use of the GWP or conversion to Mt in the equation	Jennifer Politsch	Noted	See answer to comment ID 8062.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8056	3	6	650	659	Is ther any reason in having a Tier 1 for HTFs	Jennifer Politsch	Noted	A tier 1 method is required by the IPCC.
8060	3	6	665	667	The language that Tier 2 neglects fluid losses during filling new or existing equipment does not seem consistent with the equations for Tier 2. The net result after accounting for filling new tools or removing entire tools should be the amount required to "top off" existing equipment.	Jennifer Politsch	Accepted	The sentence of lines 665-666 will be removed (The Tier 2 method neglects… costly fluids).
8058	3	6	670	691	This section is aligned with the EPA MRR and the complication is necessary in facilities which are adding/removin a large number of tools. The purchase volumes of HTF can be large and if the use is not tracked appropriately it will not correctly reflect emissions on an annual basis.	Jennifer Politsch	Noted	The authors agree.
4588	3	6	693		Figure 6.2 is not readable	Kewei Yu	Rejected	No readability issue noted.
4172	3	6	704	759	It would be useful to explicitly include guidelines for calculating emissions in cases where there is no emission factor is listed (i.e. the emission factor is listed as "NA"). Current practice in the US is to assign a utilization of 0 for these input gases, resulting in an emission factor of 1. As the 2006 guidelines do not specify how to assign an emission factor to these cases, they may end up being unaccounted for.	Stephanie Bogle	Accepted	See answer to comment ID 7504.
4174	3	6	725	750	C4F6 is unlikely to be a significant by-product in terms of CO2e due to it's extremely low GWP and typically low by-product emission factor. You may want to exclude it from the by-product list for simplicity.	Stephanie Bogle	Rejected	C4F6 is not included in the list of byproducts (B factors) but is included as a process gas. C4F6 usage is not insignificant according to the latest industry surveys and the potential for the formation of CF4 and C2F6 as byproducts of the use of C4F6 is not negligible, in particular for ≤200mm wafer size (according to US EPA 40 CFR 98 Subpart I Tables I-3 and I-4).
8066	3	6	768	771	Why is wet called out in Hot-wet < 800 and Hot-Wet > 800C. The "wet" portion is not critical to GHG abatement.	Jennifer Politsch	Noted	The definitions and discussion related to Table 6.6A (now 6.7) have been updated.
8068	3	6	768	771	Please include more detailed description or distinction on specific types such as cartridge, catalyst.	Jennifer Politsch	Noted	The definitions and discussion related to Table 6.6A (now 6.7) have been updated.
8070	3	6	768	771	it should be noted that not all hot-wet or combustion devies are designed to abate at default DRE values. For example most Combustion POU for chamer clean (thin-films) are designed to abate NF3 but not any PFC byproducts such as CF4, CH3F...	Jennifer Politsch	Accepted	Refined guidance and methodological approaches will be added to the emissions control section as part of the SOD. The authors agree that the Refined guidelines should allow reporters to claim abatement for NF3 from CVD chamber cleaning while having zero DRE for other byproducts such as CF4 when the abatement device is only designed for NF3/F2 abatement.
8100	3	6	768	771	It should be noted that not all combustion devices are designed to abate all FCs checked in the table.	Jennifer Politsch	Accepted	The authors agree and refined guidance and methodological approaches will be added to the emissions control section as part of the SOD.
10206	3	6	768	773	Include references for abatement technologies. For example, the catalyst only abates CF4 and NF3 or is there a technical paperthat only evaluated these gases.	Tina Gilliland	Accepted	The authors agree and refined guidance and methodological approaches will be added to the emissions control section as part of the SOD.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1856	3	6	768	793	Default values of EF and DRE in combination of gas and detoxification technology will be decided in the future (as Table6.6A), but when making a decision, you should not use measurement results in bad maintenance state, measured only in a/some country/ies. (Bad maintenance state: a state where the original ability of the abatement system can not be realized. These measurement results will indicate the capacity shortage of he abatement systems. The data showing these lack of capability indicates that it must be strongly regulated in the country to use the abatement system in good maintenance state. It should also be noted that, these data do not indicate that countries other than the country are also using abatement systems in bad maintenance state. Regardless of the number of the "lack" data, this holds.	hiroshi ito	Noted	The authors agree with the comment that DRE data should be reflective of properly maintained equipment. However, the comment about the need to strongly regulate the operation of abatement systems is rejected because the IPCC guidelines are not to be construed as imposing regulatory requirements at national levels or otherwise.
7436	3	6	77	78	recommend replacing lines with "As part of its manufacturing processes, the electronics industry uses greenhouse gases (GHG) in the form of fluorinated compounds (FCs) and nitrous oxide (N2O) for plasma etching intricate patterns, cleaning substrates, and tool manufacturing" Why? It isn't such as but those are only ones compiled for emissions inventory in this chapter	Jennifer Politsch	Rejected	There are no FC emissions related to tool manufacturing. The second sentence of the comment is not understood.
300	3	6	770	771	Hot-wet should be changed to Heater-wet in Table 6.6.A.	Tsutomu Tsukada	Rejected	Heater-wet is not a common or recognized terminology in the electronics industry.
301	3	6	770	771	Hot-wet > 800 C can abate PFC gases more than 90% of DRE. Then x should be put in all the gases..	Tsutomu Tsukada	Rejected	The Hot-wet >800 C technology is not capable of abating all PFC under all conditions. Data is being collected to determine the gases that can effectively be abated by such technologies and the table will be updated as part of the SOD.
8072	3	6	776	777	Add to decision tree after "Is the devise OEM certified to [2] to abate this gas" the question "Is the OEM certified DRE lower than the default DRE in Table ... ?" If yes use OEM DER, If No go to next question.	Jennifer Politsch	Accepted with modification	The question in the decision tree will be revised to read: Is the device OEm certify that the abatement device is certified to abate the target gas at or above the default DRE?
8080	3	6	776	777	This decision tree or within the chapter do not specifically call out whether you can use default DRE or a combination of default with Tier 3 on a gas by gas basis	Jennifer Politsch	Accepted	Guidance has been developed to allow reporters to use both default and site specific DREs. Figure 6.3 was revised to address this issue.
8082	3	6	776	777	Should an option to use a different DRE for an input gas versus a byproduct gas? EPA subpart I calculation workbook (Sheet"Semiconductors f-GHG 300 mm", starting on Row 419 provides alternative DRE for byproducts separate from Input chemical DRE	Jennifer Politsch	Noted	Yes, different DREs will be used for different input gases and byproducts.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8088	3	6	776	791	Will there be specific language or references as to which testing protocols will be acceptable for measuring or certifying DRE performance. Requirement to account for dilution should be in any acceptable testing protocol. References should be provide. EPA method 1, 2 or ISMI methods for example. Should JEITA or any other region methods be included? (Yes if they account for dilution and concentration calibration).	Jennifer Politsch	Accepted	References to existing / recognized DRE testing standards will be provided. It is agreed that such standard should account for dilution effects.
8090	3	6	776	791	Should POU DRE section include details on how to test or account for byproduct DRE performance?	Jennifer Politsch	Noted	No, the POU DRE section will only provide general guidance about testing requirements but will provide references to existing / recognized DRE testing standards.
8074	3	6	780	782	This note [2] is complicated and difficult to follow. OEM certified should mean that it meets default DRE or performance specifications agreed to by vendor for the tool type/recipe conditions in which it is connected. These performance specifications should not be so tight that they do not cover the wide range of potential operational conditions which may occur for the tool type.	Jennifer Politsch	Noted	Regarding the lack of clarity, more refined guidance has been provided in the SOD. Regarding equipment design, that is out of the scope of this refinement and therefore this part of the comment is rejected.
8076	3	6	785	785	This 5% requirement should only apply to those sites which are defining a site specific DRE which is greater than the default DRE's published in this specification	Jennifer Politsch	Noted	This section is still under development / discussion and refined guidance will be developed as part of the SOD.
10208	3	6	785	785	Reference appears incomplete. Is this in reference to 40CFR98 Subpart I FR 2013. Need to be clear on what 5% annual requirement.	Tina Gilliland	Noted	This section is still under development / discussion and refined guidance will be developed as part of the SOD.
8086	3	6	786	787	Is this going to be referenced to a comment associated with decision tree? If not language about accounting for dilution should be included in the chapter under testing requirements	Jennifer Politsch	Noted	This section is still under development / discussion and refined guidance will be developed as part of the SOD.
8084	3	6	788	790	This should be removed or added to language in decision tree adding option to use an OEM DRE less than default. Note: any abatement should be certified by manufacturer at this lower DRE only. Facility can implement Tier 3 option which requires deriving a facility specific DRE if manufacturer will not certify lower value.	Jennifer Politsch	Noted	This section is still under development / discussion and refined guidance will be developed as part of the SOD.
8092	3	6	811	814	Should this table and details be removed if not being updated since 2005?	Jennifer Politsch	Accepted	The text of lines 811-814 is outdated and will be updated as part of the SOD. Table 6.7 will be removed from the Refined Guidelines.
8094	3	6	815	828	What is added to the calculation methodology to have this added discussion or % utilisation standard of differnce facilities? Is the 86% supposed to be used for variable defined in Row 307 ("CPV = fraction of PV manufacture that uses FCs, fraction."). If so the variable subscripts do not match. Also the discussion in this paragraph is for % utilisation of a facility and not the % of the manufacture process which uses FCs	Jennifer Politsch	Accepted	The 86% was an annual manufacturing capacity estimate from the 2006 GL. The definition of Production ('P') in equation 6.1 states "If annual production is not available from an electronics producer, P may be calculated as the product of the annual manufacturing capacity and annual plant production capacity utilisation (fraction) of that producer." A list of databases providing design capacities was added to section 6.2.3 (Choice of activity data) and an explanation of how design capacaties can be adjusted for utilization efficiencies was added to that section. A footnote refering to section 6.2.3 was added to the definition of P in Equation 6.1.
7438	3	6	84	84	recommend changing "The gases include" to "Examples of FCs included are" Why? The list is potentially not all inclusive and will still be representative if production gases change in the future.	Jennifer Politsch	Noted	Changed to "Examples of FCs included are".

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
7440	3	6	87	87	Delete carbonyl fluoride (COF2). It is not an emission but is an input chemical and does not have a documented GWP.	Jennifer Politsch	Rejected	COF2 was not deleted as an input gas because of the potential formation of CF4 and C2F6 byproducts. Due to the lack of measured EFs/BEFs for COF2, the default provision applies, which provides for using (1-U)=0.8 and BEFs of 0.1 for CF4 and C2F6. Alternatively, reporters can use the Tier 3a method to apply facility-specific measured emission factors.
7442	3	6	88	88	recommend change "(i) plasma etching silicon containing materials" to "(i) plasma etching and wafer cleaning of silicon containing materials"	Jennifer Politsch	Accepted	
7444	3	6	89	89	recommend replacing "cleaning chemical vapour deposition (CVD) tool chamber-walls" to "cleaning thin-film tool chamber walls after processing substrates." Why? This aligns language to be more general as chamber cleaning occurs in more than just CVD processes. Recommend changing references througout document for CVD to thin-films if this comment is adopted	Jennifer Politsch	Accepted	
1854	3	6	924,925.970,		Some companies' HP's are listed as Reference. But some of them are not suitable as a reference, such as only data up to 2010 are listed (too old), or/and only describe CO2 of energy origin, not describe PFCs.	hiroshi ito	Noted	The Applied Materials (2016) and IBM (2015) references have been removed. The entire list of references was scrubbed one more time to remove those that are not appropriate for IPCC purposes.
7446	3	6	97	97	See comment for Volume 3, Chapter 6, Start line 89, end line 89. Replace CVD with thin-film	Jennifer Politsch	Accepted	
10168	3	6	97	97	Need to define CVD as Chemical Vapor Deposition or Thin Film. Chapter uses CVD and Thin Film throughout.	Tina Gilliland	Accepted	
10170	3	6	98	98	Grammar error, need to change "results" to "result".	Tina Gilliland	Accepted	
4890	3	6	Table 6.6A		NF3 and SF6 need to be grouped separately from PFC (Perfluorocarbon) gases.	Elsa Hatanaka	Accepted	The title in line 2 of Table 6.6A (now 6.7) has been updated to ABATEMENT SUITABILITY TABLE
1524	3	7	100	101	……. Kuwait) will freeze HFC use by 2028. In this way it has been estimated that up to 0.5° Celsius warming will be avoided by the end of the century (Velders et al., 2009; 2012; 2015). DELETE sentence “In this way……..2015) and the references.You must avoid giving the (false) impression that this supposed 0.5degC is part of the 2degC aim of the Paris Agreement. The fact is that 0.5degC was a consequence of the spurious scenarios in Velders (2009) that was subsequently reduced significantly in Velders (2012) and reduced again in Velders (2015). The scenarios have little basis in fact and are certainly not predictions, so you cannot say “will be avoided”. The additional 0.5degC is a consequence of supposed rampant growth in HFC production and use	Archie McCulloch	Accepted	Sentences to be deleted. Not important for content.
456	3	7	106	106	I am concerned by the reliance in this chapter on such an old IPCC/TEAP reference for the use pattern of alternatives; why not use the most up to date UNEP/TEAP report (2016)?	Pauline Midgley	Noted	Information from TEAP 2016 is used in the updated sections (table 7.3a). The text that is referenced to in line 106 is still valid though.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
358	3	7	173	174	The information provided in Table 7.3 is of limited use for inventory complilers, since it reports outdated information, with significant differences from country to country and therefore not applicable for countries not referred to in the Table. It could be replaced by Tables A5.19/A5.20 of the EEA report "Fluorinated greenhouse gases 2017" (see also attached file Vol3_Chp7_L173-174)	Domenico Gaudioso	Noted	It is not our mandate to delete tables from the 2006 Guidelines, but to provide updated information. We belive the new tables 7.3a-7-3c provide the necessary information. The report containes information only for EU-countries.
71	3	7	174	175	Please define RAC	Mingshan Su	Accepted	
4896	3	7	268	269	Although the thinking of mentioning UNFCCC reporting requirements here can be fully understood, is it normal to mention the UNFCCC context in the IPCC Guidelines?	Elsa Hatanaka	Accepted	Sentence to be deleted.
4898	3	7	282	282	It is much appreciated that 'gradual improvement' is expressly taken note of here, since adding F-gas reporting will surely be challenging for some countries.	Elsa Hatanaka	Noted	
4900	3	7	284	284	Is it rather 'you should assess how much information and time you need to achieve the desired aim' or 'you should decide how much time you want to spend to achieve the desired aim'?	Elsa Hatanaka	Accepted	Sentence to be changed.
4902	3	7	292	295	It would be useful to mention this information with 'as of when'.	Elsa Hatanaka	Accepted	Information to be added.
870	3	7	300	300	The reference to Box 7.4 is not correct. The Box that provides a short description of common data sources is Box 7.3.A.	Virginia Sena	Accepted	
4904	3	7	305	305	It might be useful to mention at the end of Step 5 that if no statistics are currently available, the country needs to set up a system of collection, since the situation has changed drastically with the Kigali amendment to the MP now in place.	Elsa Hatanaka	Accepted with modification	The FOD text has now been superceded. The Kigali amendment and Montreal Protocol is described in box 7.3 A
1526	3	7	338	339	Like for all parts of the inventory, it is important that the assumptions applied in the calculation process are well documented.Change is to are	Archie McCulloch	Accepted	
2456	3	7	350	351	As also in Box 7.2A (lines 252-253), the Box 7.2B gives guidance on the Tier 2 EF approach which would be beneficial to point out in the heading of the Box.	Päivi Lindh	Accepted	
1528	3	7	357	357	FIGURE. SCHEMATIC EXAMPLE OF THE YEARLY INVENTORY DEVELOPMENT. This attempt to illustrate a vintaging model does not work well. It needs to have a clearer relationship between the annual additions to the bank and the releases. More thought is needed concerning the vertical scale and how the growth in the bank and emissions progresses. Writing needs to be larger.	Archie McCulloch	Accepted	
872	3	7	371	371	The reference to Box 7.4 is not correct. The Box that provides guide on how to put together information on what the bank looks like is Box 7.2.C.	Virginia Sena	Accepted	
874	3	7	388	388	The reference to Box 7.4 is not correct. The Box that provides tips on where to find data (data sources) is Box 7.3.A.	Virginia Sena	Accepted	
4592	3	7	391		"See" box 7.4?	Kewei Yu	Accepted	
876	3	7	391	391	The reference to Box 7.4 is not correct. The Box that provides tips on where to find data (data sources) is Box 7.3.A.	Virginia Sena	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
1530	3	7	392	392	3. Removal of substances exported, emitted, retired or destroyed. Change destructed to destroyed	Archie McCulloch	Accepted	
2458	3	7	424	425	As also in Box 7.2A (lines 252-253), the Box 7.2C gives guidance on the Tier 2 EF approach which would be beneficial to point out in the heading of the Box.	Päivi Lindh	Accepted	
4594	3	7	427	428	bank?	Kewei Yu	Noted	
4906	3	7	450	450	Is it normal to mention the UNFCCC context in the IPCC Guidelines?	Elsa Hatanaka	Accepted	
4596	3	7	455		(bank)?	Kewei Yu	Noted	
4590	3	7	46	48	letter case, percentage?	Kewei Yu	Accepted	
740	3	7	478	540	The explanation is not clear about whether it is permitted or not to use the values presented on Tables 7.9A and Table 7.9B.	Kendal Blanco Salas	Accepted	
4992	3	7	478	546	There is valuable information on emission rates in new Tables 7.9a-7.9c. Text in lines 478-530 should give clear guidance when to use default emission factors from Table 7.9 and what is the status of the emission factors in Tables 7.9a-7.9c. This is already done in current version in some extent but authors could check if this could be done even more transparent way when referring especially to Tables 7.9b and 7.9c. Related to Table 7.9a it is written that “Countries with similar regulations or incentives in place can consider using these factors for relevant years”. If a country uses these emission factors are those considered Default or perhaps Other because not given in Table 7.9? And if considered Default, for example reviewers should be familiar with references behind the data given in these Tables in order to be able to evaluate circumstances in which emission factors from different Tables can be applied.	Päivi Lindh	Accepted	
878	3	7	491	492	There are two different references to find emission factors from the German study. The correct reference in Table 7.9.a.	Virginia Sena	Rejected	The reference in table 7.9 is correct
6832	3	7	531	531	In Table 7.9, col (k), the factor for the initial emission should have the dimension % instead of %/year.because it is accounted only once.	Edgar Dullni	Rejected	The units are stated to apply to both columns, "% of initial charge" and "% per year" for the operational loss, and therefore it is written "% of initial charge/year"
8694	3	7	531	532	It is unclear how the information provided in Table 7.9 is related to the information provided in Table 7.9a-c. For example, the initial charge remaining in mobile AC is listed as between 0 and 50 % in table 7.9, while table 7.9c lists between 27 and 55.6 %. Another example is industrial refrigeration where table 7.9 provides an operating emission of between 7 and 25 %, while table 7.9a lists 4.71 %. It is necessary that the information is harmonised. Also, it is necessary that it is made completely clear what the default values are so the users are not left guessing on what value to use, if many different values are presented. Based on the additional tables, it seems that it would be obvious to split mobile AC into different vehicle categories as data supporting this seem to be available.	Ole-Kenneth Nielsen	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
6318	3	7	538	539	Recommend adding additional table to supplement Table 7.9A "German Study 2015". The existing operation emissions in terms of percent of initial charge/year (annual leak rates) are very low and likely represent the extremely well-managed systems surveyed in the German study. If estimators use the leak rates in Table 7.9A, they will underestimate GHG emissions from refrigeration and AC equipment. In California, we collect annual data on refrigerant usage from thousands of businesses and our data show much higher annual leak rates. Recommend a new table with the same format as Table 7.9A, to be titled "California Study 2014: Emission Factors for Refrigeration and Air-Conditioning Systems". Using the same sub-applications, the alternative emissions factors (% of intial charge/year) for California 2014 are as follows: Medium & Large Commercial Refrigeration (centralized): 15.0 - 21.0. Small Commercial Refrigeration (condensing units): 14.5 - 15.0. Industrial Refrigeration including Food Processing and Cold Storage: 6.8 - 28.8. AC Chiller: 1.4 - 6.9. AC Multisplit/VRF: 10.0 - 11.3.	Anny Huang	Accepted with modification	Reference to California study used to strengthen the assessment of default values in Table 7.9
1532	3	7	586	587	……..consumption data on HFCs annually. This might provide valuable data for the ODS-substitutes inventories. The paragraph should be deleted. The Kigali Amendment applies to HFCs in aggregate, so countries will only report their total production and consumption of HFCs in CO2 equivalents. It might mean that their accountancy systems will be in place to enable estimation of HFC emissions but there is no direct link here between this emissions inventory and the data required for the Montreal Protocol.	Archie McCulloch	Rejected	The reporting requirement under the Kigali Amendment may well lead to countries collecting new data at a useful level of resolution for national inventory compilers.
4994	3	7	591	592	Bulk importers do not always know in which types of equipment imported gases are used. The sentence could contain e.g. phrase “what equipment type it will be used in if these data are available.”	Päivi Lindh	Accepted	
880	3	7	744	744	The reference to Equation 7.8 is not correct. The correct reference to calculate total MAC emissions may be Equation 7.10 (from the 2006 IPCC Guidelines).	Virginia Sena	Accepted	
1522	3	7	94	95	…...HFCs, having only an indirect impact on the ozone layer (Hurwitz et al., 2015), were not regulated under the Montreal Protocol. However, during the 28th meeting of the parties (MOP28) held in Kigali (Rwanda) in October ….delete " having only an indirect impact on the ozone layer (Hurwitz et al., 2015)," Hurwitz et al., 2015 showed that the indirect effect of HFCs was small and due to their effect on stratospheric temperature, an attribute that they share with other well mixed greenhouse gases. As it stands, the sentence gives a false sense of the history and politics of the change in the Montreal Protocol to include HFCs.	Archie McCulloch	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
4892	3	7	Table 7.3B		It would be useful to mention in the Table itself that it is based on estimated consumption for HFCs in CO2 eq.	Elsa Hatanaka	Accepted	
4894	3	7	Table 7.3C		It would be useful to mention in the Table itself that it is based on estimated consumption for HFCs in CO2 eq.	Elsa Hatanaka	Accepted	
2518	3	8			Section 8.5 needs proof-reading.	Anna Mikis	Accepted	
6834	3	8	110	110	As evaluated in Table 1 of the attached paper for Germany, reported SF6 emissions aggregated under electrical equipment (chapter 8.2) not only contain emissions from electrical switchgear, but also from accelerators (chapter 8.3) and solar panels (chapter 6), which should be reported separately. This could be improved by defining electrical equipment more precise.	Edgar Dullni	Noted	No action can be taken because the comment is out of scope of the 2019 Refinement.
4598	3	8	21	41	letter case	Kewei Yu	Accepted	Corrected
9606	3	8	378	383	Is it possible to change the names of the groups to avoid describing them as high-GWP and low-GWP? My thoughts when reading this is that a reader might understand that CH4, C3F6, COF2, and C2H4 are less harmful GHGs as they have lower GWP values, which is somehow true but may motivate industry to use these gases using this justification. I would like to suggest two more generic names for the groups such as "High Value (HV)" and "Low Value (LV)".	Raul Salas Reyes	Accepted with modification	Due to the confidentiality of data we will limit the emission factors to the three principle gases (i.e. the high GWP gases, namely CF4, C2F6, and CHF3) and allocate emissions to 33% each by weight. For the avoidance of doubt, emissions will not be reported in CO2e but emission factors will be expressed in terms of kg of CF4, C2F6, and CHF3 emitted per circuit board manufactured as this is the way the data has been obtained. More details will be included in the SOD.
4600	3	8	390		CVD, appears only here	Kewei Yu	Noted	The acronym has been defined.
4988	3	8	393	411	Emission factors are given for high-volume manufacturing environment. As the size of the chamber presumably reflects to the amount of gases used in the process and accordingly to the emissions, it would be beneficial to give guidance how to use this method and emission factors for smaller facilities (e.g. research facilities) if the method is also presented in the final version of the guidelines (noticed that chapter is still under development).	Päivi Lindh	Accepted	The authors understand the Tier 1 emission factors that are currently available are based on high-volume manufacturing. Further, the authors acknowledge that the source of such Tier 1 emission factors are currently equipment-specific and may evolve as new generations of equipment and processes may be designed in R&D and released in production. Thus, the SOD includes guidance to measure process-specific and equipment-specific emissions factors (based on a Tier 3 approach), with the long-term objective of collecting experimental factors that will eventually enable the development of more refined Tier 1 and/or Tier 2 approaches.
4602	3	8	394		HVM should be placed before "environment"	Kewei Yu	Accepted	
4604	3	8	395		CO2, subscript, and other places	Kewei Yu	Accepted	
4606	3	8	396		Table 8.11, C2F6?	Kewei Yu	Accepted	
9604	3	8	396	396	The acronym FTIR has not yet been defined. In addition, I would suggest to further elaborate what a working fab installation means to increase the clarity of the 2019 guidelines	Raul Salas Reyes	Noted	
4990	3	8	396	398	CH4, PFCs and HFCs should be reported separately and therefore emission factors should be presented disaggregated in the final version of the guidelines (noticed that the chapter is still under development).	Päivi Lindh	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
8696	3	8	396	398	It is a clear break with normal practice to present EFs in CO2e and it is fundamentally at odds with the practice of reporting national inventories in pure substances. Also, it begs the question of what common metric has been used to convert the emissions to CO2e. Noting that GWPs (and other metrics) are regularly updated, the GWP values used would have to be defined. Either EFs should be presented in terms of pure substances or this should be left out of the GL.	Ole-Kenneth Nielsen	Accepted	
4608	3	8	406	411	C2F6 and others, subscript	Kewei Yu	Noted	The authors further note that emissions will be reported in mass terms, not CO2e.
882	3	8	409	409	Reference to Table 8.11 is not correct. The correct reference is Table 8.12.	Virginia Sena	Accepted with modification	Table 8.12 has been removed.
4986	3	8	467	468	The section for uncertainty assessment in IPCC 2006 Gls. is not providing enough needed information. Also, there is completely missing guidance for uncertainties for emission estimation from accelerators. Refinement is not providing any new guidance in this matter. More broad guidance would be highly appreciated.	Eva Krtková	Noted	No action can be taken because the comment is out of scope of the 2019 Refinement. However, the authors note that the 2006 Guidelines do provide guidance regarding assessing the uncertainty of accelerator emissions in section 8.3.3 on page 8.33.
8698	3	8	477	1193	This new chapter is very substantial and it is unclear what the relevance of this source to global emissions is. It should be included in the introduction a description on the expected level of emissions deriving from this activity. Currently, more than 20 pages are included with several subsections still to be completed. This seems very excessive. Also, the text should use the typical referencing rather than having references as footnotes as has been done in the first-order draft.	Ole-Kenneth Nielsen	Accepted	In light of the performed interviews and acquired information no emission levels could be obtained at the moment. Thus, no Tier 1 and Tier 2 methods can be provided. The chapter will be substantially reduced and information will be included in the appendix considering a Tier 3 approach in order to provide guidance for the measurent of emission factors. The references will be corrected and adapted to IPCC style.
884	3	8	493	493	Reference to Table 8.3 is not correct. Table 8.3 from 2006 IPCC Guidelines shows information on CLOSED PRESSURE ELECTRICAL EQUIPMENT (HV SWITCHGEAR) CONTAINING SF6: DEFAULT EMISSION FACTORS. The correct reference may be Table 8.15.	Virginia Sena	Accepted	The table number has been corrected.
886	3	8	495	495	Reference to Table 8.7 is not correct. Table 8.7 from the 2006 IPCC Guidelines shows infromation on SF6 EMISSIONS PER PLANE PER YEAR. The correct reference may be Table 8.19.	Virginia Sena	Accepted	The table number has been corrected.
888	3	8	507	507	It is written " plasma-based-based" instead of "plasma-based".	Virginia Sena	Accepted	
4910	3	8	508	509	If there are challenges in acquiring data for EFs, it can easily be assumed that the AD that is specific enough for these sources will be extremely hard to acquire. Guidance on AD will be of importance, and if good data/guidance cannot be acquired in time, would it be better to move this section to an annex?	Elsa Hatanaka	Accepted	
4996	3	8	641	645	Guidelines should provide methods and emission factors to calculate emissions with Tier 1 or Tier 2 methods. Inventory calculator has no mandate to demand facilities to measure their emissions.	Päivi Lindh	Noted	The authors further note that the potential concept for Tier 1 and /or Tier 2 methodologies will be proposed as part of future development of guidance.
72	3	8	681	692	Please define the unit of FCi and revise unit of EFi.	Mingshan Su	Accepted	The unit definition has been corrected (Kg).
890	3	8	689	689	The reference to Table 8.4 is not correct. Please include the correct one.	Virginia Sena	Accepted	Corrected

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
4610	3	8	694		m2of??	Kewei Yu	Accepted	Corrected
5588	3	8	71	199	Urban green areas are in the forefront of recent academic researches with plenty of journal publications, books and conference proceeding. As the newest cited document comes from 2013, therefore literature background shall be widened and renewed in order to be up-to-date. Comprehensive review of recent literature in the topic may be needed.	Attila Buzasi	Noted	[Transferred to AFOLU, must be Chapter 8 Volume 4]. Commenter is apparently referring to Volume 4, not Volume 3.
892	3	8	734	734	It is written "Di" instead of "Dk" in the equation.	Virginia Sena	Accepted	Corrected
9608	3	8	820	820	Is it possible to include a table with examples on the p types of processes? This would increase the clarity of the guidelines for users with less experience in this sector.	Raul Salas Reyes	Noted	The authors further note that the potential concept for Tier 1 and /or Tier 2 methodologies will be proposed as part of future development of guidance.
4908	3	8	general		Could all F-gases be expressed both in the chemical formula and the common name? (i.e. CF4 (PFC-14))	Elsa Hatanaka	Accepted	
4912	3	8	Table 8.11		The EF is expressed in grams, but would be more useful if it is in kg or t, since it is rare to have an EF in grams in this sector.	Elsa Hatanaka	Accepted	
4914	3	8	Table 8.12		The EF is expressed in grams, but would be more useful if it is in kg or t, since it is rare to have an EF in grams in this sector.	Elsa Hatanaka	Accepted	
4612	3	Annexes			In Table A1.1, letter case problems for word "issues", "assessment", "transfer fluids", "anode" and others.	Kewei Yu	Accepted	
9648			981	1496	the "2" in CO2 should be made a subscript; overall the text is well written and show almost no errors. Just a few comments on the production of hydrogen; line 1044 the title may be better named as "Reforming Technologies" instead of "Complete Oxidation" as this would make easier to understand and not to confuse with full combustion which does not generate H2 Line 1063: the reader may confuse between gasification in Figure 3.19 and Partial Oxidation in 1090. In fact, Gasification is partial oxidation. Parital oxidation is not endothermic as suggested it is exothermic when oxygen is added to the system, but it requires heat to generate steam which later is used in the water gas shift reaction. Hence, I suggest moving the gasification processes to the Partial Oxidation Section in Line 1090, and keeping line 1044 for the steam reofrming technologies which are endothermic.	Yousef Alshammari	Accepted with modification	[Transferred from AFOLU, must be Chapter 3 Volume 3]. Addressing several comments in one: 1. Accepted. Subscripts changed; 2. Noted; 3. Accepted with modification. Title retained in line 1044, but clarification included in the previuos paragraph saying that oxidation here refers to feedstock carbon and not hydrogen; 4. Rejected. Gasification can be both partial oxidation and complete oxidation (as defined elsewhere in the hydrogen chapter). The water gas shift reaction and PSA completes the oxidation; 5. Accepted. Sentence about endothermic is removed. According to f.ex. https://www.netl.doe.gov/research/coal/energy-systems/gasification/gasifipedia/gasification-chemistry the overall reaction (excl. combustion) is endothermic, but the water-gas-shift-reaction is slightly exothermic.
9650			1072	1072	Equation 1b is not a hydrogen generation reaction and there is no need for this equation. A better euqation to be specified is the water gas shift reaction which follows the reforming of methane (equation 1a) CO+H2O=CO2+H2 and that means equation (1a) should be rewritten as CH4+H2O=CO+3H2 this is followed by the water gas shift CO+H2O=CO2+H2	Yousef Alshammari	Rejected	[Transferred from AFOLU, must be Chapter 3 Volume 3]. The purpose of the equations is to show the conversion from organic carbon into hydrogen (g) and CO2 in stoichiometric terms, and both process emissions and process related combustion emissions are relevant.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors notes
9652			1076	1082	The same comment here as well, equation 2b is not a hydrogen generation reaction, this is combustion and has no relevance, it should be rewritten as a partial oxidation reaction followed by water gas shift, and the same comment for line (1082) equation 3b	Yousef Alshammari	Accepted with modification	[Transferred from AFOLU, must be Chapter 3 Volume 3]. The guidance has been rewritten to say that: "Emissions from combustion should be included only if the fuel is derived from the feedstock."