

Review comments by Experts on First Order Draft of Volume 2 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 note
5644	2	4	247	247	It seems the bullet for this line is missing. Add the symbol of bullet before of: "Seam gas emissions...".	Javier Marcelo Hanna Figueroa	Accepted	
4462	2	4	255		CH4 not methane, be consistent	KEWEI YU	Accepted	
4464	2	4	266		CH4 not methane, be consistent	KEWEI YU	Accepted	
4466	2	4	287		CH4 not methane, be consistent	KEWEI YU	Accepted	
5646	2	4	300	300	Replace "these sources" by "coal gas drainage wells".	Javier Marcelo Hanna Figueroa	Accepted	Accepted to avoid ambiguity. The sentence may be rewritten as under: Fugitive emissions from coal seam gas drainage wells are already counted in Underground and Surface Mining Activities.
5648	2	4	314	314	Table 4.1.1 would benefit of adding a column indicating the availability of default EF (and related gas) at the level of each category/subcategory, as well an indication of the methods available in the Refinement/Guidelines (tier 1, tier 2, tier 3).	Javier Marcelo Hanna Figueroa	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
5650	2	4	314	314	Instead of "Sector name", the heading of the second column should be "Category/subcategory".	Javier Marcelo Hanna Figueroa	Accepted	The heading of the Table column has been changed into "Category/Subcategory".
5652	2	4	327	327	After "other coal mining sources" it would be good to illustrate to what are those sources referred, mention at least two examples.	Javier Marcelo Hanna Figueroa	Accepted	
5654	2	4	349	349	The part of the sentence "augmented during the period" is unclear. To what period are you referring? What is the meaning of amount augmented? Please clarify with clearer language.	Javier Marcelo Hanna Figueroa	Accepted	Accepted to clarify. The sentence has been rewritten as Emission during exploratory borehole drilling may be largely associated to the amount of coal or lignite added to the resources during the reporting period..
4468	2	4	352		lower "global warming", not "greenhouse"	KEWEI YU	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
5552	2	4	368	368	If parts shaded in grey means unchanged text, therefore, "included in the guidelines for the first time" is no longer needed as it was included before.	Marie-Eve Bonneau	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
554	2	4	391	392	It is rather strange to read here implicitly that CO2 could be utilized for energy production or flaring. CO2 does not burn and therefore can not be used as such. I assume that the authors refer to the possibility that CO2 might be present in the mixture of gases fed into a burner or a flare. These lines therefore might need a bit rephrasing. At the same time it could be mentioned that this CO2 then should be reported as originating from energy or from flares.	Tinus Pulles	Accepted with modification	Equation 4.1.2 says that "the amount of CO2 contained in the gas recovered and utilized for energy production or flared" should be taken into account by the subtraction item; it does not imply that CO2 could be utilized for energy production or flaring. In the SOD, Further explanation has been provided in the paragraph just below the Equation 4.1.2, to avoid that kind of misunderstanding.
5554	2	4	392	392	Why "CO2 contained in the gas recovered and utilized for energy production or flared" is subtracted from emissions from underground mining CO2? When recovered and utilized, this CO2 will remain CO2 and will be released. Is it because it is included elsewhere?	Marie-Eve Bonneau	Accepted	Further clarification has been provided in the SOD.
5656	2	4	396	399	The language here needs some elaboration to take into account that equation 4.1.2 also presents CO2. It should be showed the link between CH4 recovered/utilized/flared and CO2 "contained in the gas" recovered/utilized/flared.	Javier Marcelo Hanna Figueroa	Accepted	Further clarification has been provided in the SOD.

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5556	2	4	425	428	Is the source insignificant when compared to not gassy underground coal mines? If the source is significant, consider adding a methodology.	Marie-Eve Bonneau	Accepted with modification	Coal low temperature oxidation is one among other CO2 sources from mining activity and elaborated CO2 EF of includes emissions from coal low temperature oxidation.
5658	2	4	437	437	I am not sure if there is a tier 3 method for CO2 from underground mines. Is it related to measurements? Not aware of this practice and if exist how wide it is spread across the world. Please confirm.	Javier Marcelo Hanna Figueroa	Accepted with modification	Tier 3 method is the direct measurement of CO2 emissions from an underground coal mine ventilation air, based on gas composition and volume flow. Essentially it is the same as a CH4 Tier3 method except utilises the CO2 gas composition. This will be made clearer in the text.
5558	2	4	450	450	Change Ch4 for CH4	Marie-Eve Bonneau	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
53	2	4	473	477	China is mentioned in line 475 but there is no reference for it. The semicolon ";" may be an spelling error.	Mingshan Su	Accepted	Reference added.
5660	2	4	474	477	The meaning of "for the coal mining countries and regions" is unclear, it would be better to indicate "of the following countries". Otherwise looks that EFs have been derived only for those countries and the regions in which they are located. My guess is that the default EFs presented are applicable for any country, without restriction, if no country-specific data available. The references in brackets should not be located after the full stop. Czech Republic should be changed to Czechia as this is the new name of the country (check).	Javier Marcelo Hanna Figueroa	Accepted with modification	After consulting the UN reference for Czech Republic (https://unterm.un.org/UNTERM/Display/Record/UNHQ/NA/4275087d-4018-4082-899d-95f37efeda65), the authors have decided to keep using the long form name.
8998	2	4	485	488	CO2 emission factor (low, ave, high) are representative of whole globe or just few countries in line 476,477	Tiwari Yogesh	Noted	The Tier 1 emission factors are global defaults for application by all countries. A Tier 2 method is also available where countries can develop country-specific emission factors based on data collected from own their coal mines.
9000	2	4	485	488	Unit of emission factor is "meter cube per ton CO2". As its indicator of emission, should it be "ton CO2 per Megawatt"?	Tiwari Yogesh	Rejected	The emission factor unit is cubic metre per tonne of underground coal production.
4158	2	4	485	488	CO2 emissions emission factors are proposed in the new guidelines for underground coal mining. CH4 emission factors of 2006 IPCC Guidelines (IPCC, 2006) are confirmed in the new guidelines. The proposed CO2 emission factors are significantly higher (from 2.6 to 9.1 times) those obtained considering the species profile in coal mine gas by literature data (EMEP/CORINAIR, 2007), 80% of CH4 and 6% of CO2 by volume (Williams, 1993).	Eleonora Di Cristofaro	Accepted with modification	The lower and average CO2 emission factors have been modified and reduced remarkably after representative data from more countries have been taken into account.
5662	2	4	486	488	It would be good to provide some very short information on the conditions given for application of the lower and higher end of the range of the default EF. This comment would be applicable to all EFs provided with a range in the Guidelines (this chapter).	Javier Marcelo Hanna Figueroa	Accepted with modification	The text currently suggests factors that may influence the level of the CO2 emission factor. Guidance will be also be provided for the higher end of the range to indicate that where CO2 outbursts have been frequently observed as a safety issue in mining, then a country should consider the use of the high end emission factor. It is difficult to add further specific guidance for the lower end of the range to that already provided as the lower end can be influenced by many local/coal basin factors. A better understanding of the CO2 levels in underground mines are best gained through sampling and analysis of mine air ventilation flow. The addition of guidance for existing emissions factors currently in the 2006 IPCC Guidelines is outside the scope of this refinement.

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4230	2	4	486	488	Japan estimates the CO2 emission factor (EF) of underground mines by multiplying the volume basis CH4 EF by 0.0088 (see National Greenhouse Gas Inventory Report of Japan, 2017, page 3-72). The CO2 EF could be 0.088 - 0.22 m ³ /t if the default CH4 EF (10 - 25 m ³ /t) and the Japan's factor would be applied. The proposed EF in FOD is 3.5 - 12.3 m ³ /t. The order of magnitude is inconsistent between them. I would appreciate it if the authors would reconfirm the proposed EF. I also take note that Japan's data may not be always representative of global average.	Naofumi Kosaka	Noted	It is noted that Japan's CO2 emission factor is significantly lower than that of other coal mining countries. There is significant inherent variability observed in the CO2 content of coals. In recognising this, the refinement of the IPCC guidelines has also made available a Tier 2 method which provides the flexibility for countries such as Japan can make use of country-specific emission factor, rather than using the Tier 1 default emissions factors.
8762	2	4	492	494	Is there in the data analysed any correlation between CO2 and CH4 emission rates, i.e. could it be assumed that a mine with high CH4 emissions would also have high CO2 emissions? Whether there is a correlation or not, it is relevant that this is mentioned.	Ole-Kenneth Nielsen	Accepted	The text has been modified accordingly; The authors also decided to analyze and address the issue of correlation between CO2 and CH4 emission rates in the Second Order Draft.
5664	2	4	502	502	In accordance with comment above for tier 3 for CO2. If really exist such practice, it would be good to add some words on this and clarify the current technical knowledge.	Javier Marcelo Hanna Figueroa	Accepted with modification	Tier 3 based on directly measured data from coal mines and technical possibility of measurement was known from last century.
4470	2	4	521		25-40%	KEWEI YU	Rejected	The authors have decided to use "percent" in text and "%" in tables.
5560	2	4	553	553	If parts shaded in grey means unchanged text, therefore, "This represents a departure from the previous guidelines" is no longer needed as it was included before.	Marie-Eve Bonneau	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
5564	2	4	577	577	Change (a) to (b)	Marie-Eve Bonneau	Accepted	Has Changed (a) to (b) as (a) corresponds to the first equation inside the box corresponding to EQUATION 4.1.5
5562	2	4	580	580	Change "oxidised" to "flared" to reflect the term used into the equation 4.1.5	Marie-Eve Bonneau	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
4472	2	4	584		Gas? letter case	KEWEI YU	Accepted	Has changed "gas" to "Gas".
5566	2	4	631	633	If parts shaded in grey means unchanged text, therefore, "This is a departure from previous guidelines which suggested that the methane emissions or reductions only be accounted for during the year in which the coal was produced (e.g. the degasification wells were "mined through.")" is no longer needed as it was included before.	Marie-Eve Bonneau	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
4474	2	4	658		better use 50%	KEWEI YU	Rejected	The authors have decided to use "percent" in text and "%" in tables.
4476	2	4	679		flow rates	KEWEI YU	Accepted	Has inserted a space between "flow" and "rates".
4478	2	4	739		CH4 Emission, a space	KEWEI YU	Accepted	Has inserted a space between "CH4" and "Emission".
5570	2	4	750	777	Same sentence 750-751 and 776-777. Suggest to remove one.	Marie-Eve Bonneau	Accepted	Has deleted lines 750-751... The other place makes more sense.
5568	2	4	753	754	Some font size are smaller	Marie-Eve Bonneau	Accepted	Font size of "data reported to the Australian National Greenhouse and Energy Reporting program for years 2009-17 and measurements of gas in Kazakhstan surface mines." has been enlarged to size 10 instead of 9.

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5666	2	4	753	755	It seems that a mention to Japan's reporting/measurements is missing at the beginning of the sentence, because in the brackets there is a reference to the MoE of Japan. Check.	Javier Marcelo Hanna Figueroa	Accepted	Has modified the text accordingly.
5668	2	4	753	755	It would be good to provide some very short information on the conditions given for application of the higher end of the range of the default EF.	Javier Marcelo Hanna Figueroa	Accepted	Guidance has been provided that it is good practice to use the high CO2 emission factor for those mines with overburden depths over 50 meters.
4160	2	4	766	768	CO2 emissions emission factors are proposed in the new guidelines for surface coal mining. CH4 emission factors of 2006 IPCC Guidelines (IPCC, 2006) are confirmed in the new guidelines. The proposed CO2 emission factors are significantly higher (from 4.1 to 10.5 times) those obtained considering the species profile in coal mine gas by literature data (EMEP/CORINAIR, 2007), 80% of CH4 and 6% of CO2 by volume (Williams, 1993).	Eleonora Di Cristofaro	Accepted with modification	The lower and average CO2 emission factors have been modified accordingly!
4232	2	4	766	768	Japan estimates the CO2 emission factor (EF) of surface mines by multiplying the volume basis CH4 EF by 0.0088 (see National Greenhouse Gas Inventory Report of Japan, 2017, page 3-75). The CO2 EF could be 0.003 - 0.018 m ³ /t if the default CH4 EF (0.3 - 2.0 m ³ /t) and the Japan's factor would be applied. The proposed EF in FOD is 0.37 - 0.94 m ³ /t. The order of magnitude is inconsistent between them. I would appreciate it if the authors would reconfirm the proposed EF. I also take note that Japan's data may not be always representative of global average.	Naofumi Kosaka	Noted	It is noted that Japan's CO2 emission factor is significantly lower than that of other coal mining countries. There is significant inherent variability observed in the CO2 content of coals. In recognising this, the refinement of the IPCC guidelines has also made available a Tier 2 method which provides the flexibility for countries such as Japan can make use of country-specific emission factor, rather than using the Tier 1 default emissions factors.
1478	2	4	771	771	To maintain consistency between the methane and carbon dioxide volume to mass conversion factors it is proposed to limit rounding to 2 decimal points, i.e. write 1.84 instead the 1.839 (10 ⁻⁶ Gg m ⁻³)	Michael Gytarsky	Accepted	1.839 has been rounded to be 1.84.
8764	2	4	772	775	Is there in the data analysed any correlation between CO2 and CH4 emission rates, i.e. could it be assumed that a mine with high CH4 emissions would also have high CO2 emissions? Whether there is a correlation or not, it is relevant that this is mentioned. Also, the basis for recommending the lower value for mines with an overburden depth less than 25 meters should be provided including a proper reference.	Ole-Kenneth Nielsen	Accepted with modification	There is no useful correlation between methane and carbon dioxide emission rates for the purposes of estimating tier 1 emissions from coal mining. This is a consequence of the two gases having different origins that may take place at different time scales and periods. Methane is derived from coalification and/or microbial processes whereas carbon dioxide is often derived from magmatic activity at more recent geological periods. The final gas composition is the intergation of those past processes plus the opportunity to escape as a result of surface weathering. A note of the lack of usefule correleation between the gases will be inserted in the text. The basis for reccomending the lower value for mines with overburden less than 25 metres is to align with the existing reccomendation structure for methane in the 2006 Guidleines. Underpinning this assumption is the general understanding that those coal deposits closer to the surface will tend to be of lower gas concentration as a result of interaction with surface weathering processes which provide pathways for gas to escape to the atmosphere over geological time scales.

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5190	2	4	1148	1197	Please clarify the meaning of 'Augmentation of Resource'. Under subchapter 4.1.6.3 Choice of Activity Data (starting at line 1190) the provided description is not clear at all. It would be helpful to provide some examples of potential activities.	Marion Pinterits	Accepted	
8766	2	4	1151	1151	The sentence "Since this information is not readily available in the exploration or any other report." seems to be missing something.	Ole-Kenneth Nielsen	Accepted	The sentence should be modified as "This information is not readily available in the exploration or any other report."
5572	2	4	1151	1151	The following sentence is incomplete : Since this information is not readily available in the exploration or any other report.	Marie-Eve Bonneau	Accepted	The sentence should be modified as "This information is not readily available in the exploration or any other report."
5670	2	4	1151	1153	The sentences starting from "Since this information..." and ending in line 1154, need editorial checking and improvement. It is very unclear the link among the three sentences there. What is the relation among lack of highly technical information around exploration boreholes and updating of an inventory? How updating of an inventory could be part of coal exploration? what is the meaning of annual augmentation of coal resources? There is a clear definition of this term? Please consider carefully these issues and improve the guidance provided, in particular define "annual augmentation of coal resources" and "coal resource" or "resource". This should be made clearly in section 4.1.6.3.	Javier Marcelo Hanna Figueroa	Accepted	The paragraph may be rewritten as "However, annual updating of national inventory of coal and lignite resources is an integral part of exploration for these minerals. Therefore, augmentation of coal resources in a reporting year over that of the preceding year can be easily estimated by subtracting the resources of the current year and that of the preceding year, and may be used as activity data for exploration boreholes. It may not be out of place to mention here that the augmentation of coal resources is the additional resource of coal found during exploration in a reporting year which gives current resource when added to the previous year's resource. Further, the augmentation of coal or lignite resource is linked to the drilling performed in a year and hence to the number of exploration boreholes drilled."
5574	2	4	1152	1152	The following sentence is unclear. Specifying which National Inventory could help. Is it the inventory of coal or lignite resources?	Marie-Eve Bonneau	Accepted	The words "National Inventory" have been replaced with "the national quantity of coal and lignite resources"
8768	2	4	1152	1154	The sentence "However, annual updating of National Inventory is an integral part of coal exploration. Therefore, augmentation of coal resources in a year over that of the preceding year can be easily ascertained and may be used as activity data for exploration boreholes." is very difficult to understand. The first part that annual updating of the national inventory (emission inventory?) is an integral part of coal exploration does not make sense. Also, it is not clear how "augmentation of coal resources" (increase in coal production?) could be used as activity data for coal exploration. This part needs further elaboration.	Ole-Kenneth Nielsen	Accepted	Changes made above against comment number 5670 takes care of comment number 8768 .
1480	2	4	1152	1189	The use of augmentation of coal reserves as an activity data for estimation methane emissions from exploration boreholes may result in overestimation of exploration emissions. This is because not all methane releases from augmentation coalbed through the exploration boreholes. With this, additional justification for the augmentation of coal reserves as the activity data for these particular estimates is required. Otherwise it is recommended to reconcile the activity data proposed for this category source.	Michael Gytarsky	Accepted	Changes made above against comment number 5670 takes care of comment number 1480 .

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5672	2	4	1156	1157	This sentence seems to be incomplete. It looks that a conclusion is lacking after the statement. Is the reason that an EF based on other parameter was not possible to develop (number of [new] mines in a year, production, etc.)? Complete, clarify.	Javier Marcelo Hanna Figueroa	Accepted	The paragraph to be rewritten as "No results are available in the literature on measurement of fugitive emission specifically from coal exploration boreholes. However, emission factors provided below are as per expert opinion. Since the exploration boreholes are filled with water or mud, the hydrostatic pressure on the coal seams encountered will be significant. Accordingly, emission factors for exploration boreholes are supposed to be small compared to those of coal mining.
8774	2	4	1156	1189	It is stated that there are no data available in the literature on fugitive emissions from coal exploration, yet default emission factors are included. This begs the question of how the default EFs have been determined and the validity of them. The assumptions should be made clear to allow for a review of the suggested EFs and if no data are available, it could be considered premature to include a methodology and default EFs without any scientific basis.	Ole-Kenneth Nielsen	Accepted	Changes made above against comment number 5672 takes care of comment number 8774 .
5576	2	4	1160	1160	Lacking what this tier 1 method apply: Coal exploration boeholes fugitive methane emissions	Marie-Eve Bonneau	Accepted	Changed "TIER 1: GLOBAL AVERAGE METHOD" to "TIER 1: GLOBAL AVERAGE METHOD - FUGITIVE EMISSION FROM COAL EXPLORATION BOREHOLES"
8770	2	4	1166	1166	What is meant by "Augmentation of Resource"?	Ole-Kenneth Nielsen	Accepted	Changes made above against comment number 5670 takes care of comment number 8770 .
4234	2	4	1168	1186	I suggest that the authors specify which literatures are cited to determine the default emission factors of coal exploration.	Naofumi Kosaka	Accepted	Text has been added under section 4.1.6.2 "emission factors provided below are as per expert opinion."
8772	2	4	1176	1176	Equation 4.1.15 for tier 2 should be amended to show that it should be summed over the different depth ranges.	Ole-Kenneth Nielsen	Accepted	Equation 4.1.5 has been modified accordingly.
5578	2	4	1176	1176	Lacking what this tier 12method apply: Coal exploration boeholes fugitive methane emissions	Marie-Eve Bonneau	Accepted	Has been addressed in the Second Order Draft.
4480	2	4	1191		activity? Letter case	KEWEI YU	Accepted	The word "Activity" in line 1191 has been changed into "activity".
5674	2	4	1191	1197	Include the definition of "resource", "category-wise net augmentation of quality-wise resource" and "increase of depth-wise resource". How the two last may correspond to higher tiers? Complete.	Javier Marcelo Hanna Figueroa	Accepted	Has been addressed in the Second Order Draft .
8776	2	4	1191	1197	It is still not clear what is meant by "Augmentation of Resource". Should this be interpreted as simply the difference in production between two years? If so, I think that it is unlikely that changes in production would be an accurate proxy for coal exploration. This should be further elaborated.	Ole-Kenneth Nielsen	Accepted	Elaboration made above against comment number 5672.
5580	2	4	1194	1194	Suggest the following equation instead: Augmentation or New Addition = (Resource for a year-mine abandoned during that year) – (Resource for the previous year - mine abandoned during that year)	Marie-Eve Bonneau	Rejected	Emissions are being estimated from exploratory drilling of boreholes and such holes are never made in the command area of an abandoned mine. In fact, drilling through disturbed zone is very difficult due to geotechnical reasons. Secondly, there is no need of coal exploration in the leasehold area of a mine which is going to be abandoned in near future.

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5676	2	4	1198	1203	Commenting on these sections should be possible for experts before Governmental review.	Javier Marcelo Hanna Figueroa	Noted	
4482	2	4	1265		Chapter 8? Letter case	KEWEI YU	Accepted	Has been addressed in the Second Order Draft.
6706	2	4	1280	1323	Clarify how reporters should determine if emissions from co-producing wells belong in Natural Gas Systems or Petroleum Systems.	David Lyon	Accepted	Added footnote upfront and text in the tier 1 EF sections for exploration and production.
8778	2	4	1280	1280	Considering the expansion to reflect town gas and biogas, the chapter should be renamed in order not to just reference oil and natural gas.	Ole-Kenneth Nielsen	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
9912	2	4	1280	1281	The new draft guidance on fugitive emissions from oil and gas systems, particularly unconventional techniques, is critically important for keeping the IPCC GI relevant to changing conditions in this important industry.	Irving William	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
5678	2	4	1287	1287	1.B.2 Fugitive emissions from oil and natural gas systems is to be considered a category and not a subcategory (of the fugitive emissions "category"). In that sense (and undersatnding that the scope of the Refinement is not to do this improvement), the use of terms "category" and "subcategory" should be standardized across all volumes and sectors of the 2006 IPCC Guidelines and the 2019 Refinement. For a time being there is inconsistency in the treatment of these terms across the guidelines.	Javier Marcelo Hanna Figueroa	Accepted with modification	Category, subcategory and segment have been polished throughout the chapter to improve consistency. Text was added to glossary.
1670	2	4	1294	1294	This document mentions NMVOCs, so wouldn't fugitives include these too?	Adam Eisele	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
5582	2	4	1295	1296	Why area fugitive emissions (from oil sands mining mine surface and tailing pond) are not included?	Marie-Eve Bonneau	Accepted with modification	Added a footnote under table 4.2.4, saying the fugitive emission from tailings ponds and the exposed mine surface has included in the Efs of Oil Sands Mining and Ore Processing.
1672	2	4	1297	1297	instead of "deliver", would it be more appropriate to use "transport" or "distribute"?	Adam Eisele	Rejected	Existing language is clear.
10006	2	4	1298	1298	Recommend striking out the phrase "including fugitive emissions from appliances". End-Use emissions should not be aggregated with emissions from operations of natural gas systems. End use emissions, including gas fired appliances, vary widely by country and region. These emissions should be reported separately in a manner consistent with the approach utilized for the use of natural gas for transportation and industry, which are excluded from Distribution emissions.	Miriam Lev-On	Rejected	Emissions from internal piping and leakage of end-use appliances are part of the chain from production to final use. Hence, they have to be reported in the chapter of fugitive emissions.
10008	2	4	1308	1309	Recommned amnding the sentence to read: "... occur at industrial facilities and due to use of gas appliances...". Fugitive Emissions from gas appliances should be included in the Product Use Volume (Volume 3 Chapter 8). Chapter 8 addresses, "Other Produce Manufacture and Use". A NEW subchapter could be developed to include a range of methane emissions from Natural Gas use (in a manner similar to section 8.4 on N2O from product use).	Miriam Lev-On	Rejected	Emissions from internal piping and leakage of end-use appliances are part of the chain from production to final use. Hence, they have to be reported in the chapter of fugitive emissions.

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8780	2	4	1308	1309	This statement is very confusing as for example in the IPPU chapter on metal production there is a reference to this chapter related to emissions from flaring. It should be coordinated between the different sectors (Energy, IPPU and waste) where methodological descriptions and EFs should be presented for flaring in other than oil and natural gas installations, i.e. where is the guidance on estimating emissions from flaring associated with industry (other than oil and natural gas) and waste handling?	Ole-Kenneth Nielsen	Rejected	The scope is clear: oil and gas system.
5680	2	4	1323	1323	Footnote 2: In second line, better use "town gas" instead of "coal gas". In the first line, it should read "a manufactured gaseous fuel", instead of "fuels".	Javier Marcelo Hanna Figueroa	Accepted	Text was replaced.
1674	2	4	1327	1327	Should working losses be added here?	Adam Eisele	Accepted	Revised text to show that working losses are included.
1676	2	4	1328	1329	Suggest using "..., while leak emissions are unintentional (or uncontrolled)"	Adam Eisele	Accepted	
10010	2	4	1352	1360	Recommend adding here that there is a distinction between hydraulic fracturing practices - such as the use of reduced emissions completions - in different countries that greatly impact the atmospheric emissions associated with unconventional completions.	Miriam Lev-On	Accepted	Added text.
10012	2	4	1360		Recommendations for revision or insertion of new terms will be provided below as part of the comments to the Annex of Terms.	Miriam Lev-On	Noted	
4236	2	4	1362	1369	Figure 4.2.1 is very user-friendly.	Naofumi Kosaka	Noted	
5682	2	4	1363	1368	In both of these figures under Figure 4.2.1, it would be good to show for each of the segment with small arrows the occurrence of fugitive, flaring and venting emissions with showing the gases involved. These is clear needed in accordance with the heading of the figure. Replace "petroleum" by "oil" in the titles.	Javier Marcelo Hanna Figueroa	Accepted with modification	The figure title change to match caption has been addressed in the Second Order Draft, as it was difficult to illustrate "occurrence of emissions and gases involved" within the figure Accepted change of "petroleum" to "oil".
5684	2	4	1363	1364	Under the distribution segment, you may delete "evaporative losses" as you are showing more the activities in the chain and not this type of losses that may occur also in othe segments. Under the refining segment, change "lubes" by "lubricants",a sthis the term used elsewhere in the guidelines.	Javier Marcelo Hanna Figueroa	Accepted with modification	Evaporation is dominant in this part and should remain, as it is included in Table 4.2.15. Changed "lubes" to "lubricants".
10014	2	4	1366	1367	Figure 4.2.1 should be amended since sources in the natural gas systems should not include leakage from end users. As such, distribution emissions should only include vents and leaks associated with distribution pipelines but not those that occur at the customer side when using gas appliances.	Miriam Lev-On	Rejected	Both should be included; by definition IPPU sector includes GHGs from industrial processes, use of GHGs in products (specifically, F-gases), and non-energy use of fossil fuels. Therefore, natural gas appliances do not fit in IPPU sector because it is an energy use of fossil fuels.
5686	2	4	1367	1368	Delete the green CCS arrow, it is not related to the natural gas chain.In the distribution segment, delete the lower part of the picture (Not included) as it is irrelevant. You may keep the power plant and the industry icons to be connected to the distribution network of the upper figure. In the upper figure you better show a distribution gas network (with houses and others), together with the appliances shown. No need to put the word "Included" and instead of "fugitive emissions past city gate" simply indicate "distribution network past city gate".	Javier Marcelo Hanna Figueroa	Accepted with modification	Kept the qualifying statement "not included" for clarity; deleting it may be more confusing. Added a "distribution gas network" between houses/factories/appliances. Adopted wording "distribution network past city gate".

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
4484	2	4	1373	1374	formation of	KEWEI YU	Rejected	The correct terminology is "formation CO2".
2364	2	4	1381	1381	Starter motors on compressors engines are not considered pneumatic devices in the same sense as a pneumatic controller or chemical injection pump. Classifying starter motors in the same group as pneumatic controllers could lead to inappropriate application of pneumatic controller emission factors.	FIJI GEORGE	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
1682	2	4	1396	1397	Should this sentence include waste gas characteristics such as energy content (HHV)?	Adam Eisele	Accepted with modification	Revised as: The decision on whether to vent or flare depends largely on the amount and energy content of the gas to be disposed of and the specific circumstances (e.g., public, environmental and safety issues as well as local regulatory requirements) (line 1395-1397).
2362	2	4	1399	1400	The statement "Waste gas volumes are usually vented on gas transmission systems and may be either vented or flared on gas distribution systems..." is incorrect. Transmission pipeline systems may have flares at the compression stations. It is very rare to have a flare on a gas distribution pipeline or station.	FIJI GEORGE	Accepted	"flaring" is deleted.
6704	2	4	1413	1420	Provide more information about O&G CH4 emission assessment issues. For example, component-level measurements tend to underestimate site-level emissions due to issues such as inaccessible or difficult to measure sources.	David Lyon	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
5688	2	4	1430	1432	Please check carefully the language in this sentence, as it could be interpreted as a deviation of the general principles established in the decision trees for methodological choice. Remember that the recommended disaggregation for the key category analysis is oil, natural gas and venting/flaring, so no segments (subcategories) are mentioned. Therefore, figures 4.2.2, 4.2.3 and 4.2.4 accordingly should be carefully revised or made consistent, in particular the diamond where it is asked if the oil and gas operations are key category. In addition is necessary to define the term "significant" contribution (first time appears in line 1443). The language identified here can be seen as contradicting other parts of the text of the guidance (e.g. line 1541).	Javier Marcelo Hanna Figueroa	Accepted with modification	Clarified the language to be clear that compilers may apply different methodological tiers to different subcategories and segments within categories. (line 1429-1430, p.4.42). Throughout, clarified the language to be consistent on the definitions of subcategories and categories. The remainder of the comment is on text that was not changed from the 2006 GL and therefore is out of scope of the refinement.
5690	2	4	1435	1450	Same comment as above.	Javier Marcelo Hanna Figueroa	Rejected	The CRF tables clearly distinguish between the segments so it is appropriate to note that here.
2366	2	4	1439	1440	Abandoned wells are called out in the same manner as crude oil production and natural gas production. This seems inappropriate. Abandoned wells should be treated as an emission source under crude oil production and natural gas production.	FIJI GEORGE	Rejected	Emissions from abandoned wells are not a part of producing activities. It occurs when producing activities are completed.
5692	2	4	1464	1464	Replace "petroleum" by "oil".	Javier Marcelo Hanna Figueroa	Accepted	
5694	2	4	1468	1487	In figures 4.2.2, 4.2.3, 4.2.4 and 4.2.5 define in footnote "significant".	Javier Marcelo Hanna Figueroa	Rejected	Framing is consistent with 2006 GL.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
2368	2	4	1484	1486	Abandoned wells are called out in the same manner as crude oil production and natural gas production. This seems inappropriate. Abandoned wells should be treated as an emission source under crude oil production and natural gas production.	FIJI GEORGE	Rejected	Emissions from abandoned wells are not a part of producing activities. It occurs when producing activities are completed.
1482	2	4	1485	1486	Correct the second step in decision tree to replace "Yes" with "No" in the vertical path line	Michael Gytarsky	Accepted	
2290	2	4	1485	1486	Figure 4.2.5: There seems to be a mistake in the text in the third choice box. The text is "If emissions from abandoned wells are a key category, are contributions from abandoned wells significant". It is suggested that the text should like be "If emissions from oil and gas operations are a key category, are contributions from abandoned wells significant"	Vigdis Vestreng	Rejected	The sentence is consistent with 2006 IPCC GLs (e.g. decision trees in Fig.4.2.2-4.2.4 use the same language).
8782	2	4	1485	1486	The first box of the decision tree only has 'yes' options to proceed.	Ole-Kenneth Nielsen	Accepted	
8784	2	4	1485	1486	The sentence "If emissions from abandoned wells are a key category, are contributions from abandoned wells significant?" does not make sense.	Ole-Kenneth Nielsen	Rejected	The sentence is consistent with 2006 IPCC GLs (e.g. decision trees in Fig.4.2.2-4.2.4 use the same language).
5696	2	4	1486	1486	In the box, correct "Tier 2".	Javier Marcelo Hanna Figueroa	Accepted	
2370	2	4	1498	1507	The subscript "gas" needs to be defined as CO2, CH4, or N2O.	FIJI GEORGE	Rejected	This comment is on text that was not changed from the 2006 GL to the 2019 refinement, and is therefore out of scope.
10016	2	4	1534	1535	In Table 4.2.1 Consumer appliances should not be part of Gas Distribution segment	Miriam Lev-On	Rejected	Emissions from internal piping and leakage of end-use appliances are part of the chain from production to final use. Hence, they have to be reported in the chapter of fugitive emissions.
9614	2	4	1534	1535	I support the addition of "Liquefied Natural Gas" in Table 4.2.1. However, I think it is better to rename "Liquefied Natural Gas Supply" (or "Liquefied Natural Gas System", etc.) in order to be consistent with the names of other industry segments. The rule of naming seems to be product + segment (e.g. gas exploration).	Naofumi Kosaka	Accepted	Agree, changed to "system".
9914	2	4	1534	1534	Table 4.2.1 has useful updates to industry segments and sources. Consider a short text box example on the Aliso Canyon leak to illustrate "Other: anomalous leak events"	Irving William	Accepted	Added example to table 4.2.1
5698	2	4	1534	1535	Recognizing the value of the new figures (4.2.1) showing graphically the segments of the industry, it seems that still is needed the definitions of categories and subcategories that are presented in Table 4.2.1 of the 2006 IPCC Guidelines (this is implemented but in limited manner, e.g. for gas exploration). These definitions are really fundamental and necessary to have in the 2019 Refinement in tabular format. In addition, the revised table 4.2.1 would benefit of adding a column indicating the availability of default EF (and related gas) at the level of each category/subcategory, as well an indication of the methods available in the Refinement/Guidelines (tier 1, tier 2, tier 3).	Javier Marcelo Hanna Figueroa	Accepted with modification	See comment No.5678.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
4486	2	4	1565		good practice in italic	KEWEI YU	Accepted	
6708	2	4	1571	1577	Reporters should validate that GOR values are based on gross production (e.g., pressurized liquid sample from separator). If GOR is based on marketed production, then it could underestimate emissions from associated gas venting.	David Lyon	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
4488	2	4	1575		m3/m3, superscript	KEWEI YU	Accepted	
2372	2	4	1595	1597	Equation 4.2.5 should include a term for the flare efficiency. As written, it assumes flaring is 100% efficient, which is not correct.	FIJI GEORGE	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
2374	2	4	1595	1597	The units conversion factor for Equation 4.2.5 is incorrect. It should be 42.3×10^{-6} as used in Equations 4.2.3 and 4.2.4	FIJI GEORGE	Accepted	This error has been delt with following the IPCC Error Protocol apart from the development of the 2019 Refinement. See 10th Corrigenda for the 2006 IPCC Guidelines. https://www.ipcc-nggip.iges.or.jp/public/2006gl/corrigenda10.html
6710	2	4	1624	1626	0.98 is too high for a default production flaring destruction removal efficiency (DRE). For example, Gvakharia et al 2017 reports that Bakken flares had a median DRE of 0.97. They state that using 0.98 would overpredict methane destruction due to the positively skewed distribution of individual flare DREs.	David Lyon	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
556	2	4	1672	1990	Without studying the proposed tier 1 Efs in detail, I noted that for very many of these three significant digits are provided, where at the same time relatively large uncertainty intervals are proposed and in many cases not provided (yet; TBD). Providing three significant digits ofr such EFs might therefore be not very appropriate and suggesing a higher precision (lower uncertainty) than is defensible. I propose that the authors revisit these proposed EFs and limit the precision in their values to a number of significant digits that reflects the uncertainty. In most cases I feel that one significant digit would be enough.	Tinus Pulles	Accepted with modification	Changed the number to scientfic format in case the number having several "0" (for example, 0.00003 to 3×10^{-5}).
5700	2	4	1680	1698	Here it should be a clear reference and explanations leading to to Annex 4A.2, where are presented the % emissions that are leaked, vented, and flared in the data sets used for the Tier 1 EFs. Because this change (aggregated EFs) represents a significant structural change in the reporting, in particular under the UNFCCC for Annex I Parties, the guidance should be very clearly included and at the beginning of the section on default EFs. the reasons for this new approach should be provided, showing a qualitative positrive change. Also, some words on the change from presenting two sets of default EFs, one for developed countries and another for developing countries and EITs in the 2006 IPCC Guidelines to the current presentation in the 2019 Refinement should be transparently discussed.	Javier Marcelo Hanna Figueroa	Accepted	We provided text on leak/vent/flare discussion, and point to the an example for how to calculate leak/vent/flare disaggregation in annex 4A.2. We provided discussion on how factors are technology or practice-specific.
9916	2	4	1682	1684	Qualify the statement about only certain basic types of statistics being consistently available, by adding "...in some/many countries."	Irving William	Accepted with modification	Added text "...in many countries".
8786	2	4	1692	1696	Why has the NMVOC EFs not been updated using the correlations provided?	Ole-Kenneth Nielsen	Accepted with modification	Developed values for NMVOCs using ratios with Ch4 from 2006 GL.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
4238	2	4	1694	1694	I suggest that the authors replace "values for CH4" by "values for NMVOC". This line is related to discussion on NMVOC.	Naofumi Kosaka	Rejected	Text irrelevant in SOD; deleted.
4240	2	4	1694	1694	I suggest that the authors replace "buy" with "by".	Naofumi Kosaka	Rejected	Text irrelevant in SOD; deleted.
1690	2	4	1695	1695	"buy" should be "by"	Adam Eisele	Rejected	Text irrelevant in SOD; deleted.
7152	2	4	1695	1695	replace 'buy' with 'by'	Amanda Penistone	Rejected	Text irrelevant in SOD; deleted.
10018	2	4	1695		Text should read "by assuming" and not "buy assuming"	Miriam Lev-On	Rejected	Text irrelevant in SOD; deleted.
1484	2	4	1723	1723	After the first sentence in line 1723 the following text is proposed for inclusion: "In some countries, the associated petrol gas annual production data are also available. If available, the annual associated gas production is an optimum activity data that can be used for estimation of emissions from oil exploration and the elaboration of relevant emission factors."	Michael Gytarsky	Rejected	Efs related to associated petrol gas are only available in few countries. Therefore, we try to link the EF with AD that more broadly available in most countries.
54	2	4	1732	1733	The subscript of the variables in Equation is too long. It is better to have same format as Equation 4.2.7.	Mingshan Su	Rejected	The full subscripts help to clarify what is included in each segment calculation.
2376	2	4	1733	1734	The reference "EPA analysis (2015)" is not included in the reference list.	FIJI GEORGE	Accepted	Added.
8790	2	4	1733	1734	Footnote d refers to gas exploration while Table 4.2.3 only covers oil production.	Ole-Kenneth Nielsen	Accepted	Fixed.
55	2	4	1733	1734	The format of Table 4.2.3 is not good. The Part of table in Page 4.55 just have first 2 rows.	Mingshan Su	Accepted	
8788	2	4	1733	1734	Is there a difference between onshore and offshore emissions that should be reflected? E.g. are the EFs for conventional oil production equally applicable to both onshore and offshore production? This should be clarified. The third set of EFs for conventional production mentions onshore, but the first two sets do not. If no emissions are expected from offshore production this should be mentioned in the text.	Ole-Kenneth Nielsen	Rejected	1) The comment is unclear on which table is referred to. 2) The Efs listed in table 4.2.4 (assuming the reviewer commencing on this table) provides Efs by on shore and off-shore. Due to the data availability, the Efs for off-shore is less detailed than on-shore.
8792	2	4	1733	1734	N2O emissions are in many cases listed as NA (Not applicable). However, it seems illogical that N2O is applicable when using one type of AD (oil production) but not when using wells drilled or well population. This should be clarified.	Ole-Kenneth Nielsen	Accepted with modification	Data revised.
1488	2	4	1734	1734	Table 4.2.3, footnotes a to c: The rationale for the use of implied emission factors as a proxy for default emission factors in Table 4.2.3 has not been sufficiently justified. The authors should justify the proposal to use the implied emission factors as the default emission factors for oil exploration in Table 4.2.3.	Michael Gytarsky	Rejected	The source of many EF in IPCC GL are implied EF, no need for additional justification.
6712	2	4	1734	1734	Will oil well completion EFs be updated in the near future with USEPA GHGRP data?	David Lyon	Rejected	Only one year of data are available and these have not yet been assessed for use in national inventories.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
1486	2	4	1734	1734	Table 4.2.3: It is not clear from Table 4.2.3 and corresponding text what emission sources are accounted for and how these sources correspond to the emission sources in the 2006 IPCC Guidelines. Further, it should be clarified, for what time period the emission factors have been provided in Table 4.2.3 (year, month, etc.). Furthermore, the authors should clarify, if the same emission factor referred to in table 4.2.3 is to be applied for each emission category (and the emission estimates derived should be subsequently summarised). Otherwise the emission factors in table 4.2.3 represent the aggregation of few emission categories (operations) referred to in 2006 IPCC Guidelines (for example, drilling, testing and servicing operations for oil wells, because in practice emissions from particular operation cannot be separated). However, in case of aggregation of few operations, the authors should indicate the operations aggregated to ensure the completeness and avoid underestimations. It is recommended that the authors provide the links to tables 4A.2 and 4A.3 and the method for estimation the emission factors using the tables 4.2.3, 4A.2 and 4A.3.	Michael Gytarsky	Accepted with modification	Changed the headlines of table 4.2.3 and other tables. Category into sub-category, sub-category into segments/operations; The 2019 refinements will replace the fugitive emission context in 2006 GLs. In segment of oil exploration, guidance will not go in-depth to drilling, testing and servicing operation which are hard to be separated as the reviewer commented as well, EFs would be applied to the whole segment. The operations included are now clarified in the notes under table 4.2.3. EFs are for the period of year for all sources. This was clarified in the text. Cross-reference to table 4.2.3 and 4A.2 is provided in the text. Table 4A.3 is for refineries and is not relevant for exploration.
1490	2	4	1744	1744	After the end of the sentence in line 1746 (before the sentence starting from "Where this information..."), the following text is proposed for inclusion: "If the associated petrol gas annual production data are available, it can be used for estimation emissions from oil production and upgrading and the elaboration of relevant emission factors to these category sources."	Michael Gytarsky	Rejected	See comment No.1484.
56	2	4	1774	1774	The subscript of the variables in Equation is too long. It is better to have same format as Equation 4.2.7.	Mingshan Su	Rejected	The full subscripts help to clarify what is included in each segment calculation.
57	2	4	1776	1777	The format of Table 4.2.4 is not good. The Part of table in Page 4.59 just have first 2 rows.	Mingshan Su	Accepted	
1492	2	4	1776	1777	Table 4.2.4: It is not clear from Table 4.2.4 how the proposed emission factors should be used. Do the authors propose to use both emission factors? Furthermore, the guidance should be provided on the choice of emission factor, if both activity data sets exist and are available. For example, the guiding principle for such choice could be the difference in the uncertainty. It is recommended that along with provision of links to Table 4A.2 the calculation method is provided that would describe the use of the values in tables 4.2.4 and 4A.2.	Michael Gytarsky	Accepted with modification	The SOD discusses the options available, but choice is up to compiler's judgement.
8796	2	4	1776	1777	Considering that there is a requirement to report emissions from flaring separately, it should be considered to present EFs as fugitive EFs and flaring EFs in the main chapter rather than in the annex.	Ole-Kenneth Nielsen	Rejected	The tables are unreasonably long if we include all of this information in the main body.
1494	2	4	1776	1777	Table 4.2.4, footnotes a to d: So far as the IPCC 2019 Refinement is aiming at verification and, if necessary, correction of the default emission factors in the 2006 IPCC Guidelines, the rationale for keeping the same values of default emission factors for N ₂ O and NMVOCs should be sufficiently justified in the footnotes a to d, Table 4.2.4	Michael Gytarsky	Accepted with modification	We have updated the NMVOC values to be consistent.
8794	2	4	1776	1777	In some cases Table 4.2.4 presents ranges, e.g. 0.54-0.74 for N ₂ O. A single value should be provided or further guidance to users on how to choose an EF.	Ole-Kenneth Nielsen	Accepted with modification	Added a footnote for clarification (see comment No.8792).

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
1496	2	4	1785	1786	Table 4.2.5, footnotes a, b and d: So far as the IPCC 2019 Refinement is aiming at verification and, if necessary, correction of default emission factors in the 2006 IPCC Guidelines, the rationale for keeping the same values of default emission factors for N2O and NMVOCs should be sufficiently justified in the footnotes a, b and d, Table 4.2.5.	Michael Gytarsky	Accepted with modification	We have updated the NMVOC values to be consistent.
2292	2	4	1785	1786	Table 4.2.5: Emission factors for offshore oil loading are given with reference to the Norwegian GHG Inventory. The periods chosen for the estimated factors are not uniform with respect to VRU use, and we do not recommend this use of the inventory. Please do also check the conversion from the original inventory data.	Vigdis Vestreng	Accepted with modification	Changed to: without VRU: 1990-2002; with VRU: 2003-2015; adding the word of "average" (In NIR 2017 of Norway, it says: Since year 2000 an increasing share of the shuttle tankers have had installed vapor recovery units (VRU), from 2003, Emissions, activity and emissions factors with and without VRU are reported)
5098	2	4	1787	1794	This chapter includes all refining emissions (leaks, venting and flaring). Emissions from combustion processes are reported in the stationary combustion sector (1.A.1.b). However, some important emission sources are still missing: hydrogen production (process related emissions), calcination and catalyst regeneration. They are mentioned in line 1790 regarding methane but not in terms of CO2. There is a reference from volume 3 chapter 3 to 1.B.2.iiii 4 in cases where hydrogen is produced as a by-product in refineries. But there is no methodical description available in the 1.B sector. Calcination is also a production process and insofar no venting, no flaring and no leakage in the proper sense (since the flue gas usually takes the correct way through the chimney). The exhaust heat from Catalyst regeneration is normally used for refinery processes. In some countries the catalyst material is reported as own consumption of pet coke in the energy statistic. However, often data is not complete and there is no methodical description for stationary plants in 1.A. I would suggest to open source category 1.B for other processes than leaks, venting and flaring in order to address these missing emission sources. It wouldn't be recommendable to add a new subcategory in the IPPU sector for the Refinery process emissions. Currently it's possible to aggregate emissions from source category 1.A.1.b and 1.B.2.iiii 4 in order to get the sum of all refinery emissions. An additional subcategory under IPPU would complicate the work of inventory compiler and review experts. Therefore I would suggest to add some methodical descriptions for hydrogen production, calcination and catalyst regeneration in the Guideline Chapter 2, volume 4 (1.B.2.iiii 4). Data is available from EU ETS. Otherwise these emissions are missing. (These sources are more relevant than all flares, venting and leakage activities together.) In the broadest sense all emissions from the mentioned production processes can be considered as leaks, if a renaming of this source category is impossible.	Kristina Juhrich	Accepted with modification	Regarding emissions from H2 production, a documentation box where to report was included. Methodical description are provided under the new hydrogen chapter under IPPU. Calcination has to be reported under 1.B.2.iv - the EF includes emissions from that process. Emissions from catalyst regeneration are mainly triggered by combustion and should be reported under 1.A.1.b. Renaming the category is out of scope.
10038	2	4	1788	1792	Recommend including here a citation to the 2009 API Compendium for a description of the refining sector (Section 2.2.8) and elaboration of GHG estimation for GHG emissions from refinery sources including process vents (section 5.0) and fugitive emissions (section 6.0).	Miriam Lev-On	Rejected	The existing definition on refining segment is not different from what says in 2009 API. However, the definition in 2019 Refinements on fugitive emission is different with that in API. In 2019 Refinements, fugitive emission includes leaks, processing venting and flaring, however, in API it only means leaks.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
8798	2	4	1793	1794	Does the EFs presented include emissions from flaring? If so, it would be useful to have the EFs separately since flaring emissions are reported separately. If flaring emissions are not included, there should be presented default EFs for flaring in refineries.	Ole-Kenneth Nielsen	Rejected	It will be possible for compilers to calculate this information using annex 4.A. The text was edited to make clearer the link to annex 4.a here.
5702	2	4	1811	1811	Replace "petroleum" by "oil".	Javier Marcelo Hanna Figueroa	Accepted	
558	2	4	1839	1840	Table 4.2.8 provides ranges for the tier 1 Efs for CH4 and an uncertainty range expressed in as many as 4 significant digits. These values are in my view not very helpful for users that are obliged to use a tier 1 method. Such users do not have additional information, so they cannot decide which value to use. A solution might be to provide the arithmetic mean (SQRT((lower value)*(higher value))) as the most probable default value and determine the uncertainty range from the range provided. I feel that it would be quite defensible to interpret the lower and higher values of this range as (close to) the boundaries of the uncertainty range.	Tinus Pulles	Accepted with modification	Uncertainty values and EFs were updated to use information from Townsend-Small et al.
9622	2	4	1839	1840	I suggest that the authors replace "unplugged" with "plugged" in units of measure for plugged onshore subcategory. I suggest that the authors replace "plugged" with "unplugged" in units of measure for unplugged onshore subcategory.	Naofumi Kosaka	Accepted	
9624	2	4	1839	1840	I suggest that an emission factor (EF) is determined as a single value and range is incorporated into uncertainty. Currently, the EF for plugged onshore is 0.02-3.13 kg/well with 62.22% uncertainty. For example, it could be 1.58 (median of the upper and lower range) with uncertainty of 100% (=100*(3.13/1.58-1)) or more (62.22%).	Naofumi Kosaka	Accepted with modification	The SOD includes single EFs provided from Townsend-Small et al. study.
9626	2	4	1839	1840	The CH4 emission factor (EF) for oil exploration is 1.47 kg/well and the EF for onshore production is 2-3 t/well according to Table 4.2.3 and 4.2.4. The order of magnitude is the same between the EF for plugged onshore abandoned wells in Table 4.2.8 and the EF for oil exploration. The EF for unplugged onshore abandoned wells is between the EF for oil exploration and the EF for onshore production. If the authors consider the magnitude is reasonable, it is no problem.	Naofumi Kosaka	Rejected	The values and its units are not correctly reflected in the comment.
6714	2	4	1840	1840	Providing two emission factor options for abandoned wells is confusing. Have you considered combining the Kang et al and Townsend-Small et al datasets to calculate a single emission factor? If both factors are provided, then provide more guidance about how to choose which is most appropriate for specific regions or well types.	David Lyon	Accepted with modification	The SOD includes single Efs provided from Townsend-Small et al. study.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
35	2	4	1841	1859	A good, clear explanation of approaches with hydraulic fracturing well covered. However, the scope of unconventional gas exploitation is changing rapidly. Commercial exploitation of methane clathrates is now a real possibility, with successful trials having been conducted. I realise that there is very large uncertainty as to what the fugitive emissions from such methane clathrate exploitation would be, but wonder if it could at least be noted as an activity to note in national reporting (i.e. level of activity) so that future accounting where we have a useable emissions factor can then also estimate historical emission from this source. More generally, it would be useful for the IPCC EF panel to examine this emerging area and begin to assemble emission estimates.	David Reay	Rejected	No action can be taken because comment is out of scope of 2019 Refinement.
58	2	4	1860	1861	The subscript of the variables in Equation is too long. It is better to have same format as Equation 4.2.7.	Mingshan Su	Rejected	The full subscripts help to clarify what is included in each segment calculation.
1498	2	4	1862	1863	Table 4.2.9: It is not clear from Table 4.2.9 and corresponding text, what emission sources are accounted for and how these sources correspond to the emission sources in the 2006 IPCC Guidelines. Further, it should be clarified, for what time period the emission factors have been provided in Table 4.2.9 (year, month, etc.). Furthermore, the authors should clarify, if the same emission factor referred to in table 4.2.9 is to be applied for each emission category (and the emission estimates derived should be subsequently summarised). Otherwise the emission factors in table 4.2.9 represent the aggregation of few emission categories (operations) referred to in 2006 IPCC Guidelines (for example, drilling, testing and servicing operations for gas wells, because in practice emissions from particular operation cannot be separated). However, in case of aggregation of few operations, the authors should indicate the operations aggregated to ensure the completeness and avoid underestimations. It is recommended that along with provision of the links to Table 4.A.4 and 4A.5, the calculation method is provided that would describe the use of the values in tables 4.2.9, 4A.4 and 4A.5.	Michael Gytarsky	Rejected	Calculation methods are provided and the Efs are annual as are all in the IPCC GL.
8800	2	4	1862	1863	Is there a difference between onshore and offshore emissions that should be reflected? E.g. are the EFs for conventional gas production equally applicable to both onshore and offshore production? This should be clarified. The second set of EFs for conventional production mentions onshore, but the other sets do not. If no emissions are expected from offshore production this should be mentioned in the text.	Ole-Kenneth Nielsen	Accepted with modification	No data are available on emissions from offshore exploration, therefore this category cannot be added. It is unlikely that there are significant emissions from exploration for offshore. We overlooked adding text on offshore exploration and can do so for the final draft.
8802	2	4	1862	1863	N ₂ O emissions are in many cases listed as NA (Not applicable). However, it seems illogical that N ₂ O is applicable when using one type of AD (gas production) but not when using wells drilled or well population. This should be clarified.	Ole-Kenneth Nielsen	Accepted	Added N ₂ O values.
8804	2	4	1862	1863	In some cases Table 4.2.9 presents ranges, e.g. 0.07-1.10 for N ₂ O. A single value should be provided or further guidance to users on how to choose an EF.	Ole-Kenneth Nielsen	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
10020	2	4	1862	1863	In Table 4.2.9 Footnote (a) - EFs for gas well completions from the average of 2006-2010 data are outdated, though they could be used for uncontrolled gas well completions outside of the U.S. Newer data (2013-2016) from the U.S. GHG reporting program is available for both controlled and uncontrolled unconventional completions.	Miriam Lev-On	Rejected	The years 2006-2010 represent a better average value for uncontrolled completions. In year 2011 and after, most well completions in the data set were required to use controls, which would make the uncontrolled population not representative of average uncontrolled populations but of the small unregulated population.
10022	2	4	1865	1866	Recommend separating the Production segment from Gathering and Boosting one due to the potential difference in ownership profile and data sources.	Miriam Lev-On	Rejected	Not possible to separate them due to the category numbering, but the 2019 refinement does include a separate input value for gathering for the first time.
10024	2	4	1868	1868	It is especially important to estimate emissions from gas compressing (boosting) operations, which are essential to gathering operations, and should be included in the list of sources from such operations.	Miriam Lev-On	Accepted with modification	Added text to note that compressors are included in gathering and boosting.
4086	4	2	1869	1870	Recommend that the order of the sentence be flipped to conform with the order of the natural gas systems value chain. In other words, sentence should read: "The gathering and boosting stations receive natural gas from production sites and transfer it, via gathering pipelines, to processing facilities or transmission pipelines..."	Mark de Figueiredo	Accepted	Edited.
4088	4	2	1870	1870	Recommend deleting the parenthetical because the wording is awkward. Custody transfer meters are not used to segregate gas; rather, they track the flow of gas from one owner to another. Also, some vertically integrated companies may conduct both production and processing, in which case there would not necessarily be a transfer of custody of the gas.	Mark de Figueiredo	Accepted	Deleted.
59	2	4	1891	1892	The format of Table 4.2.10 is not good. The Part of table in Page 4.70 just have first 2 rows.	Mingshan Su	Accepted	
6716	2	4	1891	1892	Based on my calculations, the Tier 1 onshore production EFs are equivalent to: low emissions technology = 0.48 kg/h/well = 0.45% production-normalized loss rate, high emission technology = 0.78 kg/h/well = 0.73% production-normalized loss rate. There is growing evidence from empirical site-level and basin-level data that the underlying data from the EPA GHG Inventory underestimates production sector emissions. Several published papers report average U.S. well pad emission rates that exceed the low and high emission technology EFs, including Omara et al 2016, Robertson et al 2017, and Zavala-Araiza et al 2017. The EFs should be updated to incorporate recent site-level measurement studies, or at least mention that the studies indicate the EFs are conservatively low.	David Lyon	Rejected	Chapter 4.2 provides information on difficulties and considerations (including measurement issues) for quantifying emissions from oil and natural gas systems (see Methodological Issues).
8806	2	4	1891	1892	Considering that there is a requirement to report emissions from flaring separately, it should be considered to present EFs as fugitive EFs and flaring EFs in the main chapter and not only in the annex.	Ole-Kenneth Nielsen	Rejected	The tables are unreasonably long if we include all of this information in the main body.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
10026	2	4	1891	1892	In Tabel 4.2.10 footone (d): the use of data from Marchese et. al. 2015 is not applicable for global Tier 1 EFs for gathering. Marchese data is hardly representative of U.S. gathering operations and should not be extrapolated globally.	Miriam Lev-On	Rejected	Other data are unavailable.
1692	2	4	1896	1896	In this line, should "uncombusted methane" also include uncombusted NMVOCs? If there is uncombusted methane present through slip, there is likely other uncombusted NMVOCs which also may be products of incomplete combustion. NMVOCs are also mentioned in other parts of this chapter	Adam Eisele	Accepted with modification	Edited to "uncombusted gas".
2378	2	4	1916	1917	The CO2 emission factors in Table 4.2.11 appear to be very low when compared to emissions from EPA's 2017 national inventory report	FIJI GEORGE	Rejected	This is because they do not include acid gas removal. For countries with acid gas removal, they must add the sour gas/acid gas removal estimate. Clarifying text added
10028	2	4	1924	1925	Recommend citing the API LNG document as a resources for description of LNG sector and calculation methodology, "Liquefied Natural Gas (LNG) Operations: Consistent Methodology for Estimating Greenhouse Gas Emissions", Version 1.0, API, Washington DC, May 2015	Miriam Lev-On	Accepted	Sentence now reads "This source also includes LNG stations and import and export terminals; further details on the LNG sector can be found in Liquefied Natural Gas (LNG) Operations: Consistent Methodology for estimating Greenhouse Gas Emissions (API, 2015). " Also added reference to EndNote.
1500	2	4	1925	1925	After the end of the sentence in line 1925 (before the sentence starting from "Where this information..."), the following text is proposed for inclusion: "For some countries, length of transmission pipelines and annual gas transmission totals may be available. Each of these data can be used for estimation the emissions from natural gas transmission within the country and the elaboration of relevant emission factors."	Michael Gytarsky	Rejected	These information are already provided in the GL.
8808	2	4	1925	1930	Two sets of EFs are presented for natural gas transmission. The text states that when there are limited or no leak detection and little use of centrifugal compressors then the EF using gas throughput should be used, while for systems with leak detection and centrifugal compressors with dry seals, the EF using length of pipeline should be used. It would be very helpful to include the reasoning behind this assertion. Also, the CH4 EF seems to be considerably higher than the value in the 2006 IPCC GL (1.3 tonnes per 10 ⁶ m3 vs. 0.8 tonnes per 10 ⁶ m3 (highest value from 20016 IPCC GL including both venting and fugitives). Any substantial changes should be addressed.	Ole-Kenneth Nielsen	Rejected	The tables would be very large if we included this in the main body.
10030	2	4	1933	1934	Recommend citing Section 4.0 of the API 2015 LNG GHG Emissions document for further elaboration of emission estimation methods	Miriam Lev-On	Accepted with modification	Added a citation in a slightly different place (lines 1933-1934). Now reads: Where LNG imports and exports or storage occur, the number of stations should be determined, and the emission factors for LNG should be used . See API (2015) for further elaboration of emission estimation methods for the LNG sector. "

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
2382	2	4	1938	1939	The units of measure "gas consumption" is unclear and is inconsistent with the activity data values shown for transmission and storage in Table 4.2.15	FIJI GEORGE	Accepted	Changed text in 4.2.15 for consistency. Table 4.2.15 was unchanged from 2006 guidelines, and listed activity as "10 ⁶ m ³ of marketable gas" whereas in new Table 4.2.12 we use "Tonnes per million cubic meter gas consumption" - Table 4.2.15 has been changed to use this activity basis and we changed the description to reflect gas consumption rather than marketable gas definition.
1502	2	4	1938	1939	Table 4.2.12: It is not clear from Table 4.2.12 and corresponding text what source categories have been accounted for and how they correspond to the emission sources in the 2006 IPCC Guidelines. Further, it should be clarified, for what time period the emission factors have been provided in Table 4.2.12 (year, month, etc.). Furthermore, the authors should clarify, if the same emission factor referred to in table 4.2.12 is to be applied for each emission category (and the emission estimates derived should be subsequently summarised). However, in case of aggregation of few operations, the authors should indicate the operations aggregated to ensure completeness and avoid underestimations. It is recommended that the authors provide the links to tables 4A.4 and 4A.5 and the method for estimation the emission factors using the tables 4.2.12, 4A.4 and 4A.5.	Michael Gytarsky	Accepted with modification	The categories are consistent with categories from the 2006 GL. Clarified text, noting that all EF are for the time period of 1 year. Added text on rationale and note that the transmission EF is within the range of reported value. Added an equation to show how emissions are to be summed.
2380	2	4	1938	1939	The CO2 emission factor for LNG import/export is 3 orders of magnitude higher than emissions reported for the U.S. in EPA's 2017 national inventory report	FIJI GEORGE	Accepted	Corrected error.
8810	2	4	1938	1939	For LNG, the EFs for both handling and storage are provided per terminal. Is this the best activity data? LNG terminals can vary from small terminals, e.g. 500 m ³ and up several 100000 m ³ . Is the expectation that these would have similar emissions. At least it should be mentioned what types of terminals have been used in establishing the EFs.	Ole-Kenneth Nielsen	Accepted with modification	A better activity data option is unavailable, but additional information on EF data set was provided in the text.
10032	2	4	1950	1955	Recommend moving the discussion and Efs for appliance to the Product Use Volume (Volume 3), where Chapter 8 addresses, "Other Produce Manufacture and Use". A NEW subchapter could be developed to include a range of methane emissions from Natural Gas use in power transport and appliances (in a manner similar to section 8.4 on N2O from product use).	Miriam Lev-On	Rejected	Emissions from internal piping and leakage of end-use appliances are part of the chain from production to final use. Hence, they have to be reported in the chapter of fugitive emissions.
4036	2	4	1953	1953	Insert between sentences: "An exception to this generalization is biogas produced from wastewater treatment, which may have a significant fossil component (see Vol5_Chp6_Annex6A.2). In such cases compilers are encouraged to determine the extent to which this may influence emissions."	Gregory Peters	Rejected	Methane losses have to be reported, no matter from what fuel they come from. There will be no exception.
8814	2	4	1962	1963	An EF for appliances is reintroduced based on the classification for gas losses reported in the 2006 IPCC GL. The value of 5 m ³ per appliance has been converted to 5 kg per appliance, which seems to fail to consider the density of the natural gas. Also, it is not clear what assumptions have been made as to the CO2 content of the natural gas to derive a CO2 EF. This should be specified.	Ole-Kenneth Nielsen	Accepted	A specification on CO2 content was provided.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
8816	2	4	1962	1963	The use of the classification of gas losses as low, medium or high at selected types of natural gas facilities as a source for a default EF for appliance losses seems questionable. The source of the data is reported in the 2006 IPCC GL as "Adapted by the authors from currently unpublished work by the International Gas Union, and based on data for a dozen countries including Russia and Algeria.". This is hardly a solid reference as it is unpublished, not peer-reviewed and impossible for users to analyse and hence assess the applicability at a wider scale. Residential natural gas boilers are usually placed indoors and with odorant being added to the natural gas any leakages would be detected and repaired, which makes it unlikely that leaks of the magnitude suggested would occur. If including a default EF the scientific basis should be better than what is currently the case. The appropriateness of the EFs should be reassessed and if proper data are not available no default emission factor should be provided. The same concern applies to the EF suggested for large-scale users. The use of the value for 'rest of the world' from an obsolete version of the IPCC GL should not be considered sufficiently scientifically robust to form the basis of a default EF. In addition, it is unclear what calorific value has been used to convert the EF from kg/PJ to t/10 ⁶ m ³ .	Ole-Kenneth Nielsen	Accepted with modification	A conversion factor was provided. The reference to the 1996 GL is agreed by the IPCC. In addition to this, the study is already published and can be downloaded from IGU.
8818	2	4	1962	1963	It is not clear whether the EF for natural gas vehicles covers emissions from the whole chain, i.e. storage at filling stations, the refuelling of vehicles and emissions from vehicle tanks. This should be specified.	Ole-Kenneth Nielsen	Accepted	The comment is right, but during the drafting of SOD, the point is still under discussion and it will be clarified in the final draft.
10034	2	4	1962	1963	The EF in Table 4.2.13 regarding Natural Gas Vehicles, Appliance, Industrial Plants and Power Plants should be included in a NEW segment in Volume 3 Chapter 8 on 'Methane Emissions from Product Use'	Miriam Lev-On	Rejected	Emissions from internal piping and leakage of end-use appliances are part of the chain from production to final use. Hence, they have to be reported in the chapter of fugitive emissions.
2384	2	4	1962	1963	The units of measure "gas consumption" is unclear and is inconsistent with the activity data value shown for gas distribution in Table 4.2.15	FIJI GEORGE	Accepted	Changed text in 4.2.15 for consistency. Table 4.2.15 was unchanged from 2006 guidelines, and listed activity as "10 ⁶ m ³ of marketable gas" whereas in new Table 4.2.12 we use "Tonnes per million cubic meter gas consumption" - Table 4.2.15 was updated to use this activity basis and we changed the description to reflect gas consumption rather than marketable gas definition.
6718	2	4	1962	1963	For the processing plant EF, the underlying EPA GHG Inventory data underestimates emissions. Marchese et al 2016 reports that processing plant emissions were higher than estimated by the EPA GHG Reporting Program, which is used in the EPA GHG Inventory. It would be more appropriate to develop the EF from the empirically-based Marchese et al 2016; for example, they report an average throughput loss rate of 0.18%.	David Lyon	Rejected	Disagree-the Marchese study measured 16 plants; the data set used to develop the EF included hundreds of plants.
6720	2	4	1962	1963	For the transmission EF, the EPA GHG Inventory data underestimates emissions by excluding the super-emitter/uncategorized emissions from Zimmerle et al, the source of the underlying data. The EF should be adjusted upward by approximately 27% to account for this important source, which represents real emissions from abnormal conditions such as malfunctions that are not easily categorized into EPA's existing source categories.	David Lyon	Rejected	The EF is a combination of Zimmerle and other data sources and covers all emission sources in the transmission segment.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
6722	2	4	1962	1963	Provide pipeline type specific EFs (CH4 / km pipeline) based on Lamb et al 2015 and EPA GHGI. They could be useful to countries with detailed pipeline activity data but no emissions data.	David Lyon	Rejected	These are in the annex.
8812	2	4	1962	1963	Based on the text preceding Table 4.2.13, it would seem that for pipelines 'Greater than 50% plastic pipelines, and leak detection and repair programs are in use' the EF to use would be based on the pipeline length. However, both set of EFs are presented for both subcategories. It should be further clarified which of the four different sets of EFs should be used under which conditions.	Ole-Kenneth Nielsen	Accepted	Clarified text.
10036	2	4	1972	1974	Recommend emphasizing that the guidance provided both for oil an gas wells may result in highly uncertain reporting. Existing data on abandoned oil and gas wells as well as practices for plugging such wells in a well regulated fashion is scarce and data about plugging practices is and the number of plugged wells is hard difficult to collect.	Miriam Lev-On	Accepted	Although it is not particularly mentioned in the text, the table (4.2.8) has provided default emission factors with a large uncertainty in SOD which is different from FOD.
5704	2	4	1975	1990	Move the text here to the beginning of the section 4.2.2.3 on choice of emission factors. This information should be given before the tables with default EFs.	Javier Marcelo Hanna Figueroa	Accepted	Moved above table.
4490	2	4	1988		better use 100%, check other places	KEWEI YU	Rejected	100 per cent = 100%
4492	2	4	2016		formation of	KEWEI YU	Rejected	Disagree, "formation CO2" is correct.
2386	2	4	2044	2045	Table 4.2.14 is indicated to provide Tier 1 emission factors for data presented in Tables 4.2.3 through 4.2.13. This description is inconsistent with the data presented in Table 4.2.14, which provides Tier 3 activity data. For the same reason that Tier 3 emission factors are not provided in Chapter 4, Tier 3 activity data should also not be provided since the level of detail can vary widely. Suggest removing Table 4.2.14	FIJI GEORGE	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
2388	2	4	2052	2053	For the same reason that Tier 3 emission factors are not provided in Chapter 4, Tier 3 activity data should also not be provided since the level of detail can vary widely. Suggest removing Table 4.2.14	FIJI GEORGE	Accepted with modification	The table is from the 2006 GL and it is out of the scope of the refinement. However, we did add text above the table to clarify why there is a table on Tier 3 AD information presented.
9630	2	4	2053	2054	Table 4.2.7 of the 2006 IPCC Guidelines corresponds to Table 4.2.4 (or 4.2.5) one-by-one. I suggest that the authors also keep this correspondence among Table 4.2.15 and 4.2.3 through 4.2.13. For example, Sweet Gas Plants and Default Weighted Total Sub-Categories in Gas Processing Category no longer exist in Table 4.2.11 and these Sub-Categories can be removed from Table 4.2.15. On the other hand, it is needed to add with/without LDAR Sub-Categories in Table 4.2.15.	Naofumi Kosaka	Accepted	Edited table--removed guidance column adding discussion above the table, noting that they should reference national statistics and that additional discussion in tier 1 ef section.
9632	2	4	2053	2054	I suggest that a horizontal line is missing between Unconventional and Conventional Sub-Categories in Gas Exploration Category.	Naofumi Kosaka	Accepted	
9612	2	4	2054	2055	I suggest that the authors replace "bitumen" with "crude bitumen" for Oil Upgrading in Table 4.2.15 in order to avoid confusion with bitumen as final products of oil refineries.	Naofumi Kosaka	Noted	No action can be taken because comment is out of scope of 2019 Refinement.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
2390	2	4	2054	2055	The 2nd option provided under guidance for abandoned wells suggests using the count of wells drilled less the number of actively producing wells. This is not a valid approximation for the number of abandoned wells. This can result in a negative well count for some producing areas. Suggest removing this option.	FIJI GEORGE	Accepted	
4494	2	4	2061		bureaux? Spelling	KEWEI YU	Rejected	British spelling is used for IPCC guidelines.
4496	2	4	2105		GCV, NCV, definitions?	KEWEI YU	Accepted	Added definitions to glossary from IEA https://www.iea.org/media/training/alumni/CheatSheet.pdf
1504	2	4	2127	2127	The following new paragraph is proposed for inclusion at the beginning of line 2127: "Different activity data sets may be available for some countries. In particular, the annual associated gas production may be available for oil operations segment, while length of transmission pipelines and annual gas transmission totals may be available for operations with natural gas. When these data are available, they can be used for estimation of fugitive emissions from oil exploration and production as well as from natural gas transmission. Furthermore, these data can be applicable for the elaboration of relevant emission factors."	Michael Gytarsky	Rejected	All of these points are covered elsewhere in the text and are unrelated to completeness.
5706	2	4	2127	2129	The language here should be carefully redrafted, it is unclear how the comparison between tier 1 EFs and tier 2/tier 3 EFs will help in the assessment of completeness. Why here reasonableness of EFs is playing a role in completeness?. Also, how emissions from specific segment will be assessed against uncertainty range? which would be here the central estimate? Clarify, redraft, as the idea is very unclear as it is now.	Javier Marcelo Hanna Figueroa	Rejected	It is always good practice to compare country-specific or technology-specific Efs with default Efs with range to facilitate the understanding on the reasonability of bottom-up data.
5708	2	4	2130	2132	It seems that still the language here refers to the table 4.2.8 in the 2006 IPCC Guidelines and is not fully applicable for the change introduced. Revise.	Javier Marcelo Hanna Figueroa	Accepted	Deleted these lines.
4498	2	4	2142		good practice in italic	KEWEI YU	Accepted	
10042	2	4	2142	2149	To reinforce the guidance provided, recommend adding that measured data should be carefully analyzed and screened to ascertain its validity. It is important to identify obvious data errors and/or outlying observations. It is also essential to ensure the applicability of short duration measurement studies to depict average annual emissions for inclusion in national inventories.	Miriam Lev-On	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
4500	2	4	2159		should be	KEWEI YU	Accepted	
9918	2	4	2160	2165	Where EF's change over time to reflect technological changes, particularly if newer technology is lower emitting, add some guidance on how to make mitigation or reductions as transparent as possible in the inventory report.	Irving William	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
10040	2	4	2174	2175	Recommend including a citation to the 2015 API/IPIECA document, "Addressing uncertainty in oil and natural gas industry greenhouse gas inventories: Technical considerations and calculation methods"	Miriam Lev-On	Noted	No action can be taken because comment is out of scope of 2019 Refinement.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
1696	2	4	2204	2213	There appears to be a formatting issue in this paragraph, perhaps with the use of special characters not showing up. Specifically, the character before the numeral percent is incorrectly formatted.	Adam Eisele	Accepted	
2392	2	4	2205	2206	Symbols for "+/-" are not displayed correctly.	FIJI GEORGE	Accepted	
4502	2	4	2205	2221	%, and some errors, err?	KEWEI YU	Accepted	
4504	2	4	2224		good practice in italic	KEWEI YU	Accepted	
2394	2	4	2256	2261	The text under "External Review" is duplicative of the text under Industry Involvement (lines 2232-2236). Suggest combining these into one section.	FIJI GEORGE	Accepted	Combined these.
4506	2	4	2265		good practice in italic	KEWEI YU	Accepted	
9920	2	4	2277	2281	See earlier comment on line 2160 regarding changing EF's over time and how reporting and documentation of mitigation in this sector should be transparently demonstrated.	Irving William	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
9634	2	4	2808	2808	I suggest that the authors replace "recalculation" with "adjustment" (or "correction"). The word recalculation is used to a limited extent in the IPCC Guidelines when overwriting the past emission estimates due to methodological changes, error corrections, etc. (cf. 2006 IPCC Guidelines, Volume 1, Section 5.2.1 and 5.4)	Naofumi Kosaka	Accepted	Replaced with "correction".
5182	2	Annexes	2844	2844	What is APG? Should be defined/explained.	Kari Grönfors	Accepted	Done
9636	2	4	2856	2857	I suggest that the "To 0 °C" and "To 20 °C" columns in Table 4A.1 are unnecessary because line 2802-2804 state that "If activity data are derived at reference conditions, which are different from those used by IPCC default EFs, inventory compiler should harmonize activity data with 15°C and 101.325 kPa." On the other hand, it is necessary to include a table for the parameters used in Equation 4A.1 through 4A.4.	Naofumi Kosaka	Accepted with modification	1 - The columns were deleted. 2 - There are around 30 pages of values of parameters used in Equations 4A.1-4A.4. Including these pages in the GLs is not reasonable. The reference on documents, from which the parameters may be taken, was provided.
9922	2	4	2861	2862	Section 4.2.2.3 could use some text describing the importance of this Annex and how it fits into the choice & use of emission factors.	Irving William	Rejected	1) The annex (4A.2) has been mentioned in the main context on p.4.54 and other pages for reference; 2) The annex is not as important as main context, otherwise it will be included in.
5978	2	Annexes	2863	2864	It is not exactly clear how the disaggregated factors in Annex 4A.2 would be used	Vincent Camobreco	Accepted	Added text to clarify link with 4A.2

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
8820	2	4	2871	2872	Table 4A.2 is very important based on the preliminary decision not to report emissions from venting, flaring and fugitive losses separately in the main part of the chapter. This makes it very important that this information is accurate. Therefore, it is worrying that e.g. flaring is only assumed to be 1 % of the CO2 emission from offshore oil production. This seems like an obvious error. For onshore oil production flaring is apparently 0 % (!) of the CO2 emission. Also, the table does not mirror the information presented in Table 4.2.3 and 4.2.4, e.g. the N2O EFs presented in these tables are not reflected in Table 4A.2, which would make it impossible for users to comply with the requirement to report flaring emissions separately from the fugitive emissions. The same goes for the other tables in this annex.	Ole-Kenneth Nielsen	Accepted	This is fixed with the latest US GHGI which reallocates oil flaring to oil, which is used in the SOD. Previously was all reported under natural gas.
1514	2	4	2877	2972	It is proposed to include additional information on country-specific emission factors from the attached file in the Annex 4A.3	Michael Gytarsky	Rejected	Annex has been deleted.
5980	2	Annexes	2877	2877	Suggest Annex 4A.3 instead reference the IPCC EFDB	Vincent Camobreco	Rejected	Annex has been deleted.
8822	2	4	2877	2972	This is a great annex with a lot of useful information. Some tables are without units but they are generally available in the accompanying text. One exception is Table 4A.10, where the unit should be added.	Ole-Kenneth Nielsen	Rejected	Annex has been deleted.
10044	2	Annexes	2888	2889	The CH4 emission factors for HF gas with and without controls seem to have been switched. All the US numbers should be updated to match current GHGI values.	Miriam Lev-On	Rejected	Annex has been deleted.
564	2	4	2888	2972	Would it be possible to add uncertainty information on these Efs as reported by these countries? I would assume that their NIRs will have this information available or at least provides references to the measuring reports that underpin these values.	Tinus Pulles	Rejected	Annex has been deleted.
2294	2	4	2900	2901	We do not recommend this use of IEFs from our GHG inventory	Vigdis Vestreng	Rejected	Annex has been deleted.
2296	2	4	2903	2904	Table 4A.10: Units for the data are missing.	Vigdis Vestreng	Rejected	Annex has been deleted.
2298	2	4	2903	2904	Table 4A.10: Emission factors for offshore oil loading are given with reference to the Norwegian GHG Inventory. The periods chosen for the estimated factors are not uniform with respect to VRU use, and we do not recommend this use of the inventory. Please do also check the conversion from the original inventory data.	Vigdis Vestreng	Rejected	Annex has been deleted.
10046	2	Annexes	3014	3015	This definition of Casing is different than the one provided in Line 3026	Miriam Lev-On	Accepted	Deleted duplicate definition in line 3014; retained this: "casing: cement pipe lowered down a well borehole meant to prevent fluids from escaping and/or the borehole from collapsing. "
10048	2	Annexes	3026	3026	A second definition of Casing that does is different than the one provide in Line 3014	Miriam Lev-On	Accepted	Deleted duplicate definition in line 3014; retained this: "casing: cement pipe lowered down a well borehole meant to prevent fluids from escaping and/or the borehole from collapsing. "

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
9638	2	4	3029	3029	I suggest that it is necessary to add the words "VRU" and "centrifugal compressors with dry seals" in Annex 4A.4 because it seems that the words are used in Table 4.2.5 and 4.2.11 without definition.	Naofumi Kosaka	Accepted with modification	Added definitions to glossary. For centrifugal compressors defined both wet and dry seals as follows - "centrifugal compressor: centrifugal compressors are widely used in production and transmission of natural gas. Seals on the rotating shafts prevent the high-pressure natural gas from escaping the compressor casing. Traditionally, these seals, termed "wet" seals, used high pressure oil as a barrier against escaping gas. An alternative to the traditional wet (oil) seal system is the mechanical dry seal system. This seal system does not use any circulating seal oil. Dry seals operate mechanically under the opposing force created by hydrodynamic grooves and static pressure. Replacing "wet" (oil) seals with dry seals significantly reduces operating costs and methane emissions." Defined VRUs as "Vapor recovery unit (VRU): a system used to recover vapours formed inside sealed crude oil or condensate tanks; consists of a switch that detects pressure variations within a tank and turns a compressor on and off. The compressor sucks vapours through a scrubber that catches liquids and vapours for return to tanks or pipelines."
10050	2	Annexes	3032	3032	The definition of Coal Bed Methane could be accompanied by a definition of Coal Bed Methane Production "Coalbed methane (CBM) was first extracted from coal mines as a safety measure to reduce the explosion hazard posed by methane gas in the mines. Today the methane is captured and used as a source of energy. Deeper coal formations might require hydraulic fracturing to release the natural gas"	Miriam Lev-On	Accepted with modification	Reworded as follows: coal bed methane (CBM): natural gas (methane/CH ₄ , mainly) generated during coal formation and absorbed in coal. Originally extracted as a safety measure to reduce explosion hazards in mines, today CBM is captured and used as a source of energy. For deeper coal formations, hydraulic fracturing may be needed to release the natural gas.
10052	2	Annexes	3036	3036	Recommend providing a separate definition of Conventional and Unconventional completions: (a) "Well Completion, Conventional refers to the process that initiates the flow of petroleum or natural gas from a newly drilled well prior to production. This stream of fluids during well completions is referred to as "flowback". During completion the reservoir is connected to the wellbore allowing the flowback of drilling and reservoir fluids (gas, oil, water, mud, etc.) to the surface. In a conventional well completion, the flowback period (also known as well cleanup) may involve flaring or venting of produced gas to the atmosphere via an open pit or tank collecting the fluids"; (b) "Well Completion, unconventional involve hydraulic fracturing and result in a higher rate of flowback than most conventional well completions, due to the large quantities of water and proppant (mainly sand) used to fracture lower permeability reservoirs. This high-rate flowback is generally composed of a mixture of fracking fluids with reservoir gas and liquids and may generate significant amount of methane and hydrocarbon emissions to the atmosphere. Similarly, flaring generates a significant amount of combustion emissions, incurs product losses and is not always a viable option depending on the well location, the concentration of flammable gases in the flowback gas as well as other considerations."	Miriam Lev-On	Accepted with modification	Adopted some of wording but not all: completion, as follows: completion: process of initiating flow of petroleum or natural gas from a newly drilled well prior to production (a) For conventional well completion a reservoir is connected to the wellbore during this process, allowing the flowback of drilling and reservoir fluids (gas, oil, water, mud, etc) to the surface. While there is flowback, a period known also as well cleanup, there may be flaring or venting of produced gas from the reservoir. (b) For unconventional well completion, if hydraulic fracturing is employed, there may be a higher rate of flowback of water, fracking fluids, reservoir gas and fracturing proppant (e.g. sand) that can release greater amounts of methane and hydrocarbons to the atmosphere when compared to a conventional well completions.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
10054	2	Annexes	3038	3038	Recommend inserting a definition of Green Completion. "Green Completions is a technology known as Reduced Emissions Completions (RECs) or "green completions" that may be implemented to offset potential loss of methane and other hydrocarbons during flowback associated with unconventional well completions. 'Green Completions' is an alternate practice that captures the produced gas during well completions and well workovers following hydraulic fracturing.	Miriam Lev-On	Accepted with modification	Added definition as subpoint of "completion". Completion: process of initiating flow of petroleum or natural gas from a newly drilled well prior to production (a) For conventional well completion a reservoir is connected to the wellbore during this process, allowing the flowback of drilling and reservoir fluids (gas, oil, water, mud, etc) to the surface. While there is flowback, a period known also as well cleanup, there may be flaring or venting of produced gas from the reservoir. (b) For unconventional well completion, if hydraulic fracturing is employed, there may be a higher rate of flowback of water, fracking fluids, reservoir gas and fracturing proppant (e.g. sand) that can release greater amounts of methane and hydrocarbons to the atmosphere when compared to a conventional well completions. (c) in a green completion or reduced emissions completion (REC) produced gas following hydraulic fracturing is captured, offsetting the loss of methane and other hydrocarbons during flowback from the well completion.
10056	2	Annexes	3151	3151	Recommend including a range in the definition of heavy crude (API < 20 degrees)	Miriam Lev-On	Accepted	Added to definition. heavy crude: a low API (< 20 degrees)/high density hydrocarbon .
10058	2	Annexes	3156	3157	Recommend broadening the definition by including the EPA explanation: "Hydraulic fracturing produces fractures in the rock formation that stimulate the flow of natural gas or oil, increasing the volumes that can be recovered. Wells may be drilled vertically hundreds to thousands of feet below the land surface and may include horizontal or directional sections extending thousands of feet.	Miriam Lev-On	Accepted with modification	Updated language to: hydraulic fracturing: a method of enhanced oil or gas recovery in which fluids are pumped into a rock formation a geologic formation is broken down by pumping down fluids at very high pressures in order to fracture the rock and stimulate the flow of natural gas or oil, increasing the volumes that can be recovered. ; the purpose is to increase production rates from a reservoir. Wells may be drilled vertically hundreds to thousands of feet below the surface and may include horizontal or directional sections extending thousands of feet away from the well.
10060	2	Annexes	3177	3177	The dfinition of LPG provided here is not adequate. It should be replaced with the definition provided in Line 3184 to 3186	Miriam Lev-On	Accepted	Deleted duplicate definition in 3177. Retained definition 3184-3186. liquid petroleum gas (LPG): a light hydrocarbon that is gaseous at atmospheric temperature and pressure and which is held in a liquid state (by pressure) in order to ease transport and handling; consists of either propane, butane, or mixtures of the two.
10062	2	Annexes	3184	3186	Retain this definition for LPG and remove the one in Line 3177.	Miriam Lev-On	Accepted	Deleted duplicate definition in 3177. Retained definition 3184-3186. liquid petroleum gas (LPG): a light hydrocarbon that is gaseous at atmospheric temperature and pressure and which is held in a liquid state (by pressure) in order to ease transport and handling; consists of either propane, butane, or mixtures of the two.
10064	2	Annexes	3192	3192	Recommending adding a statement that MBOE is a unit of energy equal to 0.1555 billion m3 of natural gas, or equivalent to 1.7 TWh	Miriam Lev-On	Accepted with modification	Changed definition to reflect that is a unit of energy; however, did not provide conversion factors since this depends on the energy content of the oil or gas which can vary significantly. million barrels of oil equivalent (MBOE): a unit of energy based on the energy release by burning one million barrels (one barrel is 42 US gallons or 158.9873 L) of crude oil.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
4820	2	4	3223	3224	The definition of oil shale in the document is given wrong (the definition of both oil shale and shale oil (lines 3292-3293) are given the same. We recommend the definition of oil shale as it is given in International Recommendations for Energy Statistics (IRES) - Oil shale / oil sands - A sedimentary rock which contains organic matter in the form of kerogen. Kerogen is a waxy hydrocarbon-rich material regarded as a precursor of petroleum.	Anna Paturska	Accepted with modification	Deleted shale oil definition. Changed oil shale to new definition - oil shale: a sedimentary rock containing organic matter in the form of kerogen, a waxy hydrocarbon-rich material regarded as a precursor to petroleum. Oil shale may be burned directly or processed by, for example, heating to extract shale oil.
10066	2	Annexes	3292	3292	Definition is redundant with definition provided in Line 3223	Miriam Lev-On	Accepted with modification	Deleted definition for "shale oil" and used "oil shale" definition according to Comment #4820.
1686	2	4		Table 4.2.1	For the Gas Production industry segment, should "wet gas" be included?	Adam Eisele	Accepted with modification	Table 4.2.1 was revised to delete activity data requirement for tier 3. For example, for gas production, the AD would be gas production volume, no mentioning dry gas or wet gas.
1680	2	4	Fig 4.2.1 (1)	Fig 4.2.1 (1)	In the Production step, shouldn't storage be included? It's common for natural gas production well pads to include storage tanks	Adam Eisele	Accepted	Added image.
1678	2	4	Fig 4.2.1 (1)	Fig 4.2.1 (1)	For (b) Production and Upgrading, does upgrading include onshore oil polishing facilities?	Adam Eisele	Rejected	No EF is available.
1684	2	4	Fig 4.2.5	Fig 4.2.5	The "Yes" in between the diamonds "Are actual measurements or..." and "Are national Tier 2..." should say "No".	Adam Eisele	Accepted	
4072	4	2	Table 4.2.1	Table 4.2.1	Gathering and boosting appears to be missing from the list.	Mark de Figueiredo	Accepted	Added it.
4076	4	2	Table 4.2.1	Table 4.2.1	It is not clear why anomalous events are categorized under "other" as industry segment instead of the industry segment itself. For example, shouldn't anomalous storage well leaks be classified under the gas storage industry segment?	Mark de Figueiredo	Rejected	Reporters could report information on the segment of origin in the documentation box if interested.
4074	4	2	Table 4.2.1	Table 4.2.1	The example activities in the second column of Table 4.2.1 differ from example activities noted in Figure 4.2.1	Mark de Figueiredo	Rejected	Figure 4.2.1 gives in brief introduction on the segments of oil system (sub-category), and table 4.2.1 refer to the AD and/or emission sources in each segments. They are not necessarily the same.
4092	4	2	Table 4.2.10	Table 4.2.10	There is a typo in footnote 3. The phrase "factor s" should be changed to "factors".	Mark de Figueiredo	Accepted	
4090	4	2	Table 4.2.10	Table 4.2.10	For second row on page 4.71, the indentation of the second column should be conformed to match the indentation of the other columns	Mark de Figueiredo	Accepted	
4094	4	2	Table 4.2.11	Table 4.2.11	On Page 4.74, recommend conforming terminology between the first and second rows for describing centrifugal compressors with dry seals. The first row calls them "dry seal compressors", while the second row describes them as "centrifugal compressors [that] are dry seal".	Mark de Figueiredo	Accepted	
4096	4	2	Table 4.2.11	Table 4.2.11	It was not clear whether the first and second rows were intended to be a continuum. For example, does "limited use of dry seal compressors" (first row) mean that less than 50% of centrifugal compressors are dry seal (second row)? Recommend changing the sub-category in the first row if they are intended to be a continuum.	Mark de Figueiredo	Accepted	

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
4098	4	2	Table 4.2.12	Table 4.2.12	In the first column, the term "Gas Transmission" is cut off due to the column width.	Mark de Figueiredo	Accepted	
4100	4	2	Table 4.2.12	Table 4.2.12	In the last column, the term "Tonnes per km pipeline" has a larger font size than the other units of measure.	Mark de Figueiredo	Accepted	
4102	4	2	Table 4.2.12	Table 4.2.12	It is not clear why the term "Extensive use of LDAR" is used rather than "Most activities occurring with lower-emitting technologies and practices"	Mark de Figueiredo	Accepted	
4104	4	2	Table 4.2.12	Table 4.2.12	Footnote a has a smaller font size than the other footnotes of the table.	Mark de Figueiredo	Accepted	
4106	4	2	Table 4.2.13	Table 4.2.13	For the first row on page 4.79, the indentation of the first column should be conformed to match the indentation of the other columns	Mark de Figueiredo	Accepted	
1694	2	4	Table 4.2.15	Table 4.2.15	In the "Gas Processing" category (and throughout the rest of the document), is it accurate to refer to Gas Processing plants as either "Sweet Gas Plants or "Sour Gas Plants"? It seems like amine treating is only one step of many at Gas Processing Plants.	Adam Eisele	Rejected	2019 refinement tries to provide more accurate and diversified Efs used by Tier 1 approach, based on the national statistic system and EF availability. In many cases, gas production is not able to be disaggregated to sweet and sour gas, and a general EF has to be provided. And EFs for other steps than amine treating is not available.
1688	2	4	Table 4.2.2	Table 4.2.2	For this table, does the US have any data available for conventional oil for areas such as the Bakken or the Eagle Ford basins? The geographical coverage seems limited.	Adam Eisele	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
4078	4	2	Table 4.2.3	Table 4.2.3	There appears to be a typo in the first row shown on Page 4.56. "Unconventional without flaring" should be written as "Unconventional without flaring or recovery" or alternatively "Unconventional without flaring or gas capture".	Mark de Figueiredo	Accepted	
4082	4	2	Table 4.2.5	Table 4.2.5	For footnotes b and c, the "4" in CH4 and "2" in N2O should be subscripts.	Mark de Figueiredo	Accepted	
4080	4	2	Table 4.2.5	Table 4.2.5	The font size for footnotes b and c is smaller than the font size for the other footnotes of the table	Mark de Figueiredo	Accepted	
4084	4	2	Table 4.2.9	Table 4.2.9	For footnote c, the "2" in N2O should be a subscript.	Mark de Figueiredo	Accepted	
5626	2	4			In Table 4.2.4, the uncertainty levels for fugitive emissions in gas transmission, storage and distribution are -20-500% which is too coarse. It is recommended that IPCC provided leakage rates per country and considers types of pipelines, age, etc.	MINGMING WANG	Accepted with modification	Uncertainty is now better explained. Leakage rates by country are unavailable but some examples are in the annex.
5958	2	4	2308	2308	Change Fusitive to Fugitive	Vincent Camobreco	Accepted	Spelling corrected.
9628	2	4	2308	2308	"FUSITIVE" may be "FUGITIVE".	Naofumi Kosaka	Accepted	Spelling corrected.
4038	2	4	2308	2308	Two typos: change "Fusitive emissions from fuel transforamation" to "Fugitive emissions from fuel transformation"	Gregory Peters	Accepted	Spellings corrected.
5710	2	4	2308	2309	Correct "Fugitive"and "Transformation"	Javier Marcelo Hanna Figueroa	Accepted	Spellings corrected.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
5108	2	4	2308	2309	2 misprints in title, should read: Fugitive emissions from fuel transformation	Kari Grönfors	Accepted	Spellings corrected.
5712	2	4	2310	2311	These sentences are irrelevant. Delete.	Javier Marcelo Hanna Figueroa	Rejected	It is important that there is a clear and simple definition that defines the scope of the section. The text has been reviewed to ensure clarity.
8824	2	4	2310	2311	This seems to be copy/paste and should either be modified to fit this section or deleted.	Ole-Kenneth Nielsen	Rejected	It is important that there is a clear and simple definition that defines the scope of the section. The text has been reviewed to ensure clarity.
5110	2	4	2311	2319	First paragraph 4.3 speaks about fossil fuels, but paragraph 4.3.1 takes in to account also biomass. Fossil fuel transformation and biomass transformation should be dealt in separate chapters. Fugitive biogenic CO2 emissions should not be estimated or reported.	Kari Grönfors	Accepted	The comment is right, but during the drafting of SOD, the cross-cutting discussion with other volumes is still going on, and it will be clarified in the final draft.
5714	2	4	2313	2313	Change the beginning to: "This section clarifies how fugitive emissions...."	Javier Marcelo Hanna Figueroa	Rejected	It is not just this section of the document that clarifies the treatment of fugitive emissions. All sections are about fugitive emissions.
5716	2	4	2318	2319	To make consistent this text with table 4.3.1, include "gasification transformation" and in brackets: coal to liquid, gas to liquid, biomass to liquid, biomass to gas. Delete "refineries".	Javier Marcelo Hanna Figueroa	Accepted	Scope of the paragraph and Table 4.3.1 has been harmonised.
3318	2	4	2322	2323	Table 4.3.1. Category number in 1A subsector where "Emissions from the use of this fuel for energy purposes should be reported" should be indicated not generally 1A, but more specifically in the last column of the table. I suppose that for charcoal production this should be 1A1cii, for coal production 1A1ci, etc.	Veronika Ginzburg	Accepted with modification	The comment is right, but during the drafting of SOD, the relevant discussion is still going on, and it will be revised in the final draft.
5112	2	4	2322	2323	In table 4.3.1 wood pellet production is mentioned as part of Solid to solid fuel transformation. This does not follow the fuel definitions mentioned in 2006GL ch. 1.4.1.1; there Solid fuels include coal and coal products, wood (in general) is included in Biomass. Production of charcoal, wood pellets and briquettes as well as biomass to liquids and biomass to gas transformation processes should be separated under title "Biomass transformation".	Kari Grönfors	Accepted with modification	The header in table 4.3.1 has been changed to "Wood pellet production".
9640	2	4	2324	2781	The International Energy Agency (IEA)'s energy balance tables have the rows of "Patent fuel plants", "BKB/peat briquette plants", "Coal liquefaction plants" and "Charcoal production plants" under "Transformation processes". These row shows the quantity of feedstock input and product output. The CO2 emissions can be estimated from the carbon balance ("Total" column) of this row. If national energy balance tables have rows such as IEA, inventory compilers can estimate the emissions. The methodology of IPPU sector in the 2019 Refinement may be good reference. Section 4.2.2.1 of Volume 3 provides production-based method as Tier 1a and simplified carbon balance method as Tier 1b.	Naofumi Kosaka	Rejected	Out of scope. The refinement for fuel transformation covers only fugitive emissions.
5114	2	4	2331	2332	Lifecycle emissions should no be mentioned here, because inventory calculations have nothing to do with lifecycle calculations. These are two totally different frameworks. It is very confusing to mention lifecycle emissions here. At least there should be a warning not to include lifecycle emissions in sectoral GHG inventory calculations.	Kari Grönfors	Accepted	References to lifecycle emissions have been removed.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
5116	2	4	2340	2341	Add : Biogenic fugitive CO2 emissions from charcoal production should not be included in 1A or 1B emission estimates.	Kari Grönfors	Accepted	Comment added that emissions of biogenic CO2 from charcoal production are considered under AFOLU.
4242	2	4	2341	2341	I suggest that the authors replace "Land Use, Land Use Change and Forestry (LULUCF)" with "Agriculture, Forestry and Other Land Use (AFOLU)". LULUCF is not used in the 2006 IPCC Guidelines.	Naofumi Kosaka	Accepted	We have replaced "LULUCF" with "AFOLU".
3320	2	4	2347	2347	Guidelines for estimation of CS EF is provided in the Vol.1 ch.2 of the 2019 Refinement. Cross reference to this chapter would be useful	Veronika Ginzburg	Rejected	In the FOD of volume 1, chapter 2, no charcoal production is mentioned. In chapter 5, a case study is there to highlight the possible overlap in CH4 estimation in charcoal production, which is not relevant to the development of CS EF.
5718	2	4	2352	2353	In figure 4.3.1 the answer NO to "national charcoal production available" should conduct to "collect AD", otherwise it will be impossible to use even tier 1 as indicated in equation 4.3.1. For tier 1 is irrelevant the judgement of key category. Correct this.	Javier Marcelo Hanna Figueroa	Accepted	We have reviewed the logic of the decision tree.
4250	2	4	2366	2366	I suggest that the authors move this sentence to line 2373 or 2374, because this sentence is related to the emission factors.	Naofumi Kosaka	Rejected	The sentence has not been moved since it follows the logic to describe the equation 4.3.1.
8826	2	4	2372	2376	In general, there should be one generic EF for charcoal production, i.e. in addition to the technology specific EFs, there should be one EF for unspecified charcoal production. Currently, there are three CH4 EFs for unspecified charcoal production, 22-89 kg/t, 32 kg/ton and 27-45 kg/ton. Based on these data sources one EF should be calculated, so that inventory compilers are not left to guess which one to choose. Another issue with Table 4.3.2 is that the CH4 EF for a high-efficiency kiln is higher than for a low-efficiency kiln, which is illogical. Also, the two EFs presented for a high-efficiency kiln differ by more than a factor 1000! This should be checked further. The unit of the EFs could also be streamlined, i.e. pick either g/kg or kg/ton.	Ole-Kenneth Nielsen	Accepted	We have selected one generic EF for charcoal production and provided lower and upper bound limits.
3322	2	4	2372	2376	The range of emission factors according to kiln technology type provided in the table 4.3.2. is huge (from 0 to 89 kg CH4/t charcoal). More detail guidelines should be provided in this section how to use the appropriate EF.	Veronika Ginzburg	Accepted	We have provided additional guidance.
4248	2	4	2373	2374	I suggest that the authors provide a guidance how to choose the default emission factors if the charcoal production by kiln efficiency is not available. The suggested text might be "If the charcoal production by kiln efficiency and country-specific emission factors are not available, it is good practice to apply the largest emission factors listed in table 4.3.2."	Naofumi Kosaka	Accepted	We have provided additional guidance.
5960	2	4	2375	2376	Table 4.3.2 22-89 kg CH4/t charcoal is this charcoal produced?	Vincent Camobreco	Accepted	We have confirmed that the reference is to charcoal being produced.
5720	2	4	2375	2376	Correct 32 +/- 5 g CH4/kg charcoal produced for the EF developed by Chidumayu and Gumbo (2013). Also for consistency you can show as 27-37 g CH4/kg charcoal produced.	Javier Marcelo Hanna Figueroa	Accepted	We have improved the consistency of the presentation of the emission factors.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
4226	2	4	2375	2376	I propose another potential reference for emission factors of charcoal production (http://dx.doi.org/10.1029/2000GB001382). This paper uses the emission factors of charcoal making as 10.7 g-CH4/kg(dry) and 0.03 g-N2O/kg(dry) (see Table 1). The 2006 IPCC Guidelines refer this paper in another context (Volume 4, Chapter 2).	Naofumi Kosaka	Rejected	The reference is about emission from biomass burning, not fugitive emission from charcoal production.
4228	2	4	2375	2376	I propose another potential reference for emission factors of charcoal production. United States Environmental Protection Agency (1995). AP 42, Fifth Edition, Volume I, Section 10.7: Charcoal (https://www3.epa.gov/ttn/chief/ap42/ch10/index.html)	Naofumi Kosaka	Rejected	This EF cited in the EPA report has a quality rating of "E", and is based on 2 EFs. One EF is from 1967 and the other from 1971.
2438	2	4	2375	2376	Table 4.3.2 provides six ranges of emission factors for CH4, for example, 0~0.036 kg CH4/kg charcoal, 22~89kg CH4/t charcoal, etc. according to various sources. The emission factors for N2O also have three ranges. The guideline will be more helpful to inventory compilers if it provides a kind of default emission factor for charcoal production or low, average, and high emission factors similar to those of underground mining.	Dong Koo Kim	Accepted	We have selected one default EF for charcoal production, and provided a range.
4244	2	4	2375	2376	I suggest that the authors aggregate as one default emission factor per each kiln efficiency (high or low), for simplification.	Naofumi Kosaka	Accepted	We have selected one default EF for charcoal production, and provided a range.
4246	2	4	2375	2376	I wonder that the CH4 emission factors (EF) depend on kiln efficiency. The EF for high efficiency kiln reported by Pennise et al (2001) and UNDP (2013) is close to the EF for low efficiency kiln reported by Smith et al (1999).	Naofumi Kosaka	Accepted	We have selected one default EF for charcoal production, and provided a range.
4252	2	4	2375	2376	The CH4 emission factor (EF) reported by Bailis (2009) Taccini (2010) is about 1000 times higher than other EF. I suggest that the authors investigate the reason of this difference.	Naofumi Kosaka	Accepted	We have investigated this.
4798	2	4	2375	2376	In Table 4.3.2, EFs for charcoal production according to kiln technology are provided. Though various kinds of CH4 EFs are provided in the table, it is difficult to choose which EF is appropriate in accordance with each country's national circumstances because enough supporting information for each EF is not provided. It would be better to provide additional information for each EF so that the inventory compiler can choose which EF should be used. (For example, three default CH4 EF for unspecified kiln are provided (22-89 kg CH4/t charcoal, 32+-5g CH4/kg charcoal produced, 27-45 gCH4/kg charcoal produced). This is confusing on which EF should be used when kiln technology used in the country cannot be specified)	Takashi Morimoto	Accepted	We have selected one default EF for charcoal production, and provided a range.
5722	2	4	2385	2385	Reference needed for bag weight of 40 kg. However, this figure is highly uncertain because weight may vary considerably from country to country and region by region. Try to avoid this reference and provide other type of guidance.	Javier Marcelo Hanna Figueroa	Accepted with modification	We have replace the single weight with "of each bag is known".

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
4254	2	4	2396	2481	The 2006 IPCC Guidelines (Volume 3, Section 4.2) provide the methodology of metallurgical coke production. I wonder how the new guidance is different from the existing guidance.	Naofumi Kosaka	Noted	It will be important to ensure harmonisation of the terminology and information in this section with the text in Volume 3, Section 4.2. But the information in this section is more detailed than that in Volume 3, Section 4.2.2.1.
7154	2	4	2397	2397	replace 'processes' with 'process'	Amanda Penistone	Accepted	Text replaced.
5962	2	4	2398	2401	Move the sentence "In the coke production process ..." to after the sentence "The processes produces coke ..." on line 2398	Vincent Camobreco	Accepted	Text moved.
5724	2	4	2404	2404	Include "coke oven gas" before COG and put this in brackets.	Javier Marcelo Hanna Figueroa	Accepted	Proposition Accepted.
3324	2	4	2404	2405	Is it significant? Data for 2014 will not be already relevant after 2019 when 2019 Refinement is approved.	Veronika Ginzburg	Accepted with modification	The authors suggest putting the scale of coke production in context is important and we have retained the sentence. We have added the latest coal production from the IEA statistics when the SOD was revised.
5118	2	4	2408	2409	It is not clear, whether petroleum coke and crashed rubber tyres can be used as input material for coke production or blast furnaces? Please clarify.	Kari Grönfors	Accepted	This has been clarified.
4256	2	4	2414	2415	I suggest that the authors delete or rewrite 'non-recovery'. It seems that 'non-recovery' contradicts 'heat recovery'.	Naofumi Kosaka	Accepted	This has been modified.
4800	2	4	2419	2420	Figure 4.3.2 shows the typical flow diagram of a coke oven plant showing emissions sources. This figure is a little bit difficult to understand which GHG emission sources should be considered because not only GHG but other emissions such as dust and water are shown together without distinction. This figure could be revised by distinguishing between GHG emissions and other substance emissions.	Takashi Morimoto	Accepted	We have marked the likely major points of fugitive GHG emissions on the diagram.
1506	2	4	2419	2420	Figure 4.3.2: The flow diagram is very helpful. However, it is not clear what stages of coke production are the sources of CO ₂ , CH ₄ and N ₂ O emissions. It would help, if the authors could indicate the particular emission sources at the diagram. The authors could also accommodate particular production stages on Figure 4.3.2 and in Table 4.3.4.	Michael Gytarsky	Accepted	We have marked the likely major points of fugitive GHG emissions on the diagram.
3326	2	4	2419	2420	Diagram is ery detailed. It would be great if it is possible to indicate on the diagram which emission sources considered as fugitive, as energy combustion and as IPPU sources	Veronika Ginzburg	Accepted	We have marked the likely major points of fugitive GHG emissions on the diagram.
5120	2	4	2434	2435	The explanations of likelihood "N", "Y", "P", "U" are missing (are they somewhere else, too far from this table?)	Kari Grönfors	Accepted	A technical error in the PDF conversion meant the table footnote explaining these terms was omitted. This has been added back.
8828	2	4	2434	2435	While it is possible to guess the meaning of Y, N, P and U, it probably should be specified somewhere.	Ole-Kenneth Nielsen	Accepted	A technical error in the PDF conversion meant the table footnote explaining these terms was omitted. This will be added back.
1508	2	4	2434	2435	Table 4.3.4: It is proposed that the description of notation keys for fugitive emission likelihood ("N", "Y", "P" and "U") is provided below the Table 4.3.4.	Michael Gytarsky	Accepted	A technical error in the PDF conversion meant the table footnote explaining these terms was omitted. This will be added back.
4258	2	4	2435	2435	I suggest that the authors add a footnote for the definition of 'N', 'Y', 'P' and 'U' in table 4.3.4.	Naofumi Kosaka	Accepted	A technical error in the PDF conversion meant the table footnote explaining these terms was omitted. This will be added back.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
3328	2	4	2436	2437	Figure 4.3.3 If onle national coke production data available it is not possible to use tier 3 AD. The box "Estimate emissions using tier 3 AD and default EF (tier 2)" should be revised. Tier 2 ususally means use of CS EFs.	Veronika Ginzburg	Accepted	Figure 4.3.3 has been revised.
5122	2	4	2436	2437	The second box in the right: should probably include "..using tier 2 AD.." instead of tier 3 AD.	Kari Grönfors	Accepted	Figure 4.3.3 has been revised.
5124	2	4	2436	2437	Using the desicion tree: how can be emissions estimated, if no coke production data is available, in non-key-category case? What does Tier 1 mean here?	Kari Grönfors	Accepted	Figure 4.3.3 has been revised.
5726	2	4	2436	2437	The answer NO to "Are process stage level emission factors available?"should conduct directly to "Estimate emissions using tier 3 AD and default EF (tier 2)".	Javier Marcelo Hanna Figueroa	Accepted	Figure 4.3.3 has been revised.
5728	2	4	2436	2437	In figure 4.3.3 the answer NO to "national coke production available" should conduct to "collect AD", otherwise it will be impossible to use even tier 1 as indicated in equation 4.3.2. For tier 1 is irrelevant the judgement of key category. Correct this. It is unclear what means tier 2 AD and tier 3 AD. Clarify.	Javier Marcelo Hanna Figueroa	Accepted	Figure 4.3.3 has been revised.
5128	2	4	2448	2452	Equation 4.3.2: this cannot be Tier 1 method, because this requires the most detailed data.	Kari Grönfors	Accepted	Equation 4.3.2 has been revised and simplified the equation further, so that it is more applicable to Tier 1.
5130	2	4	2450	2452	Equation 4.3.2: check, whether the equation is possible for tier 1 or tier 2 or tier 3 or any tier; crosscheck against desicion tree.	Kari Grönfors	Accepted	Equation 4.3.2 has been revised and simplified the equation further, so that it is more applicable to Tier 1.
8830	2	4	2450	2452	Equation 4.3.2 refers to charcoal production rather than coke production.	Ole-Kenneth Nielsen	Accepted	The text has been corrected.
5126	2	4	2452	2452	Equation 4.3.2: replace "charcoal" with "coke"	Kari Grönfors	Accepted	The text has been corrected.
3330	2	4	2467	2472	It is not clear which default EFs CH4 and N2O should be used for tier 1 approach. If there is no sufficient default fugitive emission factors for coke production then tier 1 methodology could not be applied. However, Tier 1 approaches are simple methods that can be applied by all countries in all circumstances. Default values for the emission factors and any other parameters needed must be supplied	Veronika Ginzburg	Accepted	A default factor has been included.
2440	2	4	2468	2469	The FOD does not present emission factors from coke production, however, it might be very difficult for inventory compilers to estimate the amount of GHG emissions from coke production without reliable remission factors.	Dong Koo Kim	Accepted	A default factor is provided in table 4.3.5 on p.4.119.
5730	2	4	2468	2472	If there are no default EFs this section should be dropped from the 2019 Refinement. Or put in an annex as a basis for further development. Strong objection to include some guidance that cannot be used or supported with default EFs.	Javier Marcelo Hanna Figueroa	Accepted	A default factor is provided in table 4.3.5 on p.4.119.
5132	2	4	2482	2482	Rephrase the title to follow 2006GL fuel definition principles, for example: Solid biomass transformation and write another chapter concerning fossil fuels and peat transformation processes.	Kari Grönfors	Accepted	The title of the section has been revised.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
5136	2	4	2482	2509	The whole chapter is confusing, starting with biomass, but later mixing biomass and fossil fuels. Biogenic fugitive CO2 emissions should not be estimated or reported, whereas fugitive fossil CO2 emission should be estimated.	Kari Grönfors	Accepted	The order of the sections has been changed to group fossil and non-fossil sources.
5134	2	4	2487	2488	Patent fuel, brown coal briquettes and peat briquettes and pellets should be discussed under separate chapter (fossil fuels and peat separated from biomass).	Kari Grönfors	Accepted with modification	The order of the sections has been changed to group fossil and non-fossil sources. Material on wood pellets has been put in an Appendix.
5138	2	4	2500	2503	The whole chapter should be restructured, separating fossil fuels and biomass; if this will not be done, please add : Fugitive CO2 emissions should be estimated only from fossil fuel transformation.	Kari Grönfors	Accepted	The order of the sections has been changed to group fossil and non-fossil sources.
5964	2	4	2506	2507	Make figure formatting consistent throughout section	Vincent Camobreco	Accepted	The figure formatting has been harmonised.
5966	2	4	2512	2512	Put in standard note about inclusion of biogenic CO2 emissions in LULUCF sector	Vincent Camobreco	Accepted	A note about the inclusion of biogenic CO2 in the AFOLU section has been added (note the IPCC guidelines refer to AFOLU).
5732	2	4	2512	2514	Brackets remain in the text. Carefully check. Also in line 2559, in 2581-2593, 2626-2627, 2676.	Javier Marcelo Hanna Figueroa	Accepted	Brackets have been removed in the final text.
5734	2	4	2521	2522	Decision tree needs editorial work. Replace key source by key category.	Javier Marcelo Hanna Figueroa	Accepted	The comment is right. The change on decision tree will be done in the final stage.
5140	2	4	2524	2563	It seems, that this chapter takes into account so called lifecycle-emissions. This should not be the case: inventory estimates should not include lifecycle emissions. Please check and correct the text and tables 4.3.5 - 4.3.11 correspondingly. Leave out all the issues concerning life-cycle approach.	Kari Grönfors	Accepted	References to lifecycle emissions have been removed.
4818	2	4	2528	2532	Central Statistical Bureau of Latvia is collecting data of amount of produced wood pellets, but is not collecting information about sources of pellet production (as it is given in Volume 2 Chapter 4: Pellets from forest logging residues; Pellets from wood industry residues; Pellets from stem wood; and, Pellets from agricultural residues). It is difficult to obtain such data and this would be an overload for respondents.	Anna Paturaska	Noted	No action can be taken because comment does not require any substantial reaction.
5142	2	4	2538	2539	Add a remark to the Figure 4.3.6 showing, which parts of the pathway include direct fugitive emissions, and also a comment on estimation only fossil fugitive CO2 emissions. Show clearly which boxes include possibility of direct CH4 or N2O emissions (exclude lifecycle emissions caused by the non-road machinery, transport, electricity use, heat use etc.)	Kari Grönfors	Accepted	The figure has been revised.
5144	2	4	2544	2545	Table 4.3.5 seems to give energy consumption figures (factors) for pellet production. Emissions from these energy uses should not be accounted here, but in Fuel combustion subsectors. If the emission factors in this table include emissions from energy use, remove or correct the figures.	Kari Grönfors	Accepted	The section on wood pellet production has been revised, and moved to an Appendix.
4260	2	4	2544	2546	Tables 4.3.5 and 4.3.6 refer to "EMEP/EEA Guidebook 2013 Chapter 1.A.4.c.ii", but I do not find such a chapter. If the exact chapter name is "1.A.4 Non-road mobile sources and machinery", I suggest that the authors rewrite the reference as such.	Naofumi Kosaka	Accepted	The table has been removed in SOD.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
5736	2	4	2544	2552	In all tables instead of "amount" use "value" and place the unit in a column at the right side of the value. In tables 4.3.8 and 4.3.9 there are blank cells, please fill in. It is unclear for what purpose data in table 4.3.9 is used or how it should be used. Clarify, provide clear guidance.	Javier Marcelo Hanna Figueroa	Accepted	The table has been removed in SOD.
1510	2	4	2544	2552	Tables 4.3.5 to 4.3.10: It is not clear why the Tables 4.3.5 to 4.3.10 have been included, so far as they do not provide the values of greenhouse gas emission factors.	Michael Gytarsky	Accepted	The table has been removed in SOD.
4262	2	4	2544	2553	I assume that Tables 4.3.5 through 4.3.11 refer to "EMEP/EEA Guidebook 2013, 1.A.4 Non-road mobile sources and machinery, table 3-1, Forestry". Table 3-1 specifies fuels as diesel, LPG, four-stroke gasoline and two-stroke gasoline. I think that the emission factors in table 3-1 can not be applied to biomass fuels. As explained in Appendix C of the same chapter, table 3-1 is based on engine. I think that it is inappropriate to construct default emission factors of solid to solid transformation based on the emission factors in table 3-1 of EMEP/EEA Guidebook 2013.	Naofumi Kosaka	Accepted	The table has been removed in SOD.
5146	2	4	2545	2546	Table 4.3.6 seems to give energy consumption figures (factors) for pellet production. Emissions from these energy uses should not be accounted here, but in Fuel combustion subsectors. If the emission factors in this table include emissions from energy use, remove or correct the figures.	Kari Grönfors	Accepted	The table has been removed in SOD.
5148	2	4	2547	2548	Table 4.3.7 seems to give energy consumption figures (factors) for forest residues collection. Emissions from these energy uses should not be accounted here, but in Fuel combustion subsectors. If the emission factors in this table include emissions from energy use, remove or correct the figures.	Kari Grönfors	Accepted	The table has been removed in SOD.
5150	2	4	2548	2549	Table 4.3.8 seems to give energy consumption figures (factors) for woodchipping. Emissions from these energy uses should not be accounted here, but in Fuel combustion subsectors. If the emission factors in this table include emissions from energy use, remove or correct the figures.	Kari Grönfors	Accepted	The table has been removed in SOD.
5152	2	4	2549	2550	Table 4.3.9 seems to give some transportation information for typical pellet pathways. Emissions from transportation should not be accounted here, but in Fuel combustion subsectors. Remove table, or add emission factors, if there are direct fugitive emissions of CH4 or N2O during transportation.	Kari Grönfors	Accepted	The table has been removed in SOD.
5154	2	4	2551	2552	Table 4.3.10 seems to give energy consumption figures (factors) for agri-residues preprocessing. Emissions from these energy uses should not be accounted here, but in Fuel combustion subsectors. If the emission factors in this table include emissions from energy use, remove or correct the figures.	Kari Grönfors	Accepted	The table has been removed in SOD.
5156	2	4	2552	2553	Table 4.3.11 seems to give emission factors for pellet production. Emissions from energy uses should not be accounted here, but in Fuel combustion subsectors. If the emission factors in this table include emissions from energy use, remove or correct the figures.	Kari Grönfors	Accepted	The table has been removed in SOD.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
560	2	4	2552	2553	A similar remark on the default Efs as presented in table 4.3.11. I cannot believe that the uncertainties in these Efs are consistent with their presentation with three significant digits. Furthermore, no uncertainty ranges are provided here.	Tinus Pulles	Accepted	The table has been removed in SOD.
8832	2	4	2552	2553	The derivation of the values contained in Table 4.3.11 is very unclear. The preceding tables show e.g. emissions associated with transport and the energy consumption used for e.g. woodchipping. The EFs should represent fugitive emissions and only fugitive emissions and not energy related emissions from the manufacturing or transport. This needs a lot of further clarification.	Ole-Kenneth Nielsen	Accepted	Tables 4.3.5 through 4.3.11 have been removed in SOD.
5158	2	4	2559	2559	Wood pellets are usually commercially traded, thus the amounts should be available in energy statistics.	Kari Grönfors	Accepted with modification	The introduction on wood pellets has been revised without mentioning the availability on statistical data.
5968	2	4	2574	2612	All three sections (BTL, CTL, and GTL) have a slightly different discussion of FT process. Suggest creating a generic discussion of FT and move it to the up front section after line 2573	Vincent Camobreco	Accepted with modification	These sections have been rewritten focusing on Gasification process technology and highlighting that biomass, coal and gas are the inputs that can be used in the process. However, all information related to biomass input has been provided as an appendix because the technology is developing.
4040	2	4	2575	2588	This segment on biomass to gaseous fuels seems to only consider thermal processes, whereas biogas is commonly produced by microbial fermentation of wastewater. Line 2575 should be refined to recognise this other source. Additionally the start of the sentence "The biomass used in these processes does not have any carbon of fossil origin ..." should be changed to "With the exception of many wastewater treatment processes, the inputs to these processes do not have any carbon of fossil origin ..."	Gregory Peters	Rejected	Section 4.3, this section, does not cover fugitive emissions from non-energy related sectors. BiG is related to a specific process of gasification where biomass is gasified with oxygen and steam resulting in a synthetic gas, the syngas. Biogas produced by microbial fermentation is another process not related to BiG technology.
2444	2	4	2580	2717	This part uses several different expressions for a chemical process. Those are "Fisher Tropsch (FT)"(line 2580), "Fischer-Tropsch"(lines 2600, 2601, and 2717), "FischerTropsch(FT)"(line 2609), and "Fischer and Tropsch"(line 2649). Maintaining consistency in expression will make the guideline more readable.	Dong Koo Kim	Accepted	We have used one expression for the Fischer–Tropsch process.
5160	2	4	2589	2590	This seems to be a new requirement. According to present guidelines, only biogenic CO2 emissions from combustion should be reported as an information item. Fugitive biogenic CO2 emissions have not been included under this information item. This is quite a radical change, it should be checked.	Kari Grönfors	Accepted	This comment is very important, however, the cross discussion with AFOLU is still going on during the drafting of SOD and no action is implemented right now.
5970	2	4	2590	2593	Consistent language on biogenic CO2 emissions inclusion in LULUCF	Vincent Camobreco	Accepted	This comment is very important, however, the cross discussion with AFOLU is still going on during the drafting of SOD and no action is implemented right now.
2442	2	4	2596	2599	This part uses chemical terms such as "carbon monoxide, hydrogen"(line 2596), "hydrogen sulphide"(line 2597), and "hydrogen to carbon monoxide"(line 2599), not chemical symbols such as CO, H2, CO2 which are used in other parts of the FOD. Unless there is a special reason, maintaining consistency in expression will make the guideline more readable.	Dong Koo Kim	Accepted	We have harmonised the reference to chemical terms with their usages in other parts of the 2019 Refinement.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
5162	2	4	2602	2602	...fraction of CTL plant CO2...	Kari Grönfors	Accepted	We have corrected this typographical error.
5164	2	4	2602	2602	...needs to be separated...	Kari Grönfors	Accepted	We have corrected this typographical error.
5972	2	4	2602	2602	Change sentence ... CTL plan CO2 ... to ... CTL plant CO2 ...	Vincent Camobreco	Accepted	We have corrected this typographical error.
5974	2	4	2624	2624	Table 4.3.12 add BTL CH4?	Vincent Camobreco	Rejected	No action since the context is about CTL and GTL process.
5166	2	4	2662	2663	Decision tree in Figure 4.3.7 has an endless loop.	Kari Grönfors	Accepted with modification	The decision tree is still under consideration in SOD, and will be revised in the FD.
5738	2	4	2662	2663	The title and the contents in boxes of decision tree should refer to "gasification transformation processes" and not to "fuel transformation..."	Javier Marcelo Hanna Figueroa	Accepted	The title has been updated. The decision tree is still under consideration in SOD, and will be revised in the FD.
2446	2	4	2662	2663	Figure 4.3.7 only provides tier 1 and 3. Tier 2 needs to be added in the figure.	Dong Koo Kim	Accepted	The decision tree is still under consideration in SOD, and will be revised in the FD.
1512	2	4	2672	2674	The authors should explain the reasons for the use of default data on characteristic parameters from Chapter 2 of Waste Volume of the 2006 IPCC Guidelines within the description of methodology for estimation of greenhouse gas emissions from gasification transformation processes.	Michael Gytarsky	Accepted	
5168	2	4	2677	2677	Equation 4.3.3 leaves out some CH4 and N2O due to FCFi. This is not correct. The equation should be split to 2 equations, one for CO2 and the other for CH4 and N2O.	Kari Grönfors	Accepted	The equation has been modified into 2 equations in SOD.
5740	2	4	2687	2687	Include "municipal solid waste" before MSW and put this in brackets.	Javier Marcelo Hanna Figueroa	Accepted	The use of acronyms and definitions has been reviewed.
5170	2	4	2692	2692	Equation 4.3.4 leaves out some CH4 and N2O due to FCFi. This is not correct. The equation should be split to 2 equations, one for CO2 and the other for CH4 and N2O.	Kari Grönfors	Accepted	The equation has been modified into 2 equations in SOD.
5742	2	4	2707	2707	The first sentence needs some editorial work. It seems incomplete or to be linked with the second sentence.	Javier Marcelo Hanna Figueroa	Accepted	The sentence has been rephrased.
5172	2	4	2728	2729	Table 4.3.13 gives CO2EF of BtG and BtL processes. If CO2 is biogenic, it should not be estimated or reported.	Kari Grönfors	Accepted	
562	2	4	2728	2749	Default uncertainty data should be added to the tier 1 default EF tables 4.3.13, 4.3.14 and 4.3.15	Tinus Pulles	Accepted	The table will be modified and default uncertainty estimates will be added in the FD.
5976	2	4	2729	2729	Would the CO2 emission in Table 4.3.13 be listed as memo item?	Vincent Camobreco	Noted	Yes, just as a memo item.
5744	2	4	2729	2729	Move this sentence to the end of previous paragraph (line 2728).	Javier Marcelo Hanna Figueroa	Accepted	Sentence order has been adjusted.
2448	2	4	2734	2734	The description "Table 4.3.10 presents" needs to be corrected as "Table 4.3.14 presents".	Dong Koo Kim	Accepted	Text has been modified.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
8834	2	4	2741	2749	Table 4.3.15 is under the heading of gas to liquids, but the table heading mentions biomass to gas and biomass to liquid. Finally, the unit of the EF is presented as kg per TJ natural gas input.	Ole-Kenneth Nielsen	Accepted with modification	Modified the first part but the second part was not modified because it is correct.
4270	2	4	2742	2748	Line 2742 refers to Jaramillo et al. (2008), but such paper is not included in reference list (line 3645 through 3664). The reference list includes Jaramillo et al. (2007), but this paper is not related to 'gas to liquids'. I think the correct reference is as follows. http://pubs.acs.org/doi/full/10.1021/es8002074	Naofumi Kosaka	Accepted	References have been updated.
5174	2	4	2748	2749	Title of Table 4.3.15 is erroneous, it should read GTL instead of BtG and BtL.	Kari Grönfors	Accepted	The table heading has been changed.
4268	2	4	2749	2749	I suggest that the authors replace "BTG AND BTL" by "GTL" for the title of table 4.3.15.	Naofumi Kosaka	Accepted	The table heading has been changed.
5176	2	4	2756	2756	The activity data...	Kari Grönfors	Accepted	The typographical error has been corrected.
5178	2	4	2764	2764	The activity data...	Kari Grönfors	Accepted	The typographical error has been corrected.
4272	2	4	2764	2770	I introduce that the International Energy Agency (IEA)'s energy balance tables have the row of "Gas-to-liquids (GTL) plants" under "Transformation processes". This row shows the fuel quantity of gas input and liquid output. The CO2 emissions from GTL can be estimated from the carbon balance of this row. If national energy balance tables have GTL plants row like IEA, inventory compilers can estimate the emissions. I suggest that inventory compilers investigate whether national energy balance tables take into consideration GTL plants first. If it is already considered, inventory compilers need to confirm whether the emissions are already included in fuel combustion category. If it is confirmed, there is no need to estimate the emissions separately. If it is not confirmed, the emissions should be estimated by the default emission factor and gas input.	Naofumi Kosaka	Rejected	If you use energy balance we might overestimate the fugitive emissions. It would be possible only if the amount of gas reported in energy balance report is split between natural gas use for heating and electricity generation and for processing for liquid fuel production.
5746	2	4	2772	2780	For uncertainties please provide at least the expected order of magnitude for AD and EFs.	Javier Marcelo Hanna Figueroa	Accepted	The table will be modified and default uncertainty estimates will be added in the FD.
5180	2	4	2783	2783	First sentence is strange (delete "That" from the beginning?)	Kari Grönfors	Accepted	Sentence has been modified.
4266	2	4	3550	3550	I suggest that the authors add "IPCC" before publication year (2012).	Naofumi Kosaka	Accepted with modification	Reference has been deleted.
4264	2	4	3641	3644	I suggest that the authors add a reference of Asadullah (2014) mentioned in line 2727 and table 4.3.13.	Naofumi Kosaka	Accepted	Reference has been modified.
9036	2	4	2373 2394	2376 2395	Table 4.3.2 provides a range of emission factors according to kiln technology type - low efficiency kiln, high efficiency kiln and Mound kiln. Comment: It would be helpful for GHG inventory compiler if some standard specification / criterion / classification method may be provided to demarcate between low efficiency kiln and high efficiency kiln to enable compiler to select the emission factors from Table 4.3.2 on this basis.	Vishwa Bandhu Pant	Accepted with modification	The presentation of the EFs has been revised.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
9038	2	4	2404 2467	2405 2472	In 2014, 711 173 ktce of coking coal were produced. CHOICE OF EMISSION FACTOR - Currently there are no fugitive emission factors [of CH4 and N2O] from coke production which are sufficiently reliable to present as Tier 1 factors. If inventory compilers have measurements of emissions from either parts or all of the coke production processing stages, then these could be used as the basis of reported fugitive emissions. It is good practice to try and verify these emissions to ensure that they are realistic in magnitude in comparison with emissions from other categories in the iron steel sector, and the energy sector. Comment - Coking coal production is significant amount. Absence of the reliable fugitive emission factor(s) would lead to high uncertainties in emission estimate from Coking coal production.	Vishwa Bandhu Pant	Accepted with modification	CH4 emission from coke production is provided in SOD (table 4.3.5) based on the literature available in the drafting of SOD.
9592	2	2	23		No refinement was made to Tables 2.2, 2.3 and 2.4. However, default emission factors for stationary industrial combustion are considered too general, and it is recommended that IPCC expands the disaggregation by types of equipment (boilers, furnaces, etc.), technology and capacity, to reflect difference in emissions from different types of equipment.	MINGMING WANG	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
52	2	2	32	32	It is helpful to refine this section by adding a sentence to describe the reporting boundary of Energy sector and IPPU sector, especially for iron and steel subsector.	Mingshan Su	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
4448	2	4	33		emission? Letter case	KEWEI YU	Accepted	
4446	2	2	37	46	Define AFOLU, IEA	KEWEI YU	Rejected	These acronyms are available elsewhere in the guidance.
9702	2	2	46	49	the use of international statistics (FAO or IEA) for AD would underestimate the caused emissions. In most countries there are in addition large private collection procedures in place (this could add up to 100% range of the data in official statistics. Should be mentioned in the data sources as well - a good tool to estimate these fuel quantities could be questionnaires.	Michael Strogies	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
4450	2	4	54		transformation, spelling	KEWEI YU	Accepted	
4452	2	4	58		production? letter case	KEWEI YU	Accepted	
4454	2	4	76	90	letter case	KEWEI YU	Accepted	
4456	2	4	80		CO2, CH4, upper case letters	KEWEI YU	Accepted	
4458	2	4	135	136	default, emission	KEWEI YU	Accepted	
4460	2	4	188		Background	KEWEI YU	Rejected	No action can be taken because comment is out of scope of 2019 Refinement.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
9718	2	3			The FOD does not contain any update to section 3.6 Civil aviation. However, as mentioned in previous comments, cities as the largest GHG emissions contributors often do not have access to airport and flight data, whereas national government or agencies mostly do. Therefore it is strongly recommended that IPCC requires national inventories to report aviation emissions per airport and even per flight where possible.	MINGMING WANG	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
9720	2	3			To improve modelling of LTO emissions, it is strongly recommended that IPCC expands the EEA methods to provide average taxi-time data for airports outside EU and USA, and to update the current ICAO default values of taxi-time as they are quite rough and likely too high for small and medium sized airports and too low for poorly managed large airports.	MINGMING WANG	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
552	2	4			I congratulate the authors of this FOD for the good work they have performed. As I hoped and expected, the refinements in the energy volume are not very many. Neither are my comments!	Tinus Pulles	Noted	No action can be taken because comment does not require any substantial reaction.
5262	2	4			Default emission factors for fugitive emissions are generally too coarse. For example, the value for N ₂ O from oil exploration in Table 4.2.3 range anywhere between 0.07 and 1.10. More refined data at more granular geographic level would be more helpful.	MINGMING WANG	Accepted with modification	Values were updated to use 1 value and no ranges in the SOD. We disagree that more refined data at more granular geographic levels are appropriate for Tier 1 factors.
2512	2	4			Chapter needs proof-reading, particularly from 4.2.2.4	Anna Mikis	Accepted	
5638	2	2	34	35	It is absolutely unclear what would be the issue on the link of biomass combustion and methodologies for Harvested Wood Products. However, this elaboration should be open for expert review also and not only for Governmental review.	Javier Marcelo Hanna Figueroa	Accepted with modification	Appears that the commenter misinterpreted the text to mean that additional information will be provided in this section later. We changed the wording to not say "link" but instead say "note the location".

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
7840	2	2	37	41	The text does not give compilers sufficient guidance about the implications of their choice of approach in accounting for harvested wood products that may be used as biomass fuels, and these implications include over- or under-reporting emissions, which affect the accuracy of the reporting. Thus, countries need additional guidance about how to fulfill the TACCC principles with respect to their choice of approach. One way the risk of over- or under-reporting emissions arises is due to differences in accounting approaches between importing and exporting countries. Depending on the approaches used by each country, the carbon in traded HWPs could be reported once, twice, or not at all. In particular, the use of the 'production approach' or 'stock-changes of domestic origin approach' by an importing country could lead to under-reporting of emissions, because imported wood used for biomass fuel may not be included in the inventory. The volume of trade in HWPs is significant for many countries, and therefore the guidance should explicitly indicate how their choice of approach vis-a-vis their trading partner(s) will affect the estimated emissions from HWPs in each country. One suggestion is that the implications could be made clear by including a simple table in the guidance near this point in the text. The table should show the choice of approach by exporting country in the columns and the choice of approach by importing country in the rows. The cells of this matrix should indicate the number of times HWP emissions will be counted (zero, one, or two times) for each combination of approaches by importing and exporting countries.	Jason Funk	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
5640	2	2	37	45	The language should be rearranged and make clearer here. This chapter is for energy experts, and they need first to know that: CO2 emissions from combustion of biomass fuels are estimated in the Energy sector, but reported as information item only, and not included in the sectoral and national totals. After that it should be indicated that CO2 emissions from combustion of biomass fuels are estimated and reported in the AFOLU sector. Then it should be indicated that CH4 and N2O emissions from combustion of biomass fuels are estimated and reported in the Energy sector, and included in the sectoral and national totals.	Javier Marcelo Hanna Figueroa	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
7434	2	2	37	47	Although emissions of CO2 from biomass fuels are estimated and reported in the AFOLU sector as part of the 38 AFOLU methodology. However, there is still need to elaborate more on treatment of biomass.	Onema Adojoh	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
7842	2	2	39	41	The emission factor tables referenced in these lines do not include emission factors for all classes of wood products associated with the activity data defined in Volume 4 Section 12.5.1.1. As a result, inventory compilers may not have sufficient guidance to accurately and completely report emissions from important classes of wood products. In particular, certain classes of wood products, such as wood chips and particles, have become increasingly important as exports and as sources of biomass used for energy. To provide sufficient guidance to inventory compilers for the Energy sector, Volume 4 Table 12.3 should be expanded to include all HWP categories listed in Volume 4 Table 12.2, along with default half-lives for each category.	Jason Funk	Noted	No action can be taken because comment is out of scope of 2019 Refinement.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
9174	2	2	39	41	In reference to item 2.3.3.4, where countries are to report the split the fossil- and non-fossil fractions between 'biofuels combusted jointly with fossil fuels...' This is a practical impossibility. Each firing may involve a different split between fractions, and the non-fossil component of that firing could vary from whole trees to rice straw. The better solution would be to report co-fired biomass in the energy sector, subtracting out the net carbon from pellets or torrefied materials that would still be reported under AFOLU. The emission factor tables referenced here simply do not include emission factors for the necessary range of wood products associated with the activity data defined in Volume 4 Section 12.5.1.1. To provide better guidance, Table 12.3 in Volume 4 should be expanded to include all HWP categories listed in Volume 4 Table 12.2, along with the default half-lives for each category.	peter riggs	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
9410	2	2	42	43	It is stated that CO2 from biomass combusted for energy purposes should be estimated and included as an information item in the Energy sector but not included in national total. From this explanation it is understood that all kind of biomass should be treated in the same manner. However for sludge gas produced from sewage sludge digestion, biogas from biological treatment of waste (e.g manure), and landfill gas combusted for energy purpose, it will be better to add further explanation to clarify why those are considered carbon neutral and how they are treated under AFOLU sector (or in which part of AFOLU guidelines they are considered).	AYNUR TOKEL	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
5642	2	2	52	54	Here some words should be added on the typical case of use of biomass fuels blended with fossil fuels that occurs in transport and that this issue is treated in sections 3.2.1.2 and 3.2.1.3 of chapter 3.	Javier Marcelo Hanna Figueroa	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
4034	2	2	52	54	Recent research has shown that some "biofuels" are in fact a blend of biogenic and fossil carbon (see Vol5_Chp6_L773-811). We should insert a statement after the first sentence like "It is also the case that gaseous, liquid and solid biofuels are produced in a single process unit using both biogenic and fossil carbon (see Vol5_Chp6_Annex6A.2)."	Gregory Peters	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
9172	1	4	216	220	The Inventory of Quality is incomplete. If the authors acknowledge that 'use of harvested woody biomass for energy purposes does not belong to a defined and reported carbon pool,' then what are the 'relevant categories' for biomass energy? How can biomass for energy be made into a more relevant category given its increased prominence in renewable energy strategies and international trade?	peter riggs	Noted	No action can be taken because comment is out of scope of 2019 Refinement.
9404	2	2	273	274	I found this sentence confusing in the paragraph: "With regard to allometry, new models with parameter estimates differing from the ones in use do not necessarily require recalculations, because allometry can change over time (Lopez-Serrano et al. 2005)." It should be noted that many European forests are young and not in equilibrium and thus, the relation between tree compartments can change. It is therefore interesting to highlight the interest of this analysis.	Iciar Alberdi	Transferred	Transferred to Volume 4 AFOLU.

Comment ID	Volume	Chapter	From line	To line	Comment	Expert	Response	Authors note
5628	2	3			Section 3.3.1.4 (Completeness) states that carbon from biomass should be estimated separately and reported as an information item to avoid double accounting, as these emissions are already treated in the AFOLU sector. Will the IPCC provide further guidance on emissions from combustion of renewable diesel (RD)? How can nations (and cities) share the accountability of emissions generated by the RD combustion, if RD is produced in a different country?	MINGMING WANG	Noted	No action can be taken because comment is out of scope of 2019 Refinement.