**Review Comments by Governments on Second 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 | Country | Response | Authors note |
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| 9194 | 2 | 4 | 341 | 343 | These two sentences are unclear. Should clearly differentiate between resource available to be mined and annual production. Note a more detailed explanation in lines 1166 to 1169. Replace the term resource augmentation with “proven reserves” or some variation of that term. | Canada | Rejected | Augmentation of coal resources is the additional resource of coal and lignite found as a result of exploration during a reporting year which, when added to the previous year’s resource, gives current resource. Further, the augmentation of coal or lignite resource is is a proxy data that may be linked to the drilling performed in a year and hence to the number of exploration boreholes drilled in the reporting period. It may not be out of place to mention that the entire augmented resources are not the sources of greenhouse gas emission but it indirectly represents the number of coal exploration boreholes since the exploratory drilling is usually carried at known interval over coal bearing areas for assessment of coal potentiality. The spacing of the boreholes depends on geological structure, deposit character, nature of data required for mine planners etc. Augmentation of resource is either presented in the geological reports prepared by exploration agencies or can be very easily calculated by the difference of resource of the current year and the previous year.<br>Proved reserve on the other hand represents the quantities that certainly can be recovered in the future from known deposits under existing economic and operating conditions. It is not only the reserve found in the reporting year but also includes the reserves found in past several years. Therefore, proved reserve cannot be linked to the number of exploration boreholes drilled in the reporting year.<br>Therefore, proved reserve cannot be used as activity data to represent number of exploration boreholes drilled in a reporting period but augmentation of resource (or new addition to the resource in a reporting period) may be used for this purpose. |
| 5556 | 2 | 4 | 380 | 402 | The new text addressing fugitive CO2 emissions for coal mines is confusing and could be clarified. The new text appears to be addressing the oxidized CO2 when coal mine CH4 is flared. However, the description of "the amount of CO2 contained in the gas that is recovered and utilized for energy production" is confusing, implying that what is estimated is the CO2 present in the gas prior to flaring (e.g., see the reference in the new text to CO2 already being included in the fugitive CO2 emission factor for underground mining). This text also implies a double-counting of CO2 emissions in the revised equation (due to inclusion in the fugitive CO2 emission factor for underground mining and also inclusion as fugitive CO2 emissions from flaring). The new text section, which is focused on CO2, also addresses in passing the unburned fraction of CH4 during flaring. Accounting for these CH4 emissions, due to incomplete combustion at the flare, is appropriate, but it is not addressed elsewhere in the new text or in the pre-existing text. This should be further explained and clarified. | United States of America | Accepted with modification | This new text is to interpret Equation 4.1.2 and how adjustment due to seam gas utilization and flaring should be made/considered to the seam gas emissions. Please note that the later is calculated on the basis of Equation 4.1.1. There is no double-counting of CO2 emissions in Equation 4.1.2 (the fugitive CO2 emission factor in Equation 4.1.1 only refers to formation CO2 that is contained in the seam gas because it does not take into account any scenario of seam gas utilization and flaring. Therefore, the oxidized CO2 from coal mine methane flared is not double-counted). Also please note that accounting for the oxidized CO2 from methane flared is already included in the 2006 IPCC Guidelines (See table 4.1.1 and Equation 4.1.5 in the same chapter). This new text is just to echo it from the view at an aggregate level. Nevertheless, wording of the text has been further refined to avoid such misunderstandings. |
| 6660 | 2 | 4 | 385 | 386 | Equation 4.1.2 elaborated for inclusion CO2: As it currently stands, the equation for reporting CO2 emissions for underground mining activities seems to lead to underestimation of the CO2 emissions, if those originate from recovered coalbed gas burned for energy purposes (note that the reporting on CO2 emissions from combustion for energy purposes of the recovered coalbed gas is treated under Chapter 2, Stationary Combustion, of the 2006 Guidelines). It is proposed that the authors cross-check the Equation 4.1.2 and supporting text to avoid inconsistency in the 2019 Refinement. | Russian Federation | Rejected | The new text under Equation 4.1.2 in the Refinement has explained why "the amount of CO2 contained in the gas recovered and utilized for energy production" should be subtracted. If seam gas is recovered and utilized for energy production purpose, then the CO2 contained in the seam gas is held in the recovered gas until the later is being consumed. This amount of CO2 (along with other carbon-containing components in the recovered gas) would be reported under other relevant source categories (instead of fugitive emissions from mining activities) depending on the end-use characteristics of the recovered gas. There is no underestimation of CO2 emssionns in Equation 4.1.2, or any inconsistency between the Refinement and the Chapter 2, Volume 2, of the 2006 Guidelines. |

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| 6662 | 2 | 4 | 425 | 425 | Editorial: the word "purposes" seems redundant. It is proposed to remove it. | Russian Federation | Accepted | Deleted. |
| 5558 | 2 | 4 | 568 | 568 | Should the word "sole" be inserted before "purpose of gas mining delivery". Or does the rest of the sentence also apply when gas is extracted from coal seams for delivery into the natural gas system as a secondary activity associated with actual coal mining of the seam. Degasification may be a regulatory requirement for coal mining operations, and the operator may chose to deliver the gas rather than vent it to the atmosphere. Check that there is clarity and consistency with Vol 2 Ch4 lines 1380-1382. | United States of America | Accepted with modification | "for the purpose of.." has been deleted from the text to remove any ambiguity regarding intent. The corressponding text in the the Oil and Gas section Vol 2 Ch4 lines 1380-1382 has been alighned with that of the coal section. |
| 6664 | 2 | 4 | 717 | 717 | Equation 4.1.6 elaborated for inclusion CO2: As it currently stands, the equation for reporting CO2 emissions from surface coal mining seems incomplete. It is proposed that the authors reconcile the equation and elaborate on it. | Russian Federation | Accepted | Have added a term for "Post-mining emission of CO2" in Equation 4.1.6 for completeness. Have also added clarifying text in 4.1.4.1 noting that while no default method is provided for estimating Post-mining emissions of CO2 , countries can provide their own country-specific emission estimate. |
| 6876 | 2 | 4 | 785 | 785 | Average CO2 emission factor is not correct.<br>0.65㎥/tonne → 0.44㎥/tonne | Republic of Korea | Accepted | Error identified. The text has now been updated. |
| 6878 | 2 | 4 | 979 | 979 | There is only the emission factor for the inventory year 1990 - 2016 in Table 4.1.6 but abandoned underground mines calculation for 2017 or 2018 may be necessary in the next year because 2019 Refinement will be approved in May 2019. This is one way to provide an calculation formula like Tier 2. | Republic of Korea | Accepted | The abandoned mines methodology is out of scope. However it is acceptable to update this table for years beyond 2016. |
| 9196 | 2 | 4 | 1157 | 1157 | Required coal data is often unavailable on a yearly basis. What would be the suggested solution when data on “resource augmentation” is only available on a decade by decade basis? Can options be provided for national inventories which do not have this data available? | Canada | Accepted | Included one small para in section 4.1.6 (5th Paragraph). |
| 5560 | 2 | 4 | 1161 | 1161 | Is it possible that a country would collect data on the number of exploratory borewells drilled, and that those data would be relevant to an estimate of emissions? If so, then insert the word "usually" or "typically" before "readily available". | United States of America | Accepted | Insert the word "usually" before "readily available". |
| 6668 | 2 | 4 | 1170 | 1171 | Figure 4.1.4: The decision tree seems to undermine general concept of inventory improvement, which builds upon key category analysis. In the 2006 Guidelines, the question if the category concerned is key was put in the beginning of each decision tree and guided further actions of inventory compilers. However, in the present structure of decision tree, this question is missing. To maintain concictency in decision tree presentation, it is proposed that the authors reconcile the decision tree to include key category identification. Furthermore, it is also proposed to include currently missing reference to Figure 4.1.4 in the text of section 4.1.6.1. | Russian Federation | Accepted | Decision tree updated. Reference inserted in line 983. |
| 6292 | 2 | 4 | 1170 | 1171 | The Decision tree in Figure 4.1.1 needs to accommodate the Tier 3 method option (Borehole specific approach) that is introduced in line 1217. | Australia | Accepted | Decision tree updated. |

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| 1796 | 2 | 4 | 1174 | 1175 | From line 1174-1175, it seems that no information is available in the scientific literature to develop well-established emission factors for estimating emissions from coal exploration, whether number of coal exploration boreholes or augmentation of resource is used as activity data. For this reason, as well as to be consistent with the treatment of other subcategories (such as Abandoned Surface Mines, Wood Pellet production, Biomass to Liquid and Biomass to Gas) that if insufficient information is available in the scientific literature, a methodology should not be provided in the body of the guidelines. Therefore, It is suggested that section 4.1.6.1 through 4.1.6.6 be moved to the annex part as merely an indicative methodology or a basis for further research. | China | Accepted with modification | Text modified in 4.1.6.2. |
| 1798 | 2 | 4 | 1179 | 1193 | Reference should be provided to demonstrate scientific rationality of this method, as well as source of these default emission factors. | China | Accepted | Additional detail has been provided (lines 1054 to 1060) on the source of the emission factors and method (expert judgement). |
| 6670 | 2 | 4 | 1179 | 1221 | The descriptions of tiers 1 to 3 and the equations 4.1.14 and 4.1.15 seem to be irrelevant for Choice of Emission Factors sub-section (4.1.6.2). They seem more appropriate to Choice of Method sub-section (4.1.6.1). It is proposed that the authors consider moving the description of tiers and the equastions concerned to section 4.6.1, while the emission factors are retained in the section 4.1.6.2. | Russian Federation | Accepted | Text amended. The description of tiers and corresponding equations have been moved sub-section 4.1.6.1 and the emission factors have been retained in the sub-section 4.1.6.2. |
| 6672 | 2 | 4 | 1182 | 1189 | Equation 4.1.14: The equation for estimation of methane emissions from coal exploration builds on annual augmentation of entire coal reserves. The estimation method looks incorrect, because as such, the coal reserves do not produce emissions in a stable state. The emissions occur with the start of mining activities (exploration, production, treatment etc.). With this, simple presence of augmented coal reserves cannont be considered as the source of emissions. Indeed, the exploration boreholes constructed annualy for coal reserves assessment are emission source categories. However, it does not mean that all greenhouse gases accumulated in augmented coal reserves release through exploration boreholes (note that the equation 4.1.14 is currently designed in a way that all augmented coal reserves form the source of greenhouse gas emissions that release through the boreholes). It is proposed that the authors reconcile the design of equation 4.1.14 to concentrate on the number of exploration boreholes and provision specific emission factors per exploration borehole. | Russian Federation | Accepted with modification | Major coal producing countries do present coal resources on an year-to-year basis. These may be ascertained from several governmental and non-governmental reports and links. Therefore, augmentation of coal resources on annual basis can be obtained to a large degree of accuracy. Number of exploration boreholes drilled annually seems to be a better option. However, this data is not readily available in national statistics. Therefore, we have considered this approach in a Tier 3 method. Tier 1 and Tier 2 methods based on augmentation of resorces and depth-wise augmentation of resorces respectively, can be used if data number of boreholes drilled is not available or cannot be collected from coal exploration agencies or corporates. |
| 850 | 2 | 4 | 1185 | 1193 | What is the intended meaning of “Augmentation of Resource”? | Thailand | Noted | It has already been defined in the text as "new addition of resorce". |
| 1800 | 2 | 4 | 1190 | 1196 | Given that low, average and high CH4 EFs are provided for Equation 4.1.14, some hints or instructions should be provided so that inventory compilers in practice know how to select suitable EFs. | China | Accepted | Hints has been provided. |
| 1802 | 2 | 4 | 1197 | 1213 | Reference should be provided to demonstrate scientific rationality of this method, as well as source of these default emission factors. | China | Noted | The depth-wise approach has been merged with the global average approach. Additional detail has been provided (lines 1054 to 1060) on the source of the emission factors and method (expert judgement). |

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| 6674 | 2 | 4 | 1200 | 1204 | Equation 4.1.15: The equation for estimation methane emissions from coal exploration builds on annual augmentation of entire coal reserves, which seems incorrect, because coal reserves as such do not produce human-induced greenhouse gas emissions. The human-induced emissions occur with the start of mining activities (exploration, production, treatment etc.). With this, simple presence of augmented coal reserves cannont be treated as a source category. Indeed, the exploration boreholes constructed for coal reserves assessment are emission sources. However, it does not mean that all greenhouse gases accumulated in coal reserve release through exploration boreholes (note that the equation 4.1.15 is currently designed in a way that all augmented coal reserves are the source of greenhouse gas emissions that release through the boreholes constructed). It is proposed that the authors reconcile the equation 4.1.15 to concentrate on the number of exploration boreholes and provision specific emission factors per exploration borehole. | Russian Federation | Accepted with modification | Major coal producing countries do present coal resources on an year-to-year basis. These may be ascertained from several governmental and non-governmental reports and links. Therefore, augmentation of coal resources on annual basis can be obtained to a large degree of accuracy. Number of exploration boreholes drilled annually seems to be a better option. However, this data is not readily available in national statistics. Therefore, we have considered this approach in a Tier 3 method. Tier 1 and Tier 2 methods based on augmentation of resorces and depth-wise augmentation of resorces respectively, can be used if data number of boreholes drilled is not available or cannot be collected from coal exploration agencies or corporates. |
| 6294 | 2 | 4 | 1217 | 1221 | The text discussing the Tier 3 method for coal exploration boreholes mentions the use of gas content and desorption data in determining a high tier approach, which will be useful for countries developing a Tier 3 approach. However mention should also be added of other factors relevant to a Tier 3 approach such as the number of boreholes, permeability and the impact of management actions such as borehole capping. This would allow countries to have the flexibility to develop Tier 3 approaches that are best representative o their circumstances. | Australia | Accepted | Mention of other factors has been made. |
| 6296 | 2 | 4 | 1222 | 1231 | It would be helpful to include a short paragraph here that notes when considering a borehole-specific approach, there is a need to ensure the source boundary distinction between boreholes that are drilled as part of coal mine production (which are already included as part of Undergound and Surface coal mining activities) and those drilled for coal mining exploration. Inclusion of this will assist inventory compilers to avoid double counting. | Australia | Accepted | A short paragraph has been included. |
| 6676 | 2 | 4 | 1226 | 1226 | The statement in paragraph is not necessary correct because the augmentation of coal reserves is not necessarily performed annually, and it may not be necessary to produce new boreholes to assess year-by-year changes in coal reserves, especially if the coal basin is subject to permanent exploration and processing (production). Furthermore, other exploration methods have been developed recently which do not require construction of boreholes or tend to reduce their number as much as practicable. Besides, the equation in line 1226 may have negative result, if coal reserves decrease. It is proposed that the authors reconcile the guidance on reporting on GHG emissions from coal exploration based on augmentation concept and concentrate on the treatment of boreholes produced for exploration purposes. | Russian Federation | Accepted with modification | Major coal producing countries do present coal resources on an year-to-year basis. These may be ascertained from several governmental and non-governmental reports and links. Therefore, augmentation of coal resources on annual basis can be obtained to a large degree of accuracy. Number of exploration boreholes drilled annually seems to be a better option. However, this data is not readily available in national statistics. Therefore, we have considered this approach in a Tier 3 method. Tier 1 and Tier 2 methods based on augmentation of resorces and depth-wise augmentation of resorces respectively, can be used if data number of boreholes drilled is not available or cannot be collected from coal exploration agencies or corporates. |
| 6298 | 2 | 4 | 1243 | 1252 | It may be possible that a countries statistics show a reduction in the coal resource quantity for a particular year. In this case the method may produce a negative emission in that year. It would be helpful if the text could mention this as being undesirable outcome. In that case, guidance could be provided indicating that the activity data time series may need to be rescaled consistent with methods discussed in Volume 1 Chapter 5 in order to avoid negative emission outcomes, while maintaining time series consistency | Australia | Rejected | Additional guidance is unavailable. |
| 852 | 2 | 4 | 1244 | | Typo “Cahpter5” | Thailand | Accepted | Mistake corrected! |

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| 854 | 2 | 4 | 1594 | | Should the atmospheric pressure unit be similar throughout the Guidance? Some volume use 1 atm for the standard condition, not "101.325 kPa" and it is easy to read for the reader. | Thailand | Rejected | IPCC GLs are under SI units. kPa unit must be used. |
| 856 | 2 | 4 | 1790 | | Not specific text/unclear for "In the table below,… | Thailand | Accepted | Added table # to sentence. |
| 858 | 2 | 4 | 1843 | | Not specific text/unclear for "The table below…" | Thailand | Accepted | Added table # to sentence. |
| 1804 | 2 | 4 | 2058 | 2062 | Error in Equation 4.2.13, "A• EFunconventional gas with flaring or recovery" should be "Aunconventional gas with flaring or recovery• EFunconventional gas with flaring or recovery", please check and correct the formula. | China | Accepted | Corrected variable "A". |
| 5562 | 2 | 4 | 1443 | 1443 | The figure titled "Segments included in Natural Gas Systems (1B 2b)", fails to clearly highlight the ADDITIONAL LNG life-cycle stages (namely, Liquefaction; Storage; Offloading and Onloading; Shipping and Regasification), which should emphasize the difference in emissions profiles between traditional piped gas and LNG. | United States of America | Accepted with modification | LNG is only mentioned in 1B 2b iv in the text, so we remove any wording about it under the Processing column. We alter the wording under Transmission and Storage to read "LNG Stations and Export/Import Terminals (Liquefaction, Re-gasification), Transport & Storage." We connect this with a green arrow to the LNG truck and ship to represent transportation. Under the onshore plant next to the underground storage we now state: "LNG Stations and Export/Import terminals (Liquefaction, Re-gasification), transport, and storage". The boat next to it has the listing LNG transport (and obviously represents shipping). In the caption for the figure we now note: "Note: this diagram provides examples of activities included in the segments of oil systems; it is not intended as a flow chart or supply chain diagram." |
| 5564 | 2 | 4 | 1443 | 1444 | In the Transmission and Storage segment, there is an emission source described as "Pipeline Transmission & Boosting". Boosting stations are typically described as being in the Gathering and Boosting segment of the industry. Consider rephrasing this as "Compressor Stations", "Transmission Compressor Stations" or "Transmission Compression Stations". | United States of America | Accepted | We revise to "Transmission compressor stations". |
| 5566 | 2 | 4 | 1443 | 1444 | For the green arrow between "Pipeline Transmission & Boosting" and "LNG Re-gasification and Storage", it could be shown as a double arrow, since some LNG storage may occur after the gas has been transported through a transmission system, e.g., LNG peak shaving units | United States of America | Accepted | |
| 5568 | 2 | 4 | 1482 | 1482 | I thought the term sweetening/amine units refer to H2S removal? Perhaps more appropriate to use acid gas removal. | United States of America | Accepted with modification | Acid gas removal and sweetening are synonymous. Sweeting and acid gas are defined in the glossary. We revise: "Formation CO2 removed from natural gas by the sweetening units at gas processing plants (i.e. for acid gas removal)." |
| 5570 | 2 | 4 | 1489 | 1489 | Suggest using "…are often stochastic and challenging to quantify" instead of existing text. | United States of America | Rejected | The intent of the comment is covered in the existing text. |
| 5572 | 2 | 4 | 1497 | 1497 | Suggest using "…difficult to access and dangerous for direct measurement" so supplement existing text. | United States of America | Accepted | |
| 5574 | 2 | 4 | 1756 | 1756 | Change "The level of available data also varies." to "Data availability may also change". | United States of America | Accepted | Proposed wording is clearer than SOD. |

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| 5576 | 2 | 4 | 1871 | 1872 | Typo - the phrase "gas oil ration" should say "gas to oil ratio" | United States of America | Accepted with modification | Corrected text to "gas oil ratio". |
| 5578 | 2 | 4 | 2032 | 2032 | Possible to reference or include an international reference showing where tight sands/shales occur as a guide to helping countries assess the extent of potential unconventional production? See e.g., https://www.eia.gov/analysis/studies/worldshalegas/images/fig1map_large.jpg or https://www.iea.org/ugforum/ugd/ | United States of America | Accepted | Reference has been added to the main text. |
| 5580 | 2 | 4 | 2040 | 2042 | Would well "re-drilling" or "re-fracturing" be addressed the same way, as part of the Tier 1 exploration approach? | United States of America | Accepted with modification | Edited both oil and gas production to clarify that re-drilling and refracturing are included in the production segment. |
| 5582 | 2 | 4 | 2105 | 2106 | Typo - the phrase "gas oil ratio" should say "gas to oil ratio" | United States of America | Rejected | It's commonly called gas oil ratio. |
| 5584 | 2 | 4 | 2170 | 2172 | Emissions along the LNG value chain are barely described under the “Natural Gas Systems” subsection – a cursory attempt to do this is in the form of a simple referral to the American Petroleum Institute’s (API) 2015 report on LNG emissions. This is in stark contrast with the robust description dedicated to Oil systems, from cradle to grave. | United States of America | Noted | The guidelines are not a supply chain description, but rather a guide for inventory compilers to understand where to report fugitive emissions associated with various activities. In the caption of Figure 4.2.1 we write: “ Note: this diagram provides examples of activities included in the segments of oil systems; it is not intended as a flow chart or supply chain diagram.” |
| 6380 | 2 | 4 | 1349 | | As a general observation the Guidelines tend to see the upstream oil and gas industry as either gas production or oil production. It should be recognized that many upstream oil and gas facilities produce and process both. Also, the current approach and terminology used appears very USA centric and may not reflect the terminology, nature and structure of the oil and gas industry in other jurisdictions. | Australia | Accepted with modification | We added text on the distinction between oil and gas wells, above eqn 4.2.9, eqn 4.2.10, eqn 4.2.13 and eqn 4.2.14: if national criterial is there to define the oil and gas well, please follow the national criteral or national documentation. what is more important is emission should be allcoated to either oil or gas system, without omission. We have reviewed the terminology and added additional detail in the main body and the annex to explatin what each term mean. The oil and gas industry can vary across coutnries and over time. We have been clear in the text that this is that case and that a country that thinks the appraoch/EF will not be appropriate for the country's natioanl circumstances can consider otehr data if available. |
| 6382 | 2 | 4 | 1349 | | Greater clarity is required in the Guidelines to bring the definitions of various products and activities in line with the way these are generally applied in the upstream oil and gas industry. In particular greater differentiation and clarity should be provided around the use of terms “condensate”, and ‘”natural gas liquids”. These tend to be used interchangeably in the Guidelines where as in some parts of the industry condensate generally refers to products that exist as a gas in the reservoir but condense into a liquid at the surface. Whereas natural gas liquids is generally used to refer to propane and butane (LPGs). | Australia | Rejected | Low vapor pressure condensate and NGLs are synonymous, and NGLs consist of more substances than just LPGs (see response to comment #6406). We have reviewed the use of the terms NGLs and condensate within the document and they are used correctly according to definition. The definitions used in chapter 4 are and have been in line with the fuel definitions in chapter 1 that have not been subject to refinement. In addition these definitions are in lines with those by the International Energy Agency (IEA).We note that industry does not always consistently adhere to these strict definitions, however. But for the purposes of the guidelines, we clearly define what is meant (see the glossary, for example). |
| 6384 | 2 | 4 | 1363 | | Aggregating emissions from flaring, venting, leaks etc under the umbrella of fugitive emissions has the potential to cause confusion. Generally, the term fugitive emissions is used in some parts of the upstream oil and gas industry refer to equipment leaks from process components like flanges and valves. Including sources such as flares and vents under the term fugitives risks causing confusion. | Australia | Rejected | The defition of fugitives for oil and gas systems in the IPCC guidelines has been in place for years and is out of scope of the 2019 refinement. Throughout the chapter, the authors have been clear that fugitives include leaks, vents and flaring. |

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| 6386 | 2 | 4 | 1613 | | There is scope for confusion as what is an exploration activity and what is a production activity. Generally the upstream oil and gas industry thinks of exploration as those activities leading up to the discovery of an oil and gas accumulation/field. This is then followed by field appraisal before the field is developed and production operations undertaken. Noting drilling of new production wells can often occur well into the operating life of an oil or gas field. | Australia | Accepted with modification | We have updated our definition of "exploration" to encompass any activities that may involve fugitive emissions that occur prior to a well's productive life (i.e. activities leading up to discovery, field appraisal before development etc.). In Table 4.2.1 we add for oil exploration: "Includes fugitive emissions associated with field activities prior to production: prospecting and or exploratory drilling, field development and both conventional and unconventional well development (construction/drilling, testing, completion, work overs, any fracture stimulation)." |
| 6388 | 2 | 4 | 1365 | | We understand in some jurisdictions (USA EPA) define all drilling related activities (exploration drilling, appraisal drilling, development drilling, well completions, well work overs) to be "exploration". This is not aligned with the industry use of the term exploration. Simply looking at the IPCC guidelines it is not clear where field appraisal and development drilling activities are to be reported. Do these fall in "exploration" (noting some filed development work may occur will into a field operating life) or 'production" noting the sorts of activities listed under production don't appear to cover field development drilling etc. This could be simply clarified by changing the headline of "Exploration" to be "Well Construction". For example at line 1365 it talks about the oil and gas "system begins at the well head". This does not appear to acknowledge the volume of activities and in some cases emissions that occur before the well head is in place. | Australia | Accepted with modification | We adopt the definition that the "Exploration" segment of oil and natural gas systems encompasses all activities that could potentially have fugitive emissions that occur prior to extraction of hydrocarbons that will be refined and distributed to end users. Thus, this segment includes: prospecting and/or exploratory drilling, development work in a field prior to operation, well development (construction to completion). We retain the word "Exploration", however. We revise line 1365: "The system begins during the exploration process which includes all fugitive emissions associated with activities such as prospecting and/or exploratory drilling, field development and well development (construction to completion, fracture stimulation), and ends at the consumer (including fugitive emissions between gas meters and gas appliances, but not from appliance start-stop losses or appliance combustion)." |
| 6390 | 2 | 4 | 1430 | 1431 | Lines 1430 and 1431 talk about well completions in the context of unconventional exploration and conventional exploration. The use of the term exploration to describe field development activities does not reflect the way the term exploration is used across industry. | Australia | Accepted with modification | We have revised the definition of exploration based on comment #6388 to encompass all activities with fugitive emissions that occur prior to extraction of hydrocarbons for refining and distribution. We retain the word "exploration" and revise line 1365: "The system begins during the exploration process, which includes all fugitive emissions associated with activities such as prospecting and/or exploratory drilling, well testing, field development and well development (construction to completion, fracture stimulation), and ends at the consumer (including fugitive emissions between gas meters and appliances, but not from appliance start stop losses or appliance combustion)" The guidelines distinguish between between unconventional and conventional completions (Line 1421) because they have a different emissions profiles for the exploration segment; thus, we are not considering the product in this differentiation, but rather the fugitive emissions profile. Therefore, we are already differentiating by emissions source type. In line 1430 we specifically state that: "In this chapter, unconventional exploration refers to exploration that includes well completions with hydraulic fracturing and conventional exploration refers to exploration that does not include well completions with hydraulic fracturing". |

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| 6392 | 2 | 4 | 1365 | | At present there is no category for reporting emissions related to crude oil processing as there is for natural gas processing. Generally there is some “processing” of crude oil close to where it is produced. This may take the form of separating out water and gases, may involve storage and could extend to crude oil stabilization activities. Note these are distinctly different from “crude oil upgrading” which is a more involved process and involves changing the chemical make-up of the crude. Including the activity of “crude oil processing” would remove this confusion. Alternatively “crude oil production” could be clearly defined as “crude oil production and processing” It appears odd that we have a sections for natural gas processing but not crude oil processing. | Australia | Accepted with modification | Any on-site processing of crude oil should be included in crude oil production and upgrading.<br>We added a sentence in the first sentence on p. 4.56, including on-site curde oil processing, i.e. removing water and gases contained in crude oil. |
| 6394 | 2 | 4 | 1427 | | The proposed guidelines differentiate (1427) emissions based on if the reservoir that is the source of the production from a “conventional” or ‘unconventional” resource. The differentiator should be bases on the nature of the well completion not on the type of resource being developed.as this can cause confusion for where you have a conventional reservoir but hydraulic stimulation is still required. Emissions reporting should be based on the nature of the emissions source, not on the type of reservoir the produced oil and gas is sourced from. For example if a well is hydraulically stimulated “fracked” emissions for this operation should be reported irrespective of if the reservoir is conventional or unconventional. There are plenty of conventional reservoirs that are hydraulically stimulated. Similarly there should be no differential of the product once it has been produced. Crude oil is crude oil irrespective of it coming from a conventional reservoir or unconventional reservoir, unprocessed natural gas is unprocessed natural gas irrespective of it being sourced from a conventional reservoirs or a coal seam reservoir or tight gas reservoir. | Australia | Rejected | The guidelines distinguish between unconventional and conventional completions (Line 1421) because they have different emissions profiles for the exploration segment; thus, we are not considering the product in this differentiation, but rather the fugitive emissions profile of the activity. Therefore, we are already differentiating by emissions source type/activity. In line 1430 we specifically state that: “In this chapter, unconventional exploration refers to exploration that includes well completions with hydraulic fracturing and conventional exploration refers to exploration that does not include well completions with hydraulic fracturing”. |
| 6396 | 2 | 4 | 1434 | | As discussed above the category of “exploration” we think is intended to cover much more than what is understood to be exploration activities in the upstream oil and gas sector. . If this category was renamed to something such as Well Construction, this it would be clear that emissions related to any drilling , completion, work over, fracture stimulation or related activity would be reported here. | Australia | Accepted with modification | We adopt the definition that the “Exploration” segment of oil and natural gas systems encompasses all activities that could potentially have emissions that occur prior to extraction of hydrocarbons that will be refined and distributed to end users. Thus, this segment includes: prospecting and/or exploratory drilling, development work in a field prior to operation, well development (construction to completion). We retain the word “Exploration”, however. We revise line 1365:<br>“The system begins during the exploration process, which includes all fugitive emissions associated with activities such as prospecting and/or exploratory drilling, well testing, field development and well development (construction to completion, fracture stimulation), and ends at the consumer (including fugitive emissions between gas meters and appliances, but not from appliance start stop losses or appliance combustion)” |

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| 6398 | 2 | 4 | 1434 | | Figure 4.2.1 (Oil Systems) As discussed above the category of “exploration” we think is intended to cover much more than what is understood to be exploration activities in the upstream oil and gas sector. . If this category was renamed to something such as Well Construction, this it would be clear that emissions related to any drilling , completion, work over, fracture stimulation or related activity would be reported here. | Australia | Accepted with modification | We adopt the definition that the “Exploration” segment of oil and natural gas systems encompasses all activities that could potentially have emissions that occur prior to extraction of hydrocarbons that will be refined and distributed to end users. Thus, this segment includes: prospecting and/or exploratory drilling, development work in a field prior to operation, well development (construction to completion). We retain the word “Exploration”, however. We revise line 1365:<br>“The system begins during the exploration process, which includes all fugitive emissions associated with activities such as prospecting and/or exploratory drilling, well testing, field development and well development (construction to completion, fracture stimulation), and ends at the consumer (including fugitive emissions between gas meters and appliances, but not from appliance start stop losses or appliance combustion)” |
| 6400 | 2 | 4 | 1832 | | In the section under “Production” the use of term “upgrading” may cause confusion. Upgrading would normally apply to modifying heavy oil such that it can be marketed. This should not be confused with crude oil processing such as the removal of water. As discussed above this could be made less confusing if ‘crude oil processing’ was included or “crude oil production” clearly defined so as to include the processing that occurs near the site where the oil is produced. | Australia | Accepted with modification | See comment No. 6392. |
| 6402 | 2 | 4 | 1927 | | Under the section on Refining, NGLs are identified but not condensate. As discussed above some part of the industry generally uses NGLs to talk about propane and butane (LPGs). It would be beneficial if greater clarity was provided around the differentiation between condensate crude oil,. NGLs, etc. noting condensate has more in common with crude oil than it does with LPGs. | Australia | Rejected | Both NGLs and condensate have been defined in the glossary. NGLs include LPGs (propane and butane), but also contain other hydrocarbons. Low-vapour pressure condensate and NGLs are equivalent.The use of NGLs and condensate in the text are consistent with the definitions. |
| 6404 | 2 | 4 | 1434 | | Figure 4.2.1 (Gas Systems) The comment as to the lack of clarity provided by describing the first column as exploration is repeated here. What looks like is intended is drilling, completions, work overs etc so this column should be described as such . Not exploration which is a different set of activities. | Australia | Accepted with modification | We add: Field activities prior to production that have fugitive emissions. e.g. Prospecting & exploratory well drilling, testing, completion, work overs, etc. |

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| 6406 | 2 | 4 | 1434 | | Under the column on Production, this would also likely involve condensate separation but there is no mention of this. As indicated above it would be helpful if terms could be used to reduce the risk of confusing condensate and NGLs. | Australia | Accepted with modification | We add "condensate removal~~s~~" to this column. We note, however, that low vapor pressure condensate and NGL are synonymous by definition. The Schlumberger Oil and Gas Glossary defines condensate as "A low density high API gravity liquid hydrocarbon phase that generally occurs in association with natural gas. Its presence as a liquid phase depends on temperature and pressure conditions in the reservoir allowing condensation of liquid from vapor. The production of condensate reservoirs can be complicated because of the pressure sensitivity of some condensates. During production, there is risk of the condensate changing from gas to liquid if the reservoir pressure drops below the dew point during production. Reservoir pressure can be maintained by fluid injection if gas production is preferable to liquid production. Gas produced in association with condensate is called wet gas. The API gravity of condensate is typically 50 - 120 degrees." Further, condensate liquids are "Hydrocarbons that are in the gaseous phase at reservoir conditions but condense into liquid as they travel up the wellborn and reach separator conditions. Condensate liquids are sometimes called distillate." Natural gas liquids are defined as: "Components of natural gas that are liquid at the surface in field facilities or in gas-processing plants. Natural gas liquids can be classified according to their vapor pressures as low (condensate), intermediate (natural gasoline) and high (liquefied petroleum gas) vapor pressure. Natural gas liquids include propane, butane, pentane, hexane, and heptane, but not methane and ethane, since these hydrocarbons need refrigeration to be liquefied. The term is commonly appreciated as NGL." |
| 6408 | 2 | 4 | 1434 | | Under the section of Processing it lists Offshore Gas Liquification (LNG). LNG is dominantly processed "onshore" with the technology to process gas into LNG offshore at the very early stages of development. LNG processing is just another type of gas processing and can occur onshore or offshore. What is important is not the location of the processing but the type of processing involved and the associated emissions. LNG processing for trade on international markets should be differentiated from LNG processing/storage that is used for managing peak gas demand in distribution networks and as a supply for LNG for use in road transport, remote power generation etc. While the physics is the same the plants vary quite differently in scale. | Australia | Accepted with modification | LNG is only mentioned in 1B 2b iv in the text, so we remove any wording about it under the Processing column. We alter the wording under Transmission and Storage to read "LNG Stations and Export/Import Terminals (Liquefaction, Re-gasification), Transport & Storage." We do not differentiate between international trade LNG versus LNG used for other usages as the fugitive emissions associated with processing of all LNG regardless of final use belongs within 1 B 2 b iv. |
| 6410 | 2 | 4 | 1482 | | Line 1482 the term 'gas sweetening' is used heat but in other parts of the documents the term 'acid gas removal' is used. It would be good if consistent terminology is used throughout. Suggest if terms such as 'sweetening' are used they should be defined somewhere. | Australia | Accepted with modification | Acid gas removal and sweetening are synonymous. Sweeting and acid gas are defined in the glossary. We revise: "Formation CO2 removed from natural gas by the sweetening units at gas processing plants (i.e. for acid gas removal)." |
| 6412 | 2 | 4 | 1593 | | Line 1593 talks about how throughput emissions factors are applicable to throughput at standard conditions. Please note that some commodities such as Liquefied Natural gas cannot exist at Standard Conditions so some flexibility is required for some factors. | Australia | Rejected | LNG EFs are expressed in tonnes of emissions per facility (station). They are not related to temperature and pressure. |

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| 6414 | 2 | 4 | 1613 | | Table 4.2.1 This lists Liquefied Natural Gas Systems under Gas Transmission. While this may be appropriate for LNG peaking plants and terminals providing LNG for road, ship and other uses, it's not appropriate for the internationally traded LNG sector which tends to have much larger plants which are more aligned with the section on Gas Processing. | Australia | Rejected | 1) No evidence to show the international -traded LNG sector are more aligned with the section on Gas Processing;<br>2) A conservative EFs (1660 tCH4/station) has provided in the text to reflect the possible high emisison intentsity from LNG import/export station |
| 6678 | 2 | 4 | 1542 | 1544 | The text in lines 1542 to 1544 (p. 4.44) is the repetition of the text in lines 1772 to 1774 (p. 4.56). This repetition seems unnecessary. To avoid the repetition, it is proposed that the authors move text in lines 1542 to 1544 from page 4.44 to page 4.56 to replace the text in lines 1772 to 1774 (p. 4.56) with it. | Russian Federation | Rejected | We received a lot of comments on FOD that this information was not clear enough so having it in more than one place is helpful to users. |
| 6680 | 2 | 4 | 1546 | 1547 | Figure 4.2.2: The decision tree seems to undermine general concept of inventory preparation and its further improvement, which builds upon key category analysis. In the 2006 Guidelines and in the 2019 Refinement, the question if the category concerned is key stands on top, i.e. in the beginning of each decision tree, and guides further actions of inventory compilers. However, in the present structure of the decision tree, this question is put in the bottom, which seems inconsistent with general guidance in Volume 1 of the 2006 Guidelines and the 2019 Refinement. To maintain concictency in decision tree presentation, it is proposed that the authors reconcile the oder of questions in the decision tree to move the key category identification on top of it. | Russian Federation | Rejected | The question on key category is at the end in practically almost all decision trees in the energy volume. Therefore this decision tree is in line with almost all decision trees in volume 2. |
| 6682 | 2 | 4 | 1551 | 1552 | Figure 4.2.3: The decision tree seems to undermine general concept of inventory preparation and its further improvement, which builds upon key category analysis. In the 2006 Guidelines and in the 2019 Refinement, the question if the category concerned is key stands on top, i.e. in the beginning of each decision tree, and guides further actions of the inventory compilers. However, in the present structure of the decision tree, this question is put in the bottom, which seems inconsistent with general guidance in Volume 1 of the 2006 Guidelines and the 2019 Refinement. To maintain concictency in decision tree presentation, it is proposed that the authors reconcile the oder of questions in the decision tree to move the key category identification on top of it. | Russian Federation | Rejected | The question on key category is at the end in practically almost all decision trees in the energy volume. Therefore this decision tree is in line with almost all decision trees in volume 2. |
| 6684 | 2 | 4 | 1557 | 1558 | Figure 4.2.4: The decision tree seems to undermine general concept of inventory preparation and its further improvement, which builds upon key category analysis. In the 2006 Guidelines and in the 2019 Refinement, the question if the category concerned is key stands on top, i.e. in the beginning of each decision tree, and guides further actions of the inventory compilers. However, in the present structure of the decision tree, this question is put in the bottom, which seems inconsistent with general guidance in Volume 1 of the 2006 Guidelines and the 2019 Refinement. To maintain concictency in decision tree presentation, it is proposed that the authors reconcile the oder of questions in the decision tree to move the key category identification on top of it. | Russian Federation | Rejected | The question on key category is at the end in practically almost all decision trees in the energy volume. Therefore this decision tree is in line with almost all decision trees in volume 2. |

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| 6686 | 2 | 4 | 1563 | 1564 | Figure 4.2.5: The decision tree seems to undermine general concept of inventory preparation and its further improvement, which builds upon key category analysis. In the 2006 Guidelines and in the 2019 Refinement, the question if the category concerned is key stands on top, i.e. in the beginning of each decision tree, and guides further actions of the inventory compilers. However, in the present structure of the decision tree, this question is put in the bottom, which seems inconsistent with general guidance in Volume 1 of the 2006 Guidelines and the 2019 Refinement. To maintain concictency in decision tree presentation, it is proposed that the authors reconcile the oder of questions in the decision tree to move the key category identification on top of it. | Russian Federation | Rejected | The question on key category is at the end in practically almost all decision trees in the energy volume. Therefore this decision tree is in line with almost all decision trees in volume 2. |
| 6688 | 2 | 4 | 1590 | 1591 | The sentence in lines is a repetition of the text in lines 1597 to 1598. It is proposed to remove it to avoid duplication. | Russian Federation | Accepted with modification | Edited to delete the second occurance in response to another comment. |
| 6690 | 2 | 4 | 1613 | 1614 | Table 4.2.1 provides the description of operations in oil and gas industry. It seems more approprite for section on the choice of method (Section 4.2.2.1). It is proposed to move table 4.2.1 to section 4.2.2.1. It is further proposed to include in table sub-titles "Operations with natural gas" and "Operations with oil", to improve the clarity of the table. | Russian Federation | Accepted with modification | 1) The table was moved to Section 4.2.2.2 Choice of method from 4.2.2.1 Choice of method, Decision trees, Tiers.<br>2) The existing column clearly indicates the operations related to gas and oil system, so new column is not necessary. |
| 6692 | 2 | 4 | 1766 | 1769 | The text in lines 1766 to 1769 (p. 4.55-4.56) is the repetition of the text in lines 1597 to 1600 (p. 4.49). This repetition seems unnecessary. To avoid the repetition, it is proposed that the authors remove the text in lines 1597 to 1600 from page 4.49, but retain the text in lines 1766 to 1769 (p. 4.55-4.56). | Russian Federation | Accepted | |
| 6694 | 2 | 4 | 1823 | 1828 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors to move the Equation 4.2.9 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors include the reference to equation 4.2.9 in the text of the 2019 Refinement. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - The reference to relevant equation has been included in the text. |
| 6696 | 2 | 4 | 1829 | 1830 | Table 4.2.3: To improve the clarity for the emission factors provided, it is proposed that the authors include an additional column entitled "Operation" after the column "Sub-segment", where they specify the type of activity (operation) for which the emission factor has been provided. | Russian Federation | Rejected | The footnote already says what activities are included. |
| 6698 | 2 | 4 | 1829 | 1830 | Table 4.2.3: It is proposed that the authors cross-check the units in the last column of the table. Looks like the units for Oil exploration are incorrect otherwise some parameter is missing there. | Russian Federation | Accepted | Correction made. |
| 6700 | 2 | 4 | 1902 | 1908 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors to move the Equation 4.2.10 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors include the reference to equation 4.2.10 in the text of the 2019 Refinement. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - The reference to relevant equation has been included in the text. |

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| 6702 | 2 | 4 | 1909 | 1910 | Table 4.2.4: It is proposed to remove column entitled "Emission source" from table 4.2.4, as it seems not necessary in the table so far as the level of aggregation of the emission categories has been described in the text of the 2019 Refinement. | Russian Federation | Rejected | Keeping the column is to keep consistency with IPCC 2006 GLs. |
| 6704 | 2 | 4 | 1920 | 1924 | Equation 4.2.11 seems incomplete. It is proposed that the authors cross-check the equation and revise it. | Russian Federation | Accepted | Changed |
| 6706 | 2 | 4 | 1920 | 1924 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors to move the Equation 4.2.11 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors include the reference to equation 4.2.11 in the text of the 2019 Refinement. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - The reference to relevant equation has been included in the text. |
| 6708 | 2 | 4 | 1960 | 1964 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors to move the Equation 4.2.12 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors include the reference to equation 4.2.12 in the text of the 2019 Refinement. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - Legend to the equation has been included in the text. |
| 6710 | 2 | 4 | 2058 | 2062 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors to move the Equation 4.2.13 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors reconcile the equation 4.2.13 to include the legend. Furthermore, it is proposed to include the emissions from natural gas flaring in the Equation 4.2.13, if appropriate. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - Legend to the equation has been included in the text.<br>3 - It it assumed that flaring is already covered by EFs. |
| 6712 | 2 | 4 | 2063 | 2063 | Table 4.2.9: It is not clear from the Table 4.2.9 and supporting text, what operations (emission categories) are included in the emission factor for conventional gas exploration. In particular, it is not clear, if the natural gas flaring is included in this broad category (note that in the 2006 Guidelines a separte EF factors was provided for natural gas flaring). It is proposed that the authors clarify, if natural gas flaring is included in the emission factors in Table 4.2.9. | Russian Federation | Rejected | Its noted multiple times in the text that flaring is included. |
| 6714 | 2 | 4 | 2063 | 2063 | Table 4.2.9: It is proposed that the authors cross-check the units for emission factors in the last column of Table 4.2.9. In particular, it seems like the indication of the number of wells was not included in the description of units in the last column of the table 4.2.9. | Russian Federation | Accepted | Changed labels to clarfy that it's new gas wells drilled in a year. |
| 6716 | 2 | 4 | 2110 | 2115 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors move Equation 4.2.14 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors reconcile the equation 4.2.14 to include the legend. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - Legend to the equation has been included in the text. |

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| 6718 | 2 | 4 | 2153 | 2157 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors move Equation 4.2.15 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors reconcile the equation 4.2.15 to include the legend. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - Legend to the equation has been included in the text. |
| 6720 | 2 | 4 | 2197 | 2203 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors move Equation 4.2.16 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors reconcile the equation 4.2.16 to include the legend. It is further proposed that the authors explain the rationale for addition of natural gas export and import activities. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - Legend to the equation has been included in the text.<br>3 - The equation account for emissions from LNG export/import stations, not emissoins from natural gas export/impotr itself. |
| 6722 | 2 | 4 | 2205 | 2205 | Table 4.2.12: It is proposed that th authors cross-check the units for emission factors in the last column of Table 4.2.12 and make them consistent with the units provided in other tables, namely Tables 4.2.9 to 4.2.11. Furthermore, as follows from Tables 4.2.9 to 4.2.12, the default emission factors for on-shore exploration and production of natural gas were developed based on the data from one geographical region which is North America. However, the parameters for other geographical regions were not provided. Such approach is inconsistent with the concept of complete geographical coverage introduced in the 2006 Guidelines and previous IPCC inventory guidelines. To enhance geographical coverage of the 2019 Refinement, it is proposed that the authors include in the Annex 4A.2 default emission factors for gas operations that are disaggregated by major geographic regions, where such operations occur. The default emission factors for natural gas operations in Eastern Eurpore and Western Asia are provided in the attached file. It is proposed to include them in the Annex 4A.2 | Russian Federation | Accepted with modification | 1) Add a sentence on line 1561-1564, "While the emission factor options are meant to cover technologies and practices that are common in the oil and gas industries, technologies and practices can vary significantly. In addition, the accuracy of factors is dependent on the uncertainty of underlying data. A country should periodically assess changes in technologies and practices, and changes in available emissions data, and consider updating estimates using at least a Tier 2 approach, per good practice."<br>2) The data provided by the commenter will not be included in the text or annex, based on following reasons:① : the EFs provided from the commentor comes, basically, from a case study performed in 1998 in Western Siberia (Dedikov et.al, 1999) when on-site measurements were carried out to test the CH4 fugitive/venting rate in natural gas production and transmission systems. A new study (Uvarova et.al, 2017) performed in 2016 figured out the chemical composition of natural gas in the Russian Federation, including its CO2 content, by using fugitive/venting/flaring rates measured in 1998 (Dedikov et.al, 1999) and CO2 EFs were developed.② a peer reviewed study in 2010 concluded the emission factors identified by (Dedikov et.al, 1999) is not applicable to reflect the real situation nowdays in this region.<br>(S. Lechtenböhmer & C. Dienst (2010) Future development of the upstream greenhouse gas emissions from natural gas industry, focussing on Russian gas fields and export pipelines, Journal of Integrative Environmental Sciences, 7:S1, 39-48, DOI:10.1080/19438151003774463) |
| 6724 | 2 | 4 | 2239 | 2247 | It is more appropriate to keep all equations in the section on methodological choice (Section 4.2.2.2). It is proposed that the authors to move the Equation 4.2.17 and related text to the methodological choice section (Section 4.2.2.3). It is further proposed that the authors reconcile the equation 4.2.17 to include the legend. | Russian Federation | Accepted with modification | 1 - Section 4.2.2.2 contains recommendations on method (Tier) choice and common equations for Tier 1, which can be applied to any category. Section 4.2.2.3 is devoted to EFs choice. Equations of section 4.2.2.3 are aimed to clarify application of the EFs. Reallocation of the equation is not reasonable.<br>2 - Legend to the equation has been included in the text. |
| 6726 | 2 | 4 | 2249 | 2249 | Table 4.2.13: It is proposed that the authors cross-check the units for emission factors in the last column of Table 4.2.13 and make them consistent with the units provided in other tables, namely Tables 4.2.9 to 4.2.11. | Russian Federation | Accepted | Fixed formatting |

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| 6728 | 2 | 4 | 2232 | 2233 | Table 4.2.14: It is proposed that the authors change the order of presentation of the tiers in Table 4.2.14 to start with tier 1. It is further proposed that the authors elaborate on the description of primary sources for tier 1. | Russian Federation | Accepted with modification | 1 - Changed the order of table 4.2.14. 2 - Detailed description of primery sources for tier 1 is provided in section 4.2.2.3. |
| 6730 | 2 | 4 | 2340 | 2340 | Table 4.2.15: The heading of the Table 4.2.15 does not correspond to its content. The adequate heading is: "Activity Data Values Required for Use in the Tier 1 Approach to Estimate Fugitive Emissions from Oil and Gas Systems". It is proposed that the authors change the heading. | Russian Federation | Accepted | Edited sentence to delete "Guidance on obtaining the" |
| 6756 | 2 | 4 | 3065 | 3103 | To enhance user friendliness and aplicability of the 2019 Refinement, it is proposed that the authors provide default temperature conversion factors similar with those provided for gas in table 4A.1.1. The temperature conversion factors should be provided on volume to volume and mass to mass basis for the major types of oils referred to in the 2006 Guidelines. | Russian Federation | Rejected | The conversion factors for oil can not be provided similar with those provided for gas. The conversion of oil may be performed on oil density basis. Oil density may vary in broad scale. There are around 30 pages of values of possible oil densities. Including these pages in the GLs is not reasonable. The references on documents, from which the densities may be taken, are provided. |
| 6758 | 2 | 4 | 3125 | 3128 | It is proposed that the authors elaborate on the description of data in tables 4A.2.1 to 4A.2.5 to explain on how these were derived and justify their values. | Russian Federation | Accepted | Added text |
| 6760 | 2 | 4 | 3129 | 3137 | Box 4A.2.1: Following the tittle of the Box 4A.2.1, it provides an example of application of the parameters in tables 4A.2.1 and 4A.2.2. With this, it should follow the tables referred to above. It is proposed that the authors move Box 4A.2.1 after the Tables 4A.2.1 to 4A.2.2. | Russian Federation | Accepted | Moved Box 4A2.1 after the tables 4A2.1 to 4A2.7 |
| 6762 | 2 | 4 | 3142 | 3143 | There is no disaggregation for tier 1 emission factors for gas exploration and gas production, which are important segments of oil and gas industry and are significant source categories for some countries. It is proposed that the authors develop the tables on desaggregation of tier 1 emission factors for gas exploration and gas production and include them before the Table 4A.2.4. | Russian Federation | Accepted | FOD/SOD developed disaggregated EF for segments with disaggregated EF in 2006 GL. Edited the annex to add other segments |
| 6764 | 2 | 4 | 3149 | 3150 | As follows from Tables 4.2.9 and 4.2.10, the default emission factors for on-shore exploration and production of natural gas were developed based on the data from one geographical region which is North America. However, the parameters for other geographical regions were not provided. Such approach is inconsistent with the concept of complete geographical coverage introduced in the 2006 Guidelines and previous IPCC inventory guidelines. To enhance geographical coverage of the 2019 Refinement, it is proposed that the authors include in the Annex 4A.2 default emission factors for gas operations that are disaggregated by major geographic regions, where such operations occur. The default emission factors for natural gas operations in Eastern Eurpore and Western Asia are provided in the attached file. It is proposed to include them in the Annex 4A.2. | Russian Federation | Accepted with modification | See comment No. 692 |
| 6880 | 2 | 4 | 1830 | 1830 | The title and contents of the Table 4.2.3 are separated into 3 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |
| 6882 | 2 | 4 | 1909 | 1909 | The title and contents of the Table 4.2.4 are separated into 3 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |
| 6884 | 2 | 4 | 1926 | 1926 | The title and contents of the Table 4.2.5 are separated into 2 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
|---|---|---|---|---|---|---|---|---|
| 6886 | 2 | 4 | 1937 | 1945 | In the Box4.2.1, it should make clear whether the emission from producing hydrogen as a intermediate product for oil refineries are already accounted for methodology of fugitive emissions from oil refinering | Republic of Korea | Rejected | The footnote in table 4.2.4c explains what processes are included in the EF - H2-production is not included in the EF. |
| 6888 | 2 | 4 | 2063 | 2063 | The title and contents of the Table 4.2.9 are separated into 3 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |
| 6890 | 2 | 4 | 2117 | 2117 | The title and contents of the Table 4.2.10 are separated into 3 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |
| 6892 | 2 | 4 | 2159 | 2159 | The title and contents of the Table 4.2.11 are separated into 2 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |
| 6894 | 2 | 4 | 2205 | 2205 | The title and contents of the Table 4.2.12 are separated into 3 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |
| 6896 | 2 | 4 | 2249 | 2249 | The title and contents of the Table 4.2.13 are separated into 3 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |
| 6898 | 2 | 4 | 2584 | 2584 | The title and contents of the Table 4.2.16 are separated into 3 pages so it is difficult to interpret the table. | Republic of Korea | Accepted | |
| 7128 | 2 | 4 | 2146 | 2147 | "Town gas originates from outgassing of hard coal under air exclusion in retort furnace or chamber kilns. Emissions from these processes are considered in Volume 3 Chapter 3.11 Hydrogen Production." But no estimation method is provided in Vol. 3, Ch. 3.11, since town gas is not pure H2 formed by complete oxidation of the feedstock. Suggest to rephrase or remove the reference to Vol. 3, Ch. 3.11. | Norway | Accepted | The reference has been changed to the transformation chapter. However, no explicit methodology can be found there. Although it is possible to use the outputs of CtL to Hydrogen Production, the process analysed in the 2019 Refinement 2006 Guidelines was restricted to the Syngas production. |
| 7134 | 2 | 4 | 1926 | 1926 | 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. Norway has available EFs and uncertainties both for CH4 and NMVOC. | Norway | Accepted | We have rechecked the values and they are correct. We included additional information on rationale for selection of the time periods chosen. |
| 7136 | 2 | 4 | 1564 | 1564 | 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" | Norway | Accepted with modification | Decision tree is deleted. It is assumed that decision trees on main categories (oil and gas industries) cover subcategory on abandoned wells. |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 7400 | 2 | 0 | 0 | 0 | It is well explained that combustion related emissions should be reported under 1.A.1.b, leakage under 1.B.2.iv-v and all process related emissions under 2.B. However, there is still a high chance of misinterpretation regarding the allocation of emissions from refineries with integrated chemical industries and some processes need to be explained more in detail. In the 2006 Guidelines and also in the refined guidelines, the allocation of stored refinery products is not straight forward. In chapter 4 Volume 2 line 1951, it is stated that only fuels should be reported under 1.B.2.a.v, and in Volume 3 e.g. under 3.9.2.2 (page 3.74 in 2006 Guidelines) storage of feedstock is part of methanol production. Other production processes provide neither emission factors nor methods for feedstocks. Countries with both refineries and chemical industries will need to apply a complex reporting system with this differentiation, while others with chemical industry only would underestimate their emissions. If countries produce products dedicated for export (e.g. naphtha or LPG), emissions cannot be reported with the refined guidelines.<br>A second incomprehensible aspect is asphalt blowing. This aspect used to be part of chapter 3 (page 5.14) – now it is included under 1.B.2.a.iv (Volume 2, chapter 4, line 1931). It should be clear where to report emissions from asphalt blowing in order to avoid double counting.<br>For both aspects, we recommend providing a graphical presentation, where to report such emissions. | Germany | Accepted with modification | The authors note the comments. The first element regarding the fugitive emissions from storage and loading of feedstock materials and products related to petrochemical production is out of scope of the Refinement. This was not within the terms of reference of the Refinement process. The authors agree that there is a reporting gap for fugitive emissions from loading and storage of materials in the petrochemical sector, whereas under Energy-refineries there are methods and Efs presented. The 2006 GLs present specific information on the scope of methane EFs for methanol production only, stating that the default EFs include fugitive emissions from the storage of crude product. For other petrochemical products, the description of scope of default methane EFs is not definitive, and therefore it is unclear whether those methane EFs already consider fugitive emissions from feedstock and product storage and transfer. We acknowledge therefore that the reporting of fugitive methane could be further improved, but the team of authors was not mandated to refine the petrochemical chapter.<br>Regarding the asphalt blowing, we reject the comment. The IPPU section 5.4.1 is explicit that asphalt production in refineries is excluded from the scope of reporting in IPPU, whilst the new Energy - fugitives section 4.2.2.3 for 1B2aiv also explicitly states that emissions from asphalt blowing in refineries are included there. The authors consider that this is clear, unambiguous guidance on best practice for reporting of emissions from asphalt production.” |
| 7602 | 2 | 4 | 3089 | 3091 | Why is Equation 4A.1.4 here? It seems not to convert anything from one temperature to another. | Finland | Accepted | |
| 8328 | General | | | | The emission factors for fugitive emissions in oil and gass section are considered to be very small, and this results in the output of this sector unrealistic. | Iran | Rejected | The emisison factors were developed following review of available relevant data. As no data were provided in the comment, no action can be taken in response to the comment. |
| 8330 | General | | | | The software instruction does not provide a definition of the components and fuels, while the definitions and classification of fuels vary from country to country. This issue faces uncertainty about data collection (especially in oil and gas extraction and production sectors). | Iran | Rejected | No action can be taken because comment is out of scope of 2019 Refinement. |
| 8332 | General | | | | Some emission factors for N2o, CH4, CO2 are not considered in the Fugitive oil and gas release section, and there are no national emission factors. | Iran | Rejected | No action can be taken because comment is out of scope of 2019 Refinement. |
| 8334 | General | | | | The units are intended for the oil sector in software based on cubic meters. | Iran | Noted | No action can be taken because comment is out of scope of 2019 Refinement. |
| 8336 | General | | | | Distribution coefficients in software 2006 are based on cubic meters, so if the software in 1996 was based on PJ, then the comparison of the coefficients would be difficult. | Iran | Noted | No action can be taken because comment is out of scope of 2019 Refinement. |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 9198 | 2 | 4 | 1909 | 1910 | Suggested clarifications/corrections:<br>-“Onshore: Most activities occurring with higher-emitting technologies and practices” and “Onshore: Most activities occurring with lower-emitting technologies and practices” N2O uncertainties should be -10% to +1000%.<br>-“Onshore: Oil Sands Mining and Ore Processing” uncertainties should be rounded to whole numbers as follows: CH4 ± 30%; CO2 ±25%; NMVOC -30 to +95%.<br>“Onshore: Oil Sands Upgrading uncertainties” should be rounded to whole numbers as follows: CH4: -35% to +120%; CO2 ± 15%; NMVOC -60% to +75%; and N2O -25% to +315%.<br>-Footnote c; last sentence should read: “Includes fugitive emissions from tailings ponds and the exposed oil sands mine surface.” | Canada | Accepted | Changes made. |
| 9200 | 2 | 4 | 1967 | 1978 | This section needs to include surface casing vent flow and gas migration as possible Other sources. | Canada | Rejected | This should occur in the segment in which the activity takes place as it is not an “accident” or rare event (which is required for the “other” segment). |
| 9202 | 2 | 4 | 2006 | 2007 | Section states that “most methane (around 80%) from offshore abandoned wells is dissolved in marine water”. However, Table 4.2.8 footnote b says that the offshore emission factors were developed by multiplying the onshore EFs by 0.02, which would imply that 98% of methane is dissolved in marine water. Either the footnote is incorrect and as such, the EFs need to be recalculated or the text needs to be revised. | Canada | Accepted | Discrepancy resolved. |
| 9204 | 2 | 4 | 2116 | 2117 | Footnote c. “Financial year” is not a common term used in the guidelines. Should either define what financial year means in this context or revise the language. | Canada | Accepted | Footnote c was revised. |
| 9206 | 2 | 4 | 2144 | 2145 | Section states: “If none of the proposals works, a value of 32% sour gas can be applied”. As stated in the footnote, the 32% value is taken as the average of the Germany (40%) and Austria (25%) sour gas shares and is very arbitrary. It is suggested that the compiler would be better off speaking to a representative from industry familiar with their national circumstances, in order to estimate the sweet gas to sour gas ratio. | Canada | Accepted with modification | It is good practice to ask national experts about national circumstances. We note this in the footnotes The text has been updated to provide additional information on determining this fraction (lines 2062 to 2065). |
| 9208 | 2 | 4 | 2340 | 2341 | The purpose of Table 4.2.15 is unclear. It’s titled “Guidance on obtaining the activity data values required …” but it doesn’t seem to offer any guidance. It simply restates the activity values used in the previous emission factor tables (Tables 4.2.3 to 4.2.13). Suggest the title be clarified or actual guidance be provided. | Canada | Accepted | We have renamed Table 4.2.15 from GUIDANCE ON OBTAINING THE ACTIVITY DATA VALUES REQUIRED FOR USE IN THE TIER 1 APPROACH TO ESTIMATE FUGITIVE EMISSIONS FROM OIL AND GAS SYSTEMS to ACTIVITY DATA REQUIRED FOR USE IN THE TIER 1 APPROACH TO ESTIMATE FUGITIVE EMISSIONS FROM OIL AND GAS SYSTEMS |
| 9210 | 2 | 4 | 2554 | 2554 | Should refer to Table 4.2.16, not 4.2.15, as indicated. | Canada | Accepted | Corrected. |
| 9212 | 2 | 4 | 3138 | 3139 | Oil Sands Mining and Ore Processing - All - Leaks: There is a notation for a footnote, but the footnote does not appear to be there. | Canada | Accepted | Footnote notation removed. |
| 9214 | 2 | 4 | 3235 | 3235 | Should also refer to reciprocating compressor - i.e. see also centrifugal compressor and reciprocating compressor. | Canada | Accepted | Added. |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 7398 | 2 | 4 | 2585 | 3886 | We welcome this new comprehensive chapter. To provide a better understanding, we suggest to add more references. For example, when dealing with solid to gaseous transformation, a reference to the new chapter “hydrogen production" (Volume 3, chapter 3.11) would be helpful. In addition, in Box 4.2.1 about hydrogen production a reference to fugitive gas distribution would be helpful if coke oven gas is distributed (in form of town gas). | Germany | Accepted | What the reviewer means here by "more references" is add better cross referencing to the other new sections in the 2019 Refinement. More cross referencing has been added. Although it is possible to use the outputs of CtL to Hydrogen Production, the process analysed in the 2019 Refinement 2006 Guidelines was restricted to the Syngas production. |
| 6732 | 2 | 4 | 2587 | 2588 | It is proposed that the authors supplement the statement on fugitive emissions with the description of fuel transformation process and the release of greenhouse gas emissions during this process. | Russian Federation | Accepted | A definition of fuel transformation has been added under Heading 4.3. |
| 5586 | 2 | 4 | 2587 | 2588 | Are these sentences needed? The concept appears earlier in the volume, and is not specific to fuel transformation. | United States of America | Accepted | These sentences have been replaced with a definition of fuel transformation. |
| 7586 | 2 | 4 | 2588 | 2588 | Definition (..fossil fuels..) is inconsistent with paragraph 4.3.1, which includes charcoal and wood pellets. | Finland | Accepted | The word "fossil" has been deleted. |
| 7130 | 2 | 4 | 2594 | 2596 | "Fugitive emissions from the following fuel transformation activities have been included in this section - charcoal production, coke production, other solid fuels to solid fuels, coal to liquid, gas to liquid, biomass to liquid, biomass to gas, and refineries." We can see no other references to refineries in section 4.3. Are refineries actually included here? | Norway | Accepted | This Chapter does not cover this source. Cross reference has been added "refineries are considered in Chapter 4.2 in this volume." |
| 5588 | 2 | 4 | 2594 | 2598 | The paragraph describing fugitive emissions should reference Table 4.3.1 and only include categories listed in the table, e.g., refineries are captured elsewhere. | United States of America | Accepted | The paragraph has been modified to explain what processes are included in this Chapter, and what are not included in this Chapter. |
| 6734 | 2 | 4 | 2598 | 2599 | Table 4.3.1. In the last column – “Emissions from the use of this fuel for energy purposes should be reported under the following categories” subcategories of 1A should be indicated more specifically. | Russian Federation | Accepted with modification | Column has been removed to simplify the table. |
| 7588 | 2 | 4 | 2598 | 2599 | Reporting of fugitive biogenic CO2 emissions from fuel transformation under 1B1c seems to be a remarkable change in the principles of the Guidelines. The reasons and justifications for this desicion should be made clearly available. Also, it should be clearly defined, which biogenic CO2 emissions from fuel transformation/production need to be reported (for example: if BtL is mentioned, should fugitive emissions from production of ethanol or biogas for road transport also be mentioned?) | Finland | Accepted | The final modification is written in alignment with AFOLU volume. |
| 5590 | 2 | 4 | 2605 | 2605 | Clarify if anthropogenic emissions include CH4, N2O, CO2 or all three. | United States of America | Accepted with modification | The part of sentence "2 – 7 percent of global anthropogenic emissions" has been deleted in the FD. |
| 6736 | 2 | 4 | 2622 | 2622 | Table 4.3.1. In the last column – “Emissions from the use of this fuel for energy purposes should be reported under the following categories” subcategories of 1A should be indicated more specifically. | Russian Federation | Accepted with modification | Column has been removed to simplify the table. |
| 860 | 2 | 4 | 2626 | | Logic for decision tree in Figure 4.3.1 lack of “No” option in the box “Is national charcoal production data available?”. | Thailand | Accepted | "NO" has been inserted down from "Is national charcoal production data available". |
| 5592 | 2 | 4 | 2626 | 2626 | On Figure 4.3.1 line leading down from "Is national charcoal production data available" should be No. Also should Yes line leading to Collect data for higher Tiers be coming from Is charcoal production a key category? And not Tier 1 box? | United States of America | Accepted | "NO" has been inserted down from "Is national charcoal data available" and an arrow has been inserted from rhombus instead of the rectangular. |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 6900 | 2 | 4 | 2626 | 2626 | There is no 'Yes' line for the question of “Is charcoal production a key category?” in Figure 4.3.1. | Republic of Korea | Accepted | "YES" has now been inserted immediately from " Is charcoal production a key category" |
| 6738 | 2 | 4 | 2626 | 2627 | Figure 4.3.1: The decision tree seems to undermine general concept of inventory preparation and its further improvement, which builds upon key category analysis. In the 2006 Guidelines and in the 2019 Refinement, the question if the category concerned is key stands on top, i.e. in the beginning of each decision tree, and guides further actions of the inventory compilers. However, in the present structure of the decision tree, this question is put in the bottom, which seems inconsistent with general guidance in Volume 1 of the 2006 Guidelines and the 2019 Refinement. To maintain concictency in decision tree presentation, it is proposed that the authors reconcile the oder of questions in the decision tree to move the key category identification on top of it. | Russian Federation | Accepted | The question on key category is at the end in practically almost all decision trees in the energy volume. Therefore this decision tree is in line with almost all decision trees in volume 2. |
| 5594 | 2 | 4 | 2632 | 2640 | Change equation to be on an annual basis, so kg of GHG and units of production would be on an annual basis. | United States of America | Accepted | The title changed to read on "annual basis". |
| 5596 | 2 | 4 | 2636 | 2636 | Delete "by type of fuel" | United States of America | Accepted | Text deleted. |
| 5598 | 2 | 4 | 2638 | 2639 | Delete "according to charcoal kiln type", the factors in Table 4.3.2 are not by kiln type. | United States of America | Accepted | Text deleted. |
| 6740 | 2 | 4 | 2647 | 2648 | It is proposed that the authors provide additional guidance on the choice of the emission factors from Table 4.3.2. | Russian Federation | Accepted | Guidance has been given by indicating that "lower limit correspond to certain types of kilns, and the upper limit to other types of technology". |
| 5600 | 2 | 4 | 2648 | 2648 | Table 4.3.2 does not seem to be by kiln technology but just default factors per charcoal production so could delete "according to kiln technology" | United States of America | Accepted | Text deleted. |
| 4698 | 2 | 4 | 2649 | 2658 | There is the description that "There may also be use of fossil fuels in the harvesting, transport and pyrolysis of the feedstock that would be included in the energy sector (Volume 2)" in Box2.2A of Chapter 2, Volume 4. However, the charcoal production data used as activity data for GHG emissions from charcoal production in accordance with the guidance in 4.3.2.1 charcoal production may not include the amount of biochar used for agricultural soils because this is not for energy purposes. The clear statement that the biochar production for all purposes should be included as activity data in this section should be added, or the additional guidance that GHG emissions from biochar production except for energy use should be estimated under the AFOLU sector should be added in the section related to biochar in Chapter 2, Volume 4. | Japan | Accepted | The final modification is written in alignment with AFOLU volume. |
| 6742 | 2 | 4 | 2695 | 2696 | It would be very useful to indicate on the diagram which emission sources considered as fugitive, as energy and as IPPU sources | Russian Federation | Rejected | The figure is already too crowded and the suggestion cannot be accomodated. |
| 6744 | 2 | 4 | 2695 | 2696 | It is proposed to increase the size of the diagramm because it is difficult to recognise it in a hard copy. | Russian Federation | Accepted | The diagram has been resized. |
| 5602 | 2 | 4 | 2715 | 2716 | Table 4.3.4 change U = unlikely to N = none, table includes N and only one U that could be changed to a P. | United States of America | Accepted | The use of notation keys in the table has been simplified, and the defintions refined. |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 6902 | 2 | 4 | 2715 | 2716 | In Table 4.3.4, Fugitive gas emssion from "coking" production stage might be double counting of emissions from iron and steel sector, because when emissions from coke production are estimated by Carbon mass balance following the G/L in the IPPU(Vol.3, Ch.4), it counts the total carbon in that process | Republic of Korea | Accepted | Setence added "Inventory compilers who are using a carbon mass balance approach to estimate emissions from the iron and steel sector, and who are including fugitive emissions in this balance, should not use the methods in this section to estimate emissions to avoid double counting." |
| 862 | 2 | 4 | 2717 | | Figure 4.3.3 is under development and some logic are missing. | Thailand | Accepted | The decision tree has been finalised. |
| 5212 | 2 | 4 | 2717 | 2717 | In the Figure 4.3.3, there are still items “Under development”. | France | Accepted | The decision tree has been finalised. |
| 6904 | 2 | 4 | 2717 | 2717 | In the Figure 4.3.3<br>1) There is no 'Yes' line for the question of “Is coke production key category?”<br>2) “Is coke production key category?”→ “Is coke production a key category?”<br>3) In addition to the description of figure, it is necessary to detail the logical flow for choice of methods. | Republic of Korea | Accepted | The decision tree has been finalised. |
| 6746 | 2 | 4 | 2717 | 2718 | Figure 4.3.3: The decision tree seems to be incomplete: the bottom block has not been filled? while the guidance for Tier 1 has not been provided. It is further proposed that the authors reconcile the oder of questions in the decision tree to move the key category identification on top of it. | Russian Federation | Accepted | The decision tree has been finalised. |
| 5604 | 2 | 4 | 2717 | 2718 | Figure 4.3.3 is still under development but is also not referenced anywhere in text. It could be included as part of text starting on lines 2719. | United States of America | Accepted | The decision tree has been finalised. |
| 6748 | 2 | 4 | 2732 | 2745 | To maintain consistency in the 2019 refinement, it is proposed that the authors elaborate on the Equations 4.3.2 and 4.3.3 to include all greenhouse gases subject to reporting. | Russian Federation | Rejected | Looking at Volume 2, Stationary Combustion, the form of the equation that has been used is consistent with equation 2.1. |
| 6750 | 2 | 4 | 2732 | 2745 | It is proposed that the authors provide the description of Tier 2 method for estimation fugitive greenhosue gas emissions from coke production referred to in the decision tree on Figure 4.3.3. | Russian Federation | Accepted | The section on choice of methods has been rewritten to include explanations of Tier 1, 2 and 3 methods. |
| 5606 | 2 | 4 | 2765 | 2766 | Is the N2O line on Table 4.3.5 needed? Seems like can be deleted. | United States of America | Accepted | Line in table deleted. |
| 6752 | 2 | 4 | 2775 | 2776 | So far as no emission factor has been provided for N2O in Table 4.3.5, it is proposed to remove default uncertainty estimate for N2O from Table 4.3.6. | Russian Federation | Accepted | The default uncertainty estimates have been deleted. |
| 7590 | 2 | 4 | 2783 | 2797 | In Equation 4.3.4, activity data are expressed as amount of coke produced in tonnes, however emission factors are referred as GHG per TJ. Please correct the equation. Please add an alternative equation for the cases, where flaring is estimated as volume of COG and calculated as energy content in TJs. In this case referred emission factors from Vol2 Chapter 2 could be used. | Finland | Accepted | The equation has been corrected and the EF and AD are now presented in compatible terms. |
| 5608 | 2 | 4 | 2785 | 2810 | Equation 4.3.4 has activity data listed as coke production, however Choice of Activity data is based on the amount of COG produced. There is a disconnect between the two and it seems like Equation 4.3.4 should be changed to be referencing COG activity data. | United States of America | Accepted | The equation has been corrected and the EF and AD are now presented in compatible terms. |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 5610 | 2 | 4 | 2821 | 2821 | Confirm if wood pellet production is included in Appendix 4A5 as referenced here or 4A2 as referenced in Table 4.3.1 | United States of America | Accepted | Referencing corrected by replacing Appendix 4A5 with Appendix 4a.2. |
| 6754 | 2 | 4 | 2823 | 2991 | The Section 4.3.2.4 Gasification Transformation Process seems insufficiently elaborated. It is proposed to move Section 4.3.2.4 (the text in lines 283 to 2991) to Appendix 4a.3 as the basis for future methodological development. The current text in Appendix 4a.3 could be merged with the text in Section 4.3.2.4. | Russian Federation | Rejected | As there was enough data to develop this section, the authors agreed that this text should not be placed in an Appendix. |
| 864 | 2 | 4 | 2832 | | Text format “O2” | Thailand | Accepted | The text in the figure has been revised. |
| 5612 | 2 | 4 | 2839 | 2840 | Reference Table 4.3.7 here and maybe move table up to this part of text. The Table 4.3.7 is not referenced anywhere else. | United States of America | Accepted | The section has been restructured and the table has been moved. |
| 7592 | 2 | 4 | 2848 | 2848 | Misprint: …fraction of CTL plant CO2… | Finland | Accepted | The text has been revised. |
| 5614 | 2 | 4 | 2897 | 2897 | Line references carbon content that is of fossil origin, but discussion is concerning coal and gas to liquids, biomass to liquids is not discussed. Does this refer to biogas? If so should be more clear. | United States of America | Accepted | The text has been revised. The phrase was modified and the part "that is of fossil origin" was deleted. |
| 7594 | 2 | 4 | 2899 | 2899 | should be: Figure 4.3.5. | Finland | Accepted | Adjust figue numbering. |
| 866 | 2 | 4 | 2902 | | Text format “CO2, CH4, and N2O” | Thailand | Accepted | The text has been revised. |
| 7596 | 2 | 4 | 2902 | 2903 | Decision tree in Figure 4.3.5 has an endless loop. Box 2 should be divided to two separate boxes: 1. collect p-s data 2. calculate emissions | Finland | Accepted | The decision tree has been revised. |
| 5616 | 2 | 4 | 2911 | 2967 | Equation 4.3.5 has activity data based on feedstock input but for coal to liquids emission factors listed in Table 4.3.8 and discussed in choice of activity data section is based on amount of syngas produced. So either activity data on syngas should be converted to feedstock input or formula for coal to liquid should be adjusted to be based on syngas output. | United States of America | Accepted | Equation 4.3.5 was deleted. |
| 5618 | 2 | 4 | 2918 | 2918 | The FCFi fraction of fossil carbon is not clear, does this refer to biogas or can this formula also be used for biomass to liquids? If so should indicate that is the case. | United States of America | Accepted | Equation 4.3.5 was deleted. |
| 7598 | 2 | 4 | 2928 | 2929 | Both FSj and EFi should use the same activity unit (either TJ or Gg for both parametres). Please check the use of subscript j in EFj in the Equation 4.3.6 in question and that of subscript i in EFi below the Eq. | Finland | Accepted | Eqution 4.3.5 (New) attended this comment. |
| 5620 | 2 | 4 | 2929 | 2929 | Delete Gg from i/Gg and only include i/TJ since that is what FSj is based on. | United States of America | Accepted | Eqution 4.3.5 (New) attended this comment. |
| 5622 | 2 | 4 | 2952 | 2956 | Confirm Table reference 4.3.14 listed twice in paragraph vs Table 4.3.8 shown. | United States of America | Accepted | Table number is 4.3.10 and referencing has been corrected. |
| 7600 | 2 | 4 | 2997 | 2997 | a word is missing: ..estimates reported by individual plants(?),.. | Finland | Accepted | The word "plants" has been added. |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 5624 | 2 | 4 | 3665 | 3669 | This section could usefully include some additional description of how fugitive CH4 would be generated from pellet production in non-trace quantities such that a country would want to assess inclusion in an inventory. Is CH4 generated through the heating process? Can CH4 be generated under anaerobic conditions while pellets are stored in large piles? | United States of America | Accepted | Additional text added to describe how fugitive CH4 would be generated from pellet production. |
| 7604 | 2 | 4 | 3698 | 3698 | In this sentence 'Solid fuel' has a different interpretation than generally in the Guidelines: usually Solid fuels refer to coal derived fuels, wheras Biomass inludes all types of biomass (solid , liquid and gaseous). It would be more consistent to separate Biomass transformation as a new issue. | Finland | Rejected | For the purpose of this guidance, solid biomass falls within Solid to Solid Fuel Production category. |
| 7606 | 2 | 4 | 3804 | 3809 | Check the use of subindices i and j (i for gas, j for feedstock); FSi should be changed to FSj, and CFi to CFj | Finland | Accepted | The equation was reviewed and modified to [$E_{GAS\,i} = (FS_j \bullet EF_i) \bullet 10^{-6}$]. In other words, to calculate GHG emissions ($CO_2$, $CH_4$ and $N_2O$) from BtL and BtG, is necessary multiply the total amount of biomass or syngas produced (TJ) to the Emission Factor of biomass or syngas. |
| 7608 | 2 | 4 | 3855 | 3859 | Check the use of subindices i and j (i for gas, j for feedstock); EFi explanation has both subindices i and j. | Finland | Accepted with modification | The equation has been removed. |
| 844 | 2 | 4 | 98 | 117 | Page number format | Thailand | Accepted | |
| 846 | 2 | 4 | 153 | 157 | Page number format | Thailand | Accepted | |
| 848 | 2 | 4 | 190 | 193 | Page number format | Thailand | Accepted | |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 5554 | 2 | 2 | 34 | 58 | Recommend section 2.3.3.4 be revised to provide more clarity on the accounting and reporting approach of biomass use for energy (biofuels) between chapters of GHG Inventories. Due to the current language in the 2006 IPCC Guidelines, users of IPCC methodology, researchers and other interested stakeholders have pointed to the IPCC guidelines as a point of confusion or misinterpretation of the allocation of reported bioenergy emissions, its inclusion in national totals, and ultimately the carbon neutrality of biomass used for energy. As referenced in the 2006 IPCC Guidelines, “In the reporting tables, emissions from combustion of biofuels are reported as information items but not included in the sectoral or national totals to avoid double counting.” This statement has shown to be misleading in regard to the exclusion of these emissions in the national totals. To alleviate misinterpretation of the intent of the guidelines, it should be noted that these emissions are in fact included in national totals. As stated in the previous sentence of the 2006 IPCC Guidelines (lines 38-39), “Emissions of CO2 from biomass fuels are estimated and reported in the AFOLU sector as part of the AFOLU methodology”. However, the current phrasing (i.e., not included in sectoral or national totals) has led to the interpretation that emissions from biomass combusted for energy (biofuels) are not to be included because they are carbon neutral. Also highly, recommend inclusion of additional details explaining the basis and need of the current IPCC approach (i.e., there is a need for a comprehensive international accounting approach, emphasizing the appropriateness of quantifying and reporting biomass energy emissions within the AFOLU chapter, captured in carbon stock changes). Many academic papers and reports, including but not limited to those included below, reference this topic as an issue of concern. It is recommended that the IPCC and authors be much more explicit to provide clarity as to the accounting and reporting of biomass use for energy (biofuels) between the Energy and LULUCF chapters, and its inclusion in national totals.<br>Example papers (not limited to those listed here): Chatham House (2017). The Impacts of the Demand for Woody Biomass for Power and Heat on Climate and Forests.; Liu, W. et al. Analysis of the Global Warming Potential of Biogenic CO2 Emission in Life Cycle Assessments. Sci. Rep. 7, 39857; doi: 10.1038/srep39857 (2017).; Sedjo R (2013) Comparative Life Cycle Assessments: Carbon Neutrality and Wood Biomass Energy. Resources for the Future, Washington, DC, USA, 21p.; Cherubini, F., Peters, G. P., Berntsen, T., Strømman, A. H., and Hertwich, E.: CO2 emissions from biomass combustion for bioenergy: atmospheric decay and contribution to global warming, GCB Bioenergy, 3, 413–426, doi:10.1111/j.1757-1707.2011.01102.x, 2011.; Zanchi G, Pena N, Bird N (2011). Is woody bioenergy carbon neutral? A comparative assessment of emissions from consumption of woody bioenergy and fossil fuel. GCB Bioenergy, 4, 761–772.; Gunn JS, Ganz DJ, Keeton WS (2012) Biogenic vs. geologic carbon emissions and forest biomass energy production. GCB Bioenergy, 4, 239–242.; Wiloso, E.I., Heijungs, R., Huppes, G. & Fang, K. (2016). Effect of biogenic carbon inventory on the life cycle assessment of bioenergy: challenges to the neutrality assumption. Journal of Cleaner Production 125, 78-85.; Liu, Weiguo & Yu, Zhen & Xie, Xinfeng & Gadow, Klaus & Peng, Changhui. (2017). A Critical Analysis of the Carbon Neutrality Assumption in Life Cycle Assessment of Forest Bioenergy Systems. Environmental Reviews. 26. 10.1139/er-2017-0060. | United States of America | Accepted | Additional detail on biomass has been provided in the FD. |

| Comment ID | Volume | Chapter | From line | To line | Comment | Country | Response | Authors note |
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| 6658 | 2 | 2 | 56 | 57 | Infortunately, Section 12.5, Chapter 12, Volume 4 (AFOLU) of the 2019 Refinement does not provide clear guidance on how CO2 emissions from buring woody biomass feedstocks should be reported in the Energy sector. With this, the following text is proposed for inclusion before the text in line 56: "The CO2 and non-CO2 emissions from burning wood biomass for energy purposes may be reported in the same country or in different countries. To avoid underestimation or double counting of CO2 emissions from wood biomass burning, it is good practice to identify the approach applied for reporting on CO2 emissions in the country where the energy feedstocks from harvested wood were produced. The country should decide on inclusion of CO2 emissions from wood biomass burning in national inventory totals for the Energy sector depending on the approach for reporting CO2 emissions and removals applied by the country-producer of the HWP." The text in lines 56 and 57 remains unchanged. | Russian Federation | Accepted with modification | Additional detail on biomass has been provided in the FD. |
| 6484 | 2 | 3 | | | An update of chapter 3.6 of the 2006 guidelines would have been very useful: e.g. biofuels in the aviation sector are not mentionned at all. The approches to split between domestic and international flights (section 3.6.1.3) could have been adjusted considering that only few countries levy tax on domestic aviation fuels,... | United Kingdom (of Great Britain and Northern Ireland) | Rejected | No action can be taken because comment is out of scope of 2019 Refinement. |
| 6666 | 2 | 4 | 1162 | 1169 | The augmentation of coal reserves is not necessarily performed annually for each and every mine of the particular coal basin. For economic reasons, it may not be necessary to produce new boreholes to assess year-by-year changes in coal reserves, especially if the coal basin is subject to permanent exploration and processing (production). Furthermore, other exploration methods have been developed recently which do not require construction of boreholes or tend to reduce their number as much as practicable. Consequently, assessment of changes in and augmentation of coal reserves do not directly relate to number of boreholes annually produced for exploration purposes. Alternatively, number of exploration boreholes constructed annually seems more accuarte and adequate information on corporate and national exploration efforts. These data are collected by coal companies and national stastic offices so far as these are the reports of corporate and national economic activities performed. It is proposed that the authors reconcile the guidance on reporting on GHG emissions from coal exploration based on augmentation of coal reserved and instead develop the guidance based on the information on boreholes produced for exploration purposes. | Russian Federation | Accepted with modification | Major coal producing countries do present coal resources on an year-to-year basis. These may be ascertained from several governmental and non-governmental reports and links. Therefore, augmentation of coal resources on annual basis can be obtained to a large degree of accuracy. Number of exploration boreholes drilled annually seems to be a better option. However, this data is not readily available in national statistics. Therefore, we have considered this approach in a Tier 3 method. Tier 1 and Tier 2 methods based on augmentation of resorces and depth-wise augmentation of resorces respectively, can be used if data number of boreholes drilled is not available or cannot be collected from coal exploration agencies or corporates. |