ANNEX 8 QA/QC Procedures

8.1. Background

The purpose of this annex is to describe the Quality Assurance/Quality Control (QA/QC) procedures and information quality considerations that are used throughout the process of creating and compiling the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*. This includes the evaluation of the quality and relevance of data and models used as inputs into the Inventory; proper management, incorporation, and aggregation of data; and review of the numbers and estimates to ensure that they are as accurate and transparent as possible. Quality control—in the form of both good practices (such as documentation procedures) and checks on whether good practices and procedures are being followed—is applied at every stage of inventory development and document preparation. In addition, quality assurance occurs at two stages—an expert review and a public review. While both phases can significantly contribute to the quality of the Inventory, the public review phase is also essential for promoting the openness of the Inventory development process and the transparency of the inventory data and methods. As described in respective source category text, comments received from these reviews may also result in updates or changes to continue to improve inventory quality.

8.2. Purpose

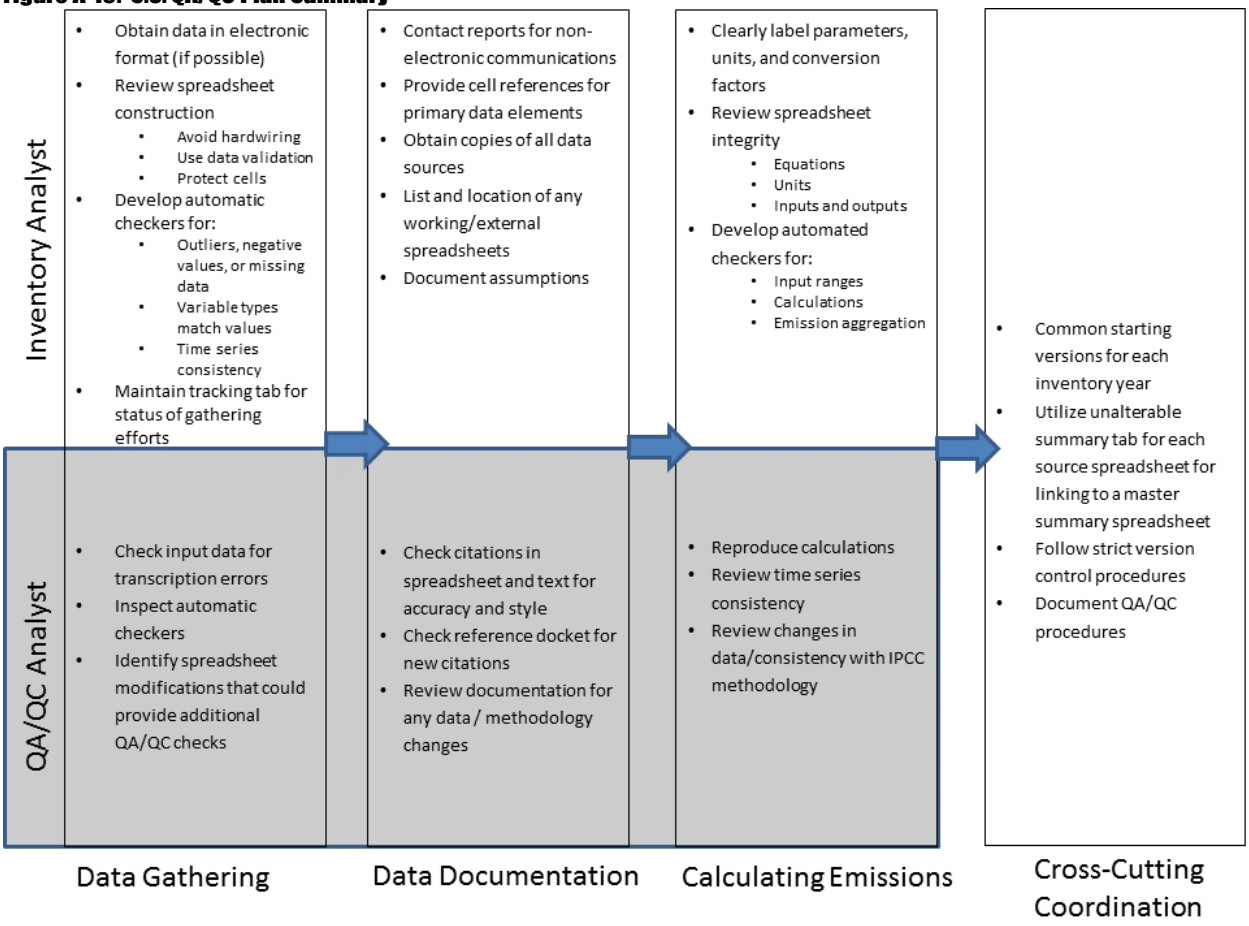
The *Quality Assurance/Quality Control and Uncertainty Management Plan* for the Inventory (QA/QC Management Plan) guides the process of ensuring the quality of the Inventory. The QA/QC Management Plan describes data and methodology checks, develops processes governing peer review and public comments, and provides guidance on conducting an analysis of the uncertainty surrounding the emission estimates. The QA/QC Management Plan procedures also stress continual improvement, providing for corrective actions that are designed to improve the inventory estimates over time.

Key attributes of the QA/QC Management Plan are summarized in Figure A-19. These attributes include:

- *Procedures and Forms:* detailed and specific systems that serve to standardize the process of documenting and archiving information, as well as to guide the implementation of QA/QC and the analysis of uncertainty.
- *Implementation of Procedures:* application of QA/QC procedures throughout the whole Inventory development process from initial data collection, through preparation of the emission estimates, to publication of the Inventory.
- *Quality Assurance:* expert and public reviews for both the Inventory estimates and the report (which is the primary vehicle for disseminating the results of the Inventory development process). The expert technical review conducted by the UNFCCC supplements these QA processes, consistent with the *2006 IPCC Guidelines* (IPCC 2006).
- *Quality Control*: consideration of secondary data and category-specific checks (Tier 2 QC) in parallel, and coordination with the uncertainty assessment; the development of protocols and templates, which provide for more structured communication and integration with the suppliers of secondary information.
- *General (Tier 1) and category-specific (Tier 2) Checks:* quality controls and checks, as recommended by the *IPCC Good Practice Guidance and 2006 IPCC Guidelines* (IPCC 2006).
- *Record Keeping:* provisions to track which procedures have been followed, the results of the QA/QC process, uncertainty analysis, and feedback mechanisms for corrective action based on the results of the investigations, which provide for continual data quality improvement and guided research efforts.
- *Multi-Year Implementation*: a schedule for coordinating the application of QA/QC procedures across multiple years, especially for category-specific QC, focusing on key categories.
- *Interaction and Coordination:* promoting communication within the EPA, across Federal agencies and departments, state government programs, and research institutions and consulting firms involved in supplying data or preparing estimates for the Inventory. The QA/QC Management Plan itself is intended to be revised to reflect new information that becomes available as the program develops, methods are improved, or additional supporting documents become necessary.

In addition, based on the national QA/QC Management Plan for the Inventory, source and sink-specific QA/QC plans have been developed for a number of sources and sinks. These plans follow the procedures outlined in the national QA/QC plan, tailoring the procedures to the specific text and spreadsheets of the individual sources. For each greenhouse gas emissions source or sink included in this Inventory, minimum general QA/QC analysis consistent with Vol. 1, Chapter 6 of the *2006 IPCC Guidelines* has been undertaken. Where QA/QC activities for a particular source go beyond the general level, and include category-specific checks, further explanation is provided within the respective source category text. Similarly, responses or updates based on comments from the expert, public and the international technical expert reviews (e.g., UNFCCC) are also addressed within the respective source or sink category text. For transparency, responses to public and expert review comments are also posted on the EPA website with the final report.

Figure A-19: U.S. QA/QC Plan Summary



8.3. Assessment Factors

The *Inventory of U.S. Greenhouse Gas Emissions and Sinks* development process follows guidance outlined in EPA's *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity, of Information Disseminated by the Environmental Protection Agency*[171] and *A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information.*[172] This includes evaluating the data and models used as inputs into the

[171] EPA report #260R-02-008, October 2002, Available online at <http://www.epa.gov/quality/guidelines-ensuring-and-maximizing-quality-objectivity-utility-and-integrity-information>.
[172] EPA report #100/B-03/001, June 2003, Available online at <http://www.epa.gov/risk/guidance-evaluating-and-documenting-quality-existing-scientific-and-technical-information>, and Addendum to: A Summary of General Assessment Factors for

Inventory against the five general assessment factors: soundness, applicability and utility, clarity and completeness, uncertainty and variability, evaluation and review. Table A-287 defines each factor and explains how it was considered during the process of creating the current Inventory.

Table A-287: Assessment Factors and Definitions[173]

General Assessment Factor	Definition	How the Factor was Considered
Soundness (AF1)	The extent to which the scientific and technical procedures, measures, methods or models employed to generate the information are reasonable for, and consistent with their intended application.	The underlying data, methodologies, and models used to generate the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* are reasonable for and consistent with their intended application, to provide information regarding all sources and sinks of greenhouse gases in the United States for the Inventory year, as required per UNFCCC Annex I country reporting requirements. The U.S. emissions calculations follow the *2006 IPCC Guidelines* developed specifically for UNFCCC inventory reporting. They are based on the best available, peer-reviewed scientific information, and have been used by the international community for over 20 years. When possible, Tier 2 and Tier 3 methodologies from the *2006 IPCC Guidelines* are applied to calculate U.S. emissions more accurately.
Applicability and Utility (AF2)	The extent to which the information is relevant for the Agency's intended use.	The Inventory's underlying data, methodology, and models are relevant for their intended application because they generate the sector-specific greenhouse gas emissions trends necessary for assessing and understanding all sources and sinks of greenhouse gases in the United States for the Inventory year. They are relevant for communicating U.S. emissions information to domestic audiences, and they are consistent with the *2006 IPCC Guidelines* developed specifically for UNFCCC reporting purposes of international greenhouse gas inventories.
Clarity and Completeness (AF3)	The degree of clarity and completeness with which the data, assumptions, methods, quality assurance, sponsoring organizations and analyzes employed to generate the information are documented.	The methodological and calculation approaches applied to generate the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* are extensively documented in the *2006 IPCC Guidelines*. The Inventory report describes its adherence to the *2006 IPCC Guidelines*, and the U.S. Government agencies provide data to implement the *2006 IPCC Guidelines* approaches. Any changes made to calculations, due to updated data and methods, are explained and documented in the report consistent with UNFCCC reporting guidelines.
Uncertainty and Variability (AF4)	The extent to which the variability and uncertainty (quantitative and qualitative) in the information or in the procedures, measures, methods or models are evaluated and characterized.	The evaluation of uncertainties for underlying data is documented in the Uncertainty section of the Annex to the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*. In accordance with the *2006 IPCC Guidelines*, the uncertainty associated with the Inventory's underlying data, methodology, and models was evaluated by running a Monte Carlo uncertainty analysis on source category emissions data to produce a 95 percent confidence interval for the annual greenhouse gas emissions for that source. To develop overall uncertainty estimates, the Monte Carlo simulation output data for each emission source category uncertainty analysis were combined by type of gas,

[173] Evaluating the Quality of Scientific and Technical Information, December 2012, Available online at <http://www.epa.gov/risk/summary-general-assessment-factors-evaluating-quality-scientific-and-technical-information>.

		and the probability distributions were fitted to the combined simulation output data where such simulated output data were available.
Evaluation and Review (AF5)	The extent of independent verification, validation and peer review of the information or of the procedures, measures, methods or models.	The majority of the underlying methodology, calculations, and models used to generate the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* have been independently verified and peer reviewed as part of their publication in the *2006 IPCC Guidelines*. In cases where the methodology differs slightly from the *2006 IPCC Guidelines*, these were independently verified and validated by technical experts during the annual expert review phase of the Inventory development process. For the data used in calculating greenhouse gas emissions for each source, multiple levels of evaluation and review occur. Data are compared to results from previous years, and calculations and equations are continually evaluated and updated as appropriate. Throughout the process, inventory data and methodological improvements are planned and incorporated. The Inventory undergoes annual cycles of expert and public review before publication. This process ensures that both experts and the general public can review each category of emissions and sinks, and have an extended opportunity to provide feedback on the methodologies used, calculations, data sources, and presentation of information.

8.4. Responses During the Review Process

During the annual preparation of the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, EPA receives comments and implements methodological improvements to the U.S. Inventory to improve the transparency, accuracy, completeness, comparability, and consistency of emission estimates. EPA reviews the significance of the improvement, QC, and uncertainty assessments when considering improvements to the Inventory. Planned improvements are documented within each source and sink category's Planned Improvements section, as well as the Recalculations and Improvements chapter. Additionally, the Executive Summary, also highlights key changes in methodologies from previous Inventory reports.

EPA is continually working to improve the Inventory in response to the feedback received during the Expert, Public, and UNFCCC Review periods, as well as stakeholder outreach. For instance, as mentioned in the Planned Improvements section of the Landfills source category (Section 7.1), EPA has engaged in stakeholder outreach to increase the transparency in the Inventory methodology and to identify supplemental data sources that can lead to methodological improvements.

As noted in the previous section, for transparency, responses to comments received while developing the annual estimates from Public Review and Expert Review are posted on the EPA website with the final Inventory.[174]

As noted above in section 8.2 the expert technical review conducted by the UNFCCC supplements these QA processes. This review by an international expert review team (ERT) occurs after submission of the final report to the UNFCCC and assesses consistency with UNFCCC reporting guidelines. More information on the UNFCCC reporting guidelines and the review process can be found here:

- UNFCCC Reporting Guidelines for annual national greenhouse gas inventories: https://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2
- UNFCCC Review Process and Guidelines for annual national greenhouse gas inventories: https://unfccc.int/resource/docs/2014/cop20/eng/10a03.pdf#page=3

[174] See <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>.

- Inventory Review reports of annual submissions (latest reviews): https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/inventory-review-reports-2016

Table A-288 summarizes the areas of improvement identified through UN review and the response column provides a status of the findings.

Table A-288: Response to UN Review of the 2016 Inventory Submission

No.	ID	Sector	Source/Sink Category	Comment	U.S. Response
1.	(G.1)	General	NA	Improve the completeness of the inventory, in particular for those categories for which there are methodologies in IPCC guidelines for national greenhouse gas inventories. A number of categories are reported as "NE" because no data are available (as reported in Common Reporting Format (CRF) table 9) for which methodologies are available in the *2006 IPCC Guidelines*.	Addressing. See updated explanations in Annex 5 and CRF Table 9 of the current Inventory.
2.	(G.2)	General	NA	Ensure time-series consistency when using Greenhouse Gas Reporting Program (GHGRP) data directly in the national GHG inventory. The United States reported that EPA will continue to assess GHGRP data to improve the inventory.	Completed. When GHGRP data are used, respective categories address time-series consistency in accordance with IPCC's technical bulletin on use of facility-specific data in national greenhouse gas inventories and Vol. 1, Chapter 5 on Time Series Consistency from the *2006 IPCC Guidelines*.
3.	(G.5)	General	NA – Multiple categories	Use the plant-specific emissions from GHGRP to improve the disaggregation of combustion and industrial process emissions. In the section on planned improvements in the national inventory report (NIR) (1.B.2.c Venting and flaring – oil and natural gas –CO_2 and CH_4), the United States includes the investigation into the appropriateness of using associated gas venting and flaring data from GHGRP.	See Introduction to IPPU chapter of current Inventory (i.e., 2018 submission). The U.S. has integrated GHGRP or other appropriate data where feasible to improve disaggregation of combustion and industrial process emissions and also indicated under category-level planned improvement discussions where further work is being considered while also avoiding double counting of emissions. See Response in Energy, rows 9 and 11.
Energy					
4.	(E.1)	Energy	NA	Include information on the progress made in the plan to use GHGRP data to: develop more accurate national emission factors (EFs) based on plant-specific measurements; estimate emissions for more detailed categories and subcategories; disaggregate energy consumption data based on the facility-level reporting, and indicate which data have been sourced from GHGRP and which from other sources. The United States stated in the NIR 2016 (pp. 3 and 4) that the "GHGRP dataset and the data presented in this inventory report are complementary and, as indicated in the respective planned improvements sections for categories in this chapter, EPA is analyzing how to use facility-level GHGRP data to improve the national estimates presented in this inventory."	Completed. For the current Inventory (i.e., 2018 submission), EPA clarified how GHGRP data are used as applicable, for example estimating emissions from more detailed categories, and for the next Inventory (i.e., 2019 submission), EPA will update the status of its approach. EPA continues to assess how to use facility-level GHGRP data to improve the national estimates.
5.	(E.2)	Energy	1.A. Fuel combustion – sectoral approach – all fuels – CO_2, CH_4 and	Collect the necessary activity data (AD) and EFs to prepare emission estimates for the combustion of biomass and other fuels for these categories, including those used in the United States territories, focusing resources, as appropriate, on improvements in	Addressing. The CRF Tables document accounting for emissions from these

No.	ID	Sector	Source/Sink Category	Comment	U.S. Response
			N_2O (29, 2013) (32 and 51, 2012)	line with the *Revised 1996 IPCC Guidelines* and the *IPCC Good Practice Guidance*, and report the corresponding emissions. The United States still has subcategories for which estimates have not been prepared, for example: biomass consumption under the category other (1.A.5.a); gaseous fuels for railways (1.A.3.c) and domestic navigation (1.A.3.d) under the category transport; AD for exploration of oil (1.B.2.a) and exploration and processing (1.B.2.b) under the category oil, natural gas and other emissions from energy production; and AD of CO_2 transport and storage (1.C).	sources, including if they are Included Elsewhere (IE) or Not Estimated (NE).
6.	(E.4)	Energy	NA – Multiple categories	Report emissions from all categories and for the full time series at the most disaggregated level, in line with the UNFCCC Annex I inventory reporting guidelines, in particular for manufacturing industries and construction and fugitive emissions. The Expert Review Team (ERT) noted that the situation has been gradually improving since the 2013 submission and that individualized emission estimates for petroleum refining (1.A.1.b) and subcategories under manufacturing industries and construction (1.A.2) are now reported for all fuels excluding biomass and other fuels. However, the lack of disaggregation remains in some categories, in particular agriculture/forestry/fisheries (1.A.4.c) under other sectors, venting and flaring under fugitive emissions (1.B.2.c), heavy-duty trucks and buses (1.A.3.b.iii) under the category transport, and commercial and institutional (1.A.4.a) under the category other sectors.	Addressing. Some emissions previously not estimated (1.B.2.a and 1.B.2.b, exploration in oil and gas systems) have been included in the current Inventory (i.e., 2018 submission). Emissions are reported to the disaggregated level available with the data and the CRF Tables document accounting for emissions from all applicable sources, including if they are Included Elsewhere (IE) or Not Estimated (NE).
7.	(E.5)	Energy	Fuel combustion – reference approach – all fuels – CO_2, CH_4 and N_2O (32, 2013) (41, 2012)	Provide a more transparent clarification of how the difference in emissions between the reference and the sectoral approaches is determined and which fuels are subtracted as non-energy use (NEU) and feedstocks. The United States provided a theoretical explanation of the reference approach, and also indicated in the NIR (p. A-431, Annex 4) that "Bunker fuels and feedstocks accounted for in the IPPU chapter are subtracted from these estimates, while fuel consumption in U.S. Territories is added". The ERT notes that transparency is not fully achieved in the information provided for some categories, especially for NEU of fuels in the iron and steel category.	Completed. More information on the Iron and Steel adjustment for NEU of fuels is included in Annex 2 of the current Inventory (i.e., 2018 submission).
8.	(E.6)	Energy	International aviation – liquid fuels– CO_2, CH_4 and N_2O (35, 2013)	Harmonize and reconcile the data between the reference and the sectoral approach or furnish an adequate explanation of these inconsistencies, where appropriate. The United States indicated in the NIR (p. 3-90) that "the feasibility of including data from a broader range of domestic and international sources for bunker fuels, including data from studies such as the Third IMO GHG Study 2014, is being considered".	Addressing. EPA continues to evaluate the feasibility of using data from other sources for the reference approach and will update as appropriate in the next Inventory (i.e., 2019 submission).
9.	(E.7, G.6)	Energy	Feedstocks, reductants and other NEU of fuels – all fuels – CO_2, CH_4	Allocate emissions from NEU of fuels reported under the energy sector to the correct categories in accordance with the UNFCCC Annex I inventory reporting guidelines and the *Revised 1996 IPCC Guidelines*.	Completed. The United States has improved the explanation of its country-specific approach to the allocation of

No.	ID	Sector	Source/Sink Category	Comment	U.S. Response
			and N_2O (38, 2013) (47, 2012)	Report only emissions from fuels combusted for the use of energy under fuel combustion, and reallocate the relevant emissions currently reported under the subcategory NEU (other) and part of the fuel used under the subcategory United States territories (other). In CRF table 1.A.4, the United States reported aggregated data and emissions from liquid fuels, solid fuels and gaseous fuels under the subcategory NEU (other). During the review, the United States explained that it uses a country-specific methodology for the non-energy use of fuels in line with paragraph 10 of the UNFCCC Annex I inventory reporting guidelines to most accurately portray emissions from this category for the United States and reported in line with paragraph 35 of the UNFCCC Annex I inventory reporting guidelines. However, noting that paragraph 35 refers to the requirement to report on "how feedstocks and non-energy use of fuels have been accounted for in the inventory, under the energy or industrial processes sector, in accordance with the *2006 IPCC Guidelines*, and noting that the *2006 IPCC Guidelines*", and also noting that this indicates that the reporting of emissions from NEU under the IPPU sector and the emissions of combustion is under the energy sector, with specific exception, e.g., the coke making, the ERT is of the view that the issue identified in paragraph 38 of the ARR2014 and paragraph 47 in ARR2012 is not yet resolved.[175]	NEU of fuels in the introduction of the IPPU chapter and Annex 2. The United States uses a country-specific methodology for non-energy use of fuels in line with para. 10, Decision 24/CP.19 to most accurately portray U.S. emissions from NEU. The United States continues to evaluate ways to update this approach and provides more clarification as applicable in the current Inventory (i.e., 2018 submission).
10.	(E.8)	Energy	1.A. Fuel combustion – sectoral approach – solid, liquid and gaseous fuels – CO_2, N_2O and CH_4 (39, 2013)	Complete the collection of AD for the consumption of biomass and other fuels for the years 2010 and 2011. Consumption of biomass in the subcategory industries (1.A.1c.i) and consumption of liquid, solid, gaseous and biomass fuels in the subcategory other energy industries (1.A.1ciii) under manufacture of solid fuels and other energy industries are reported as "IE", and the United States explained that data are not available to estimate fuel consumption separately from those for the category public electricity and heat production (1.A.1.a). The United States indicated in the NIR 2016 (p.3-32) that "In examining data from EPA's GHGRP that would be useful to improve the emission estimates for the CO_2 from fossil fuel combustion category, particular attention will also be made to ensure time-series consistency, as the facility-level reporting data from EPA's GHGRP are not available for all inventory years as reported in this Inventory". The United States further explained that in the NIR, "analyses will be conducted to align reported facility-level fuel types and IPCC fuel types per the national energy statistics. Additional work will commence to ensure CO_2 emissions from biomass are separated in the facility-level reported data, and maintaining consistency with national energy statistics provided by the U.S. Energy Information Administration (EIA)".	Addressing. EPA continues to examine the use of GHGRP data for disaggregation of emission estimates. Further clarification is planned for the next Inventory (i.e., 2019 submission).

[175] The UNFCCC ERT also raised a similar comment on emissions from NEU under the General section. To streamline the review, both comments are consolidated here.

No.	ID	Sector	Source/Sink Category	Comment	U.S. Response
11.	(E.11)	Energy	1.B.2.c Venting and flaring – oil and natural gas – CO_2 and CH_4 (44, 2013)	Make efforts to use GHGRP data to improve the resolution and disaggregation of fugitive emissions from flaring and venting. In the section on planned improvements in the NIR (p.3-66), the United States includes the investigation into the appropriateness of using associated gas venting and flaring data from GHGRP.	Completed. In this year's inventory, EPA has included improved estimates for associated gas venting and flaring CO_2 and CH_4 emissions using GHGRP data. However, based on available U.S. data and methods, the United States cannot accurately develop an estimate of vented versus flaring versus leak emissions consistently across natural gas and petroleum systems.
12.	(E.13)	Energy	1.A. Fuel combustion – sectoral approach – all fuels – CO_2, CH_4 and N_2O	Previous review reports have noted that the inventory for the energy sector of the United States is not sufficiently transparent, given that emissions from consumption of all fuel types for some categories were aggregated and reported under the subcategory other, under manufacturing industries and construction. During the review, the United States pointed out that it has reported disaggregated emissions to the extent possible given the break in data collection by industrial classification with currently available data. The Party also indicated that some of the emissions under transport (1.A.3), for example emissions from heavy-duty trucks and buses, are disaggregated in the CRF tables of the Party's 2016 submission. Referring to the recommendation in previous review reports that the Party estimate emissions from all categories and for the full time series at the most disaggregated level, in line with the UNFCCC Annex I inventory reporting guidelines, the ERT recommends that the Party report disaggregated categories to the level where the EFs are distinguished (e.g. heavy-duty trucks and buses under road transport and also the categories and subcategories referred to in E.18 below).	Completed. Emissions are reported to the disaggregated level available with the data and the CRF tables document accounting for emissions from all applicable sources including if they are Included Elsewhere (IE) or Not Estimated (NE). Annex 5 includes further information on NE sources.
13.	(E.14)	Energy	1.A.3.b Road transportation – liquid fuels – CO_2	The NIR states that the number of vehicle miles travelled by light-duty motor vehicles (passenger cars and light-duty trucks) increased by 37 percent from 1990 to 2014 as a result of a confluence of factors, including population growth, economic growth, urban sprawl and periods of low fuel prices. However, the CO_2 emissions from light-duty trucks have remained almost the same during this period. One of the reasons provided by the Party in response to a question raised by the ERT during the review is an increased share of new vehicles in the respective total stocks, resulting in better fuel economy of the respective vehicular stock. However, these details are not provided in the NIR. During the review, the United States also provided additional information on penetration, sales and fuel efficiency of new road vehicles over the years. The ERT considered that this helps to clarify the downward trends to a certain extent. The ERT recommends that the United States reference data provided in Annex 3.2 to the NIR when discussing trends in CO_2 emissions from road transportation by vehicle mode and provide more information on the national average fuel economy for each major road transport mode at a disaggregated level where the EFs (e.g. passenger	Completed. For the current Inventory (i.e., 2018 submission) when discussing trends in the transportation sector, the United States references Annex 3.2 data by vehicle mode and provides transparent information on vehicle miles travelled and the share of new vehicles (in vehicle miles travelled) where possible.

No.	ID	Sector	Source/Sink Category	Comment	U.S. Response
				cars, light-duty trucks, heavy-duty trucks, buses) are distinguished for each inventory year.	
14.	(E.15)	Energy	1.A.3.b Road transportation – liquid fuels – CH_4 and N_2O	N_2O emissions from road transport are a key category for the United States in 2014. The ERT noted that the implied emission factors (IEFs) for N_2O emissions from gasoline have consistently declined from 8.78 kg/TJ in 1990 to 2.55 kg/TJ in 2014. Similarly, the IEFs for CH_4 emissions have consistently declined from 14.55 kg/TJ in 1990 to 3.57 kg/TJ in 2014. The reasons for this are not transparently explained in the NIR. During the review, the Party provided additional information on penetration, sales and fuel efficiency of new road vehicles over the years of the inventory. The ERT considered that this helps to clarify the downward trends to a certain extent. The ERT recommends that, in order to improve the transparency of its reporting, the Party reference data in Annex 3.2 when discussing trends in CH_4 and N_2O emissions from road transportation by vehicle mode and provide information on penetration, sales and fuel efficiency of new road vehicles over the years of the inventory in its NIR to demonstrate the decrease in CH_4 and N_2O emissions is due to an increase in vehicle miles traveled (VMT) percentage by vehicles with lower emission factors (i.e. Low emission vehicles (LEV) and EPA Tier 2).	Completed. For the current Inventory (i.e., 2018 submission), the United States references and discusses updates to the CH_4 and N_2O EFs for mobile sources and explains impacts on emission trends.
15.	(E.16, E.17)	Energy	1.A.3.c Railways – gaseous fuels – CO_2, CH_4 and N_2O 1.A.3.d Domestic navigation – gaseous fuels – CO_2, CH_4 and N_2O	In CRF table 9, the United States has used the notation key "NE" with the explanation: "It is unlikely that gaseous fuels are used by railways [or by shipping], but if small uses occur this fuel use is reported under the aggregated commercial category". The ERT noted that, in the absence of any further information, this explanation is not sufficiently transparent to allow the ERT to consider whether the Party should be using the notation key "NE" or "IE" (i.e. included in the subcategory commercial/institutional under other sectors, as reported in CRF table 9). The ERT recommends that the Party provide an explanation as to why CO_2, CH_4 and N_2O emissions from gaseous fuels used in railways and by shipping have not been estimated in both the NIR and CRF table 9, in accordance with paragraph 37 of the UNFCCC Annex I inventory reporting guidelines and in a transparent manner. Further, the ERT recommends that, if the emissions from the small uses of gaseous fuels are considered to be insignificant, the Party provide in the NIR justification for the exclusion in terms of the likely level of emissions, in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.[176]	Completed: This emission source was changed to Included Elsewhere (IE) in the previous Inventory (i.e., 2017 submission) and CRF with a discussion of how that was determined.
16.	(E.18)	Energy	1.A.5. Other (not specified elsewhere) – liquid, solid and gaseous fuels – CO_2	The United States reported aggregated data and emissions from NEU of liquid fuels, solid fuels and gaseous fuels under Other (1.A.5). In the NIR, the Party explains that the consumption data of fuels have been adjusted to subtract those relating to industrial processes and product use, which are reported under the IPPU sector, and NEU which are reported under Other (1.A.5). The ERT noted that, in a footnote in the	Completed. The United States uses a country-specific methodology for non-energy use of fuels in line with para. 10, Decision 24/CP.19 to most accurately

[176] The UNFCCC ERT also raised a similar comment on 1.A.3.d Domestic navigation – gaseous fuels. To streamline review, both comments are consolidated here.

No.	ID	Sector	Source/Sink Category	Comment	U.S. Response
				NIR, the Party explained "some degree of double counting may occur between these estimates of NEU of fuels and process emissions from petrochemical production presented in the IPPU sector". Further, the Party explained, in the same footnote, "data integration is not feasible at this time as feedstock data from EIA used to estimate NEU of fuels are aggregated by fuel type, rather than disaggregated by both fuel type and particular industries (e.g. petrochemical production), as currently collected through GHGRP and used for the petrochemical production category". Noting that, according to the *2006 IPCC Guidelines*, only emissions from fuels combusted for the use of their energy should be reported under fuel combustion, the ERT recommends that the Party reallocate the emissions from NEU of fuels and process emissions currently reported under the subcategory NEU (other) under the energy sector to the relevant categories under the energy and IPPU sectors in order to avoid underestimation or overestimation of emissions.	portray U.S. emissions from NEU. See row 9. EPA continues to evaluate ways to update this approach including use of GHGRP data and provides more clarification as applicable in the current Inventory (i.e., 2018 submission).
17.	(E.19)	Energy	1.B Fugitive emissions from fuels – CO_2	The United States reported CO_2 fugitive emissions from coal mining and natural gas exploration as "NE", and "IE" is reported for oil exploration, in CRF tables 1.B.1 and 1.B.2. In CRF table 9, the Party indicated that emissions from these categories are not estimated because of difficulties in obtaining data, and the inclusion of emissions from these categories will be investigated for future inventories. During the review, the Party further informed the ERT that CO_2 emissions from exploration is included in production emissions, and due to overlap in exploration and production data and emissions sources, these emissions will continue to be reported in production. The ERT recommends that the Party correct the notation key for CO_2 emissions from the natural gas exploration (from "NE" to "IE") to reflect that those emissions are included in the CO_2 from natural gas production.	Completed. In the current Inventory (i.e., 2018 submission), the exploration emissions are reported separately from production segment emissions.
18.	(E.20)	Energy	1.B.2.c Venting and flaring – CO_2 and CH_4	The United States used the notation key "IE" for CO_2 and CH_4 emissions from venting and flaring activities under the category venting and flaring (1.B.2.c), and included the emissions under the fugitive subcategories of oil (1.B.2.a) and gas (1.B.2.b). However, the ERT noted that, in the NIR, the Party reports that the vented CH_4 and CO_2 emissions account for a large portion of the emissions from production operations. For example, it is indicated in the NIR that the flare emissions from crude oil refining accounts for slightly more than 94 percent of the total CO_2 emissions in petroleum systems. NIR tables 3-36 to 3-39 present the values for CO_2 and CH_4 emissions from various venting operations in petroleum systems. During the review, the Party explained that data are unavailable to estimate the split between venting, flaring and fugitives for these sources. Noting that the Party indicates that CH_4 emissions from petroleum systems is a key category, the ERT recommends that the United States enhance the transparency in reporting these emissions in accordance with the UNFCCC Annex I inventory reporting guidelines.	Completed: See row 11. Based on available U.S. data and methods, the United States cannot accurately develop an estimate of vented versus flaring versus leak emissions consistently across natural gas and petroleum systems.

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19.	(E.21)	Energy	1.C Carbon dioxide transport and storage – CO_2	In the NIR (p. 3-67), the Party explained that facilities conducting geologic sequestration of CO_2 are required to develop and implement an EPA-approved site-specific monitoring, reporting and verification plan, and to report the amount of CO_2 sequestered using a mass balance approach. The Party further explains that available GHGRP data relevant for this inventory estimate consists of national-level annual quantities of CO_2 captured and extracted for enhanced oil recovery (EOR) applications for 2010 to 2014. Table 3-44 in the NIR provide the amount of potential emissions from CO_2 capture and extraction for EOR operations. However, the United States reported CO_2 emissions from CO_2 transport, injection and storage as "NE", explaining that preliminary data were used to develop an estimate of potential emissions from this category, and that the availability of data to estimate emissions from this category continues to be evaluated for inclusion in future inventories. During the review, the United States explained that CO_2 emissions are currently included in the sections on natural gas systems and ammonia production of the NIR. The ERT recommends that the United States update the notation key from "NE" to "IE" to address how emissions from CO_2 transport injection and storage are estimated.	Completed. The United States implemented this recommendation in the current Inventory (i.e., 2018 submission).
Industrial Processes and Product Use					
20.	(I.1)	IPPU	2. General (IPPU) – CO_2 and CH_4 (46, 2013) (62 and 75, 2012)	Improve the completeness of the inventory, in particular for CO_2 emissions from calcium carbide production and CH_4 emissions from styrene. The United States has improved the completeness of IPPU estimates, for example, a new vending machine end-use of hydrofluorocarbons (HFCs) is included within the EPA's Vintaging Model. However, several sources in the IPPU sector are reported as "NE", including CO_2 from calcium carbide production. The ERT note that *2006 IPCC Guidelines* do not provide a methodology for styrene production.	During the Expert Review phase of the current Inventory (i.e., 2018 submission), EPA sought expert solicitation on data for calcium carbide industry. See Annex 5 of the 2018 submission for more information on calcium carbide. Reporting of CO_2 emissions from calcium carbide has been changed from "NE" to "IE".
21.	(I.7)	IPPU	2.B.9 Fluorochemical production – HFC-23 (57, 2013)	Ensure that the necessary QA/QC and verification measures are implemented at the plant level to ensure that continuous monitoring results in more accurate estimates. The NIR does not describe the QA/QC measures (e.g. QA processes within the GHGRP reporting system) or verification measures at the plant-specific (or source-specific) level.	Completed. Discussion on QA/QC and Verification is included in Chapter 4.13 HCFC-22 Production (IPCC Source Category 2B9a).
22.	(I.9)	IPPU	2.C.1 Iron and steel production – CO_2 (54, 2013) (69, 2012)	Include a clear explanation of how natural gas used as fuel in coke plants in the iron and steel production process is reflected in the emission estimates within the inventory and in the carbon balance for activities related to iron and steel production. The NIR contains several clarifications of the reporting of natural gas in this category, including where there are gaps in data yet to be addressed. No carbon balance for iron and steel production is provided.	Addressing. To improve transparency, EPA will work to incorporate a carbon balance to demonstrate how emission estimates avoid the risks of gaps and double counting in line with guidance provided in the reporting *2006 IPCC Guidelines* in Vol. 3, Ch. 4, sections 4.2.2.5 and 4.2.4.2 (Reporting and

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					documentation). This improvement is noted in the Planned Improvements section of the Iron and Steel Production chapter of the current Inventory (i.e., 2018 submission), but implementation may take additional time pending available resources.
23.	(I.12)	IPPU	2.F. Product uses as substitutes for ozone depleting substances – HFCs and SF_6 (58, 2013)	Provide further information on the EPA Vintaging model, and the assumptions and factors used in the model to calculate equipment disposal quantities and equipment disposal emission rates. The NIR Annex 3.9 provides some insight into the methods used to estimate disposal emissions. However, the ERT noted that the explanatory text provided to the previous ERT is not included.	Completed. Emissions at disposal are calculated as explained in Annex 3.9. Disposal emission rates and equipment lifetimes (i.e., the time after placed into service that equipment is disposed of) are also shown. A footnote has been added to explain the calculation. The number of products and hence the amount of chemical placed into service in each year, and hence the emissions at disposal, rely on confidential business information that EPA may not publish under U.S. regulations.
24.	(I.13)	IPPU	2. General (IPPU) – all gases	The ERT noted that the information provided in the CRF tables and the NIR on recalculations was inconsistent. Data presented in the NIR (table 9-1) did not match the data presented within the CRF tables (e.g. table 8.s.1 and 8.s.4) for several IPPU categories. For example, CRF table 8.s.4 reports 2013 recalculations for HFC emissions from 2.F.4 aerosols, and recalculations from an unspecified mix of HFCs and perfluorocarbons (PFCs) from 2.F.6 other applications, but neither of these recalculations is referenced in NIR table 9-1. The ERT also noted typographical errors in the recalculations table (table 9.1) in the NIR and also in the completion of CRF table 2(I).A-Hs1 (interchanging of rows of production data in 2.B). During the review, the United States indicated that it has experienced multiple problems in importing data into the new CRF Reporter software. However, the United States did not respond to questions regarding the errors in the NIR and a request for revised recalculations data. As a result, the ERT was not provided with a full and transparent description of the recalculations in the 2016 submission, and hence was unable to review the rationale and accuracy of recalculations in the IPPU sector. The ERT recommends that the United States report full and detailed explanations of all recalculations to IPPU categories in the NIR, and provide information on changes to methods, assumptions, AD and EFs across all years as well as the rationale for the recalculations.	Completed. The United States provided full and detailed explanations of recalculations to IPPU categories in the current Inventory (i.e., 2018 submission). For example, the Recalculations Discussion in Section 4.24 - Substitution of Ozone Depleting Substances (ODS) includes a description of updates to assumptions in EPA's Vintaging Model, which is used to estimate the actual—versus potential—emissions of various ODS substitutes. The Vintaging Model was revised in response to a peer review conducted on end uses within the Refrigeration/Air Conditioning and Fire Protection sectors.

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25.	(I.14)	IPPU	2. General (IPPU) – CO_2	Annex 2 to the NIR (p. A-31) describes the derivation of petroleum coke energy and NEU allocations; petroleum coke use in the IPPU sector is subtracted from the overall energy balance, based on reported AD estimates for five IPPU categories. However, in CRF tables 1.A(b) and 1.A(d) the "carbon excluded" for petroleum coke is reported as "NO". This is not consistent with the information in Annex 2 to the NIR and within the IPPU chapter, which indicate that petroleum coke is used in several emissive non-energy applications. During the review, the United States provided a time series of the adjustments made to the energy data for petroleum coke use in the production of titanium dioxide, silicon carbide, aluminium, ferroalloys and ammonia. The United States also noted that it had experienced multiple problems importing data into the new CRF Reporter software. The ERT recommends that the United States correct the reference approach calculations for petroleum coke in accordance with the *2006 IPCC Guidelines*, and report the relevant information in a consistent way in the energy and IPPU chapters of the NIR and in the CRF tables. The ERT also recommends that, to improve the transparency of the data sources and data checks conducted, the United States include the information provided to the ERT during the review week, including the adjustments made to the energy data for petroleum coke use in the production of titanium dioxide, silicon carbide, aluminium, ferroalloys and ammonia, in future submissions.	Completed. See CRF Tables 1.A(b) and 1.A(d) of the previous Inventory and CRF submission (i.e., 2017 submission). Additional information regarding the adjustments made to the Energy chapter were included in the previous and current Inventories (see Annex 2 of 2018 submission). More information on adjustments for IPPU categories will be updated in future inventories consistent with methodological improvements.
26.	(I.15)	IPPU	2. General (IPPU) – all gases	The ERT noted that the inventory of the United States is not complete, because there are categories that are not estimated and the NIR referred to gaps in the inventory. The ERT also noted that the list of sources "not included" in the inventory for the IPPU sector presented in Annex 5 to the NIR is inconsistent with the information presented in CRF table 9. For example, CRF table 9 lists categories that are not mentioned in Annex 5 to the NIR, in particular: CO_2 from iron and steel pellet production; CO_2 from ceramics production; CO_2 from non-metallurgical magnesium production; SF_6 from other product use; HFCs and SF_6 from photovoltaics and heat transfer fluids; and PFCs from other product use. Furthermore, the ERT notes that the NIR does not include the justification required by paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines for the following categories that are reported as "NE": CH_4 from direct reduced iron; CO_2 from ceramics and non-metallurgical magnesium production; CO_2 from iron and steel pellet production; and N_2O from glyoxal and glyoxylic acid production. The ERT further noted that, in the NIR, the United States indicates the estimation of F-gases from heat transfer fluids and the GHG emissions from pellet production as the priorities of the planned improvements. The ERT recommends that the United States estimate and report emissions from those categories currently reported as "NE" in the next submission to improve completeness and consistency of the inventory.	Completed. Within the previous and current Inventory (i.e., 2017 and 2018 submissions), the United States updated Annex 5 of the NIR to reflect the IPPU source categories listed as "NE" within CRF table 9 and Annex 5. In addition, Annex 5 has been updated to include justification for reporting categories as "NE", consistent with UNFCCC reporting guidelines.

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27.	(I.17)	IPPU	2.A.4 Other process uses of carbonates – CO_2	The ERT noted that the NIR describes several difficulties in accessing accurate and complete AD for this key category, primarily from the U.S. Geological Survey (USGS) statistical publications, including: extensive reporting of "unspecified uses" for crushed stone (limestone and dolomite); suppression of confidential data on limestone and dolomite end uses; and no data available for limestone and dolomite use in production of ceramics and non-metallurgical magnesium. As a result, the ERT notes that: (1) emissions from ceramics and non-metallurgical magnesium production are reported as "NE"; and (2) the derivation of complete and accurate AD for other emissive uses of limestone and dolomite is subject to considerable uncertainty, as evidenced by the large recalculation of 2013 data. For example, the estimated AD for total limestone and dolomite use in this category in 2013 reported in the 2016 submission are 220 percent higher than those in the 2015 submission, and the emissions for this category for 2013 are 235 percent higher in the 2016 submission than in the 2015 submission. During the review, the United States stated that EPA has assessed data availability but has not found alternative sources of data for carbonate consumption in the country. The United States also stated that GHGRP data at the facility level are incomplete and rarely include carbonate consumption by type, and that EPA will continue its efforts to work with USGS on opportunities to improve existing surveys and to seek alternative data sources. The ERT recommends that the United States conduct further research and consultation with industry, state-level regulators and/or statistical agencies to access additional AD and EFs and/or to seek verification of the current method and assumptions, and report on progress in the NIR.	Addressing. Data on ceramics and non-metallurgical magnesium has yet to be identified. The United States will continue its efforts to work with USGS to help resolve/describe uncertainties and assess reporting possibilities of "other" emissive uses of limestone and dolomite. These improvements may take time given the need to coordinate with appropriate technical staff at various agencies and available resources to implement updates.
28.	(I.18)	IPPU	2.B.1 Ammonia production – CO_2	The ERT noted that in the NIR, the United States indicates that all emissions from fuels consumed for energy purposes during ammonia production are accounted for in the energy sector. During the review, the United States explained that it uses a country-specific approach to estimate the CO_2 emissions from ammonia production to avoid double counting, consistent with paragraphs 10 and 11 of UNFCCC Annex I inventory reporting guidelines. The ERT also noted that this is not consistent with the *2006 IPCC Guidelines*, which state, "in the case of ammonia production no distinction is made between fuel and feedstock emissions with all emissions accounted for in the IPPU sector" (volume 3, Chapter 3, section 3.2.2). The ERT further noted that the IEF for ammonia production (0.90 t/t) is one of the lowest of all reporting Parties (range: 0.06–3.27 t/t). The ERT is of the view that it is likely that this category will be identified as key by a level assessment, if the allocation of emissions is performed in accordance with the *2006 IPCC Guidelines.* The ERT noted that the NIR indicates planned work to determine which EFs to include in both fuel and feedstock CO_2 emissions, and to improve the accuracy of the emission estimates based on the enhanced use of the GHGRP data.	Completed. The United States has addressed this comment within the Ammonia Production chapter of the current Inventory (i.e., 2018 submission) to increase transparency. CO_2 emissions from production of synthetic ammonia from natural gas feedstock are estimated using a country-specific approach modified from the *2006 IPCC Guidelines* (IPCC 2006) Tier 1 and 2 methods. In the country-specific approach, to avoid double counting, emissions are not based on total fuel requirement per the *2006 IPCC Guidelines* due to data disaggregation limitations of energy statistics provided by the EIA. A country-specific emission factor is developed and applied to

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				The ERT recommends that the United States provide the information, in both IPPU and energy chapters, on the country-specific approach used to estimate CO_2 emissions from ammonia production, justify the reason for its methodological choice and explain why it is unable to implement the estimates following the *2006 IPCC Guidelines* as outlined in paragraph 11 of UNFCCC Annex I inventory reporting guidelines.	national ammonia production to estimate emissions from feedstock consumption, excluding consumption of fuel for energy purposes to avoid double counting. The IEF is based on current IPCC methods and is thus appropriate for the country-specific method.
29.	(I.19)	IPPU	2.B.1 Ammonia production – CO_2	The ERT noted that, during the review, the United States indicated that it is working with appropriate energy data (EIA) institutions and GHGRP to obtain the necessary data to improve the country-specific approach and enhance its consistency with the *2006 IPCC Guidelines*. The ERT commends the United States for the planned improvements and recommends that the United States allocate emissions from all fossil fuel uses (i.e. fuel and feedstock use) for ammonia production under subcategory 2.B.1 of the IPPU sector in accordance with the *2006 IPCC Guidelines*.	Addressing. The United States is continuing this work of allocating all fossil fuel uses for ammonia production to the IPPU chapter. To increase transparency, additional information has been included in the Ammonia Production chapter of the current Inventory (i.e., 2018 submission). For the current Inventory, national circumstances regarding the aggregation and reporting of national energy statistics have not allowed EPA to allocate and report these emissions within the Ammonia Production category without double counting of emissions from fuel use.
30.	(I.20)	IPPU	2.B.4 Caprolactam, glyoxal and glyoxylic acid production – CO_2 and N_2O	The ERT noted that all subcategories under this category are reported as "NE". However, international statistical data[177] indicate that the United States is potentially one of the largest producing countries for caprolactam. During the review, the United States indicated that the EPA has reviewed data availability and obtained annual production data on caprolactam for 2004 to 2015 from the American Chemistry Council. The ERT recommends that the United States estimate emissions from caprolactam production in accordance with the method provided in the *2006 IPCC Guidelines* and with the use of available AD, and report on the emissions from this category in its next inventory submission.	Partially completed. The United States has included the emissions estimate for caprolactam production in the current Inventory (i.e., 2018 submission). Data on glyoxal and glyoxylic acid has yet to be identified. See Annex 5 for additional information.
31.	(I.21)	IPPU	2.B.5 Carbide production – CO_2 and CH_4	The ERT noted that emissions from calcium carbide production are reported as "NE", although the lack of emission estimates for this category has been the subject of recommendations in all review reports since 2008. During the review, the ERT provided information on calcium carbide production plants in the United States based	Addressing. The United States has begun reporting the CO_2 emissions from carbide production as "IE", as these emissions are implicitly accounted for in

[177] See <http://www.fibre2fashion.com/industry-article/6/global-caprolactam-production-capacity?page=2>.

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				on public domain data from the United States Chemical Safety and Hazard Investigation Board report of February 2013. The United States stated that the existing statistical and trade publications do not include national time-series data on calcium carbide production, however, some recent literature references were identified during the compilation of the 2015 NIR that provide some information on potential calcium carbide production at specific facilities in the country (including information cited by the ERT and information on associated facilities that had closed). The ERT recommends that the United States progress with research and consultation (e.g. with regulators, plant operators, statistical agencies) to obtain AD (e.g. based on reported production capacities for the known operating plant) and report emission estimates based on methods consistent with the *2006 IPCC Guidelines* across the time series.	the storage factor calculation for the non-energy use of petroleum coke in the Energy chapter. CH_4 emissions from calcium carbide production are reported as "NA" because the *2006 IPCC Guidelines* only provide information on a Tier 3 CH_4 approach for calcium carbide production.
32.	(I.22)	IPPU	2.B.8 Petrochemical and carbon black production – CH_4 and N_2O	The ERT noted that the NIR 2016 (chapter 4.12) indicates that a subset of facilities reporting under GHGRP use alternative methods to the carbon balance approach (e.g. Continuous Emission Monitoring Systems or other engineering approaches) to monitor CO_2 emissions, and that these facilities are required to report CH_4 and N_2O emissions as well. However, the ERT noted that CH_4 and N_2O from combustion and flaring are currently not included in the national inventory estimates. During the review, the United States explained that the EPA coordinator for the IPPU inventory has requested the provision of aggregated and quality-checked data on CH_4 and N_2O emissions where reported from the GHGRP coordinator, with a view to integrating these data in future submissions to improve the completeness of national inventory estimates. The ERT recommends that the United States progress its plans to analyse GHGRP data and include emissions from those installations not currently included in the inventory.	Addressing. The United States would like to clarify that the subset of GHGRP facilities using alternative methods are only required to report CH_4 and N_2O emissions from combustion of process off-gas, rather than complete CH_4 and N_2O emissions. This clarification is included in the current Inventory (i.e., 2018 submission). In addition, the United States plans to begin work with industry experts to assess GHGRP data to improve completeness of the petrochemical production inventory, as noted in the Planned Improvements section.
33.	(I.24)	IPPU	2.B.8 Petrochemical and carbon black production – CO_2 and CH_4	The ERT noted that the NIR 2016 (chapters 3.2 and 4.12) highlights that the United States inventory currently may include double counting of emissions between NEU of fuels in the energy sector and petrochemical production in the IPPU sector. The NIR (p. 3-40) transparently states that data integration (i.e. between the energy balance, GHGRP data and the GHG inventory) is not feasible because the EIA data on feedstock (i.e. NEU data) within the energy balance are presented by commodity only, with no resolution of data by industry sector (such as petrochemical production), whereas GHGRP data provide feedstock type for each installation only, and not the AD that underpin reported emissions. The ERT noted that emissions from fuels and feedstocks used for energy purposes are accounted for in the energy sector (NIR p. 4-42), which is not consistent with the *2006 IPCC Guidelines* (volume 3, chapter 3, section 3.9.1, "allocation and reporting"), and therefore that the estimates for	Addressing. The United States is addressing this comment by providing additional information within the Energy and IPPU chapters of the current Inventory (i.e., 2018 submission) to improve the explanation and justification of using a country-specific approach to estimate CO_2 emissions from petrochemical production. See Annex 2.

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				petrochemical production emissions are not comparable with those of other reporting Parties. The ERT recommends that, in both the IPPU and energy chapters of the NIR, the United States provide information on the country-specific approach used to estimate CO_2 emissions from petrochemical production, justify the reason for its methodological choice and explain why it was unable to implement the estimates following the *2006 IPCC Guidelines* as outlined in paragraphs 10 and 11 of the UNFCCC Annex I inventory reporting guidelines.	
34.	(I.25)	IPPU	2.B.8 Petrochemical and carbon black production – CO_2 and CH_4	In addition to the recommendation above, the ERT further recommends that the United States develop a methodology that is consistent with the *2006 IPCC Guidelines* as soon as is practicable, allocating all relevant fuel and feedstock emissions within the IPPU sector.	Addressing. The United States will work to address this comment to improve the comparability of petrochemical production estimates with other Parties, consistent with *2006 IPCC Guidelines*, noting that an improvement may take time to implement.
35.	(I.26)	IPPU	2.B.8 Petrochemical and carbon black production – CO_2	The ERT noted that the country-specific EF for ethylene production that is derived from GHGRP data and applied to AD from 1990 to 2009 is among the lowest of all reporting Parties. The ERT also noted that the IEFs derived from GHGRP data decline from 0.84 t CO_2/t ethylene in 2010 to 0.74 t CO_2/t ethylene in 2014. During the review, the United States provided additional information on the category-specific QC, including the consultation with the industry experts that indicates that there have been no significant changes to the processes over time and hence the IEFs derived from GHGRP are the best available for the whole time series, and that the GHGRP reporting provides a largely complete picture of emissions and production information. The ERT further notes that the United States' approach in using IEFs derived from a country-specific method (e.g. GHGRP data for the feedstock component) across the time series appears to be justified. The ERT recommends that the United States provide an explanation for its country-specific approaches using the EFs derived from GHGRP data, including the outcome of consultation with industry experts, and the results of the quality checks between GHGRP production estimates and data from trade association membership surveys.	Partially completed. The United States has added additional explanation to the current Inventory to improve transparency of the country-specific methodology. The United States has completed an initial comparison of industry data to data from the EPA GHGRP but additional time is needed to conduct further analysis of the most up-to-date data and report these results. Additional explanation on the outcome of consultation with industry experts, the country-specific quality checks and uncertainties, and results of these quality checks will be included in future Inventory submissions, as additional time is needed to complete this review.
36.	(I.27)	IPPU	2.C.1 Iron and steel production – CO_2	In addition to the issues noted above, the ERT noted that the NIR (p. 4-60) indicates that data on natural gas consumption and coke oven gas production at merchant coke plants are not available and are therefore omitted from the inventory emission estimates. The ERT considers that, because the United States did not provide a carbon balance for coke production and iron and steel production within the NIR and did not respond to the ERT's request for further information during the review, it is not feasible for the ERT to fully assess the completeness and comparability of the United	Addressing. The United States has identified this as a planned improvement within the NIR. The U.S. has initiated review of the available EPA GHGRP data for information on consumption and production from merchant coke plants. As indicated in the NIR, due to resource

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				States' submission; for example, regarding the allocation of emissions across categories in the energy sector and the IPPU sector. The ERT recommends that the United States conduct further research and consultation with industry, regulators and statistical agencies as necessary in order to access complete AD on natural gas consumption and coke oven gas production at merchant coke plants, and obtain EFs and/or emission estimates.	and timing constraints, this improvement is taking more time to implement.
37.	(I.28)	IPPU	2.C.1 Iron and steel production – CO_2	The ERT noted that the IPPU chapter of the NIR indicates that CO_2 emissions from coke production are allocated in the IPPU sector together with iron and steel production emissions instead of the energy sector as outlined in the *2006 IPCC Guidelines*. The NIR provides a transparent explanation of the country-specific approach used for the allocation of these emissions. However, the ERT noted that the NIR is unclear about the fate of other by-product emissions from coke production and iron and steel production such as secondary gases (notably blast furnace gas) that may be used to provide process heat or for power generation at integrated iron and steel facilities. According to the *2006 IPCC Guidelines* (sections 4.2.2.5 and 4.2.4.2), the relationship between the emissions reported under the energy and IPPU sectors are to be clearly managed and reported to avoid the risks of gaps and double counting, and "a clear explanation of the linkage with the source category 1A (Fuel Combustion) estimate for integrated coke production emissions" has to be provided "to demonstrate that double counting or missing emissions have not occurred", if the tier 2 method was used. In order to improve the transparency of the reporting in the NIR and the CRF tables, the ERT recommends that the United States explain the allocation of the emissions from coke production and iron and steel production across both the energy and IPPU sectors, including the amount of carbon stored in the products of iron and steel production. This could be done, for example, through the provision of a quantitative summary of the carbon balance that the United States uses to compile and quality check the inventory estimates.	Completed. The United States incorporated additional information to improve the transparency of other by-product emissions within the Iron and Steel Production chapter of the current Inventory (i.e., 2018 submission). See Annex 2. As noted in response to comment above, the United States will work to incorporate information to explain allocation of emissions from coke production and iron and steel across Energy and IPPU categories, including carbon stored in iron and steel production products potentially through a summary of the carbon balance within the Iron and Steel chapter, which has been noted in the Iron and Steel Production Planned Improvements section.
38.	(I.29)	IPPU	2.F. Product uses as substitutes for ozone depleting substances – HFCs and PFCs	The ERT noted that the NIR (Annex 3.9) provides a wealth of useful information on the models used to estimate emissions from this category, including the Refrigeration and Air-Con model, but that other key information to ensure transparency of the method and model assumptions is missing. For example, the chemical recovery rates applied in the calculations for disposal emissions in the Refrigeration and Air-Con model are not detailed, and although tables A-169 and A-170 provide a lot of detailed data, the explanation of the estimation methodologies and the application of the tabulated data within the model calculations is not clear. During the review, the United States provided many detailed clarifications on the model calculations, references and the application of data from the tables in the NIR.	Completed. Two footnotes have been added to the table, one to indicate the linear substitution between "start" and "full penetration" dates, and another to explain Growth Rate. EPA does not refer to the introduction of substitutes as "overlapping equipment technology substitutions." Instead, a specific portion of each end-use will have a specific chemical (or blend, e.g., in the case of many refrigeration and air-

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				The ERT recommends that the United States improve the documentation of the Refrigeration and Air-Con model by including the clarifications on model assumptions, data sources and calculation methodologies provided to the ERT during the review, including: the assumed linear substitution trend between "start" and "full penetration" dates for substitution gases; the information on the annual growth rates cited in the NIR are the average annual growth rate for individual market sectors from the base year to 2030 that are applied within the model; the model calculation approach for overlapping equipment technology substitutions; details of country-specific circumstances and key references for the annual emission rates for servicing and leaks applied; and assumed recovery, re-use and recycling of fluids at end of life (e.g. for fire extinguishers).	conditioning end-uses) and these vary by year as a substitute is introduced over time (linearly as stated by the response above). This is stated under Step 2 under "Methodology" at the beginning of Annex 3.9 where it says "As part of this simulation, the ODS substitutes are introduced in each of the end-uses over time."
39.	(I.30)	IPPU	2.F.1 Refrigeration and air conditioning – HFCs and PFCs	The ERT noted that there is no methodological information in the NIR to explain the derivation of emission estimates from the manufacture of new products for sectors including refrigeration and air conditioning, although emissions are reported in CRF table 2(II).B-Hs2. During the review, the United States clarified that it considers that there should not be any emissions from the manufacture of new refrigeration and air-conditioning equipment, based on the assumption that emissions during equipment manufacture are essentially negligible. The United States explained that the values in the CRF table are incorrect owing to a spreadsheet formula error when the foam sector was disaggregated into closed-cell and open-cell foams in the model that converts outputs from the EPA's Vintaging Model to the CRF Reporter software. In this case, the emissions estimated for servicing activities for commercial refrigeration and domestic refrigeration were attributed to "Actual emissions from manufacturing" rather than a component of "Actual emissions from stocks". The ERT notes that the assumption that there are no emissions in the product manufacture stage for refrigeration and air-conditioning sources is not consistent with the *2006 IPCC Guidelines* (volume 2, chapter 7, section 7.5.2.1). Furthermore, the ERT notes that the United States also highlighted that many cold storage and retail food units in the United States are large systems with kilometres of piping and hundreds of joints and component connections that are prone to leakage; therefore, the ERT considers that initial charging losses are highly likely to occur where new industrial units are charged in situ. The ERT recommends that the United States either review and update its assumptions regarding product manufacture losses or provide information in the NIR to justify the assumption that all such losses are "negligible" and accurately reflect country-specific circumstances.	Addressing. EPA is researching and gathering data so that emissions from manufacturing / first-fill operations can be accurately assessed. The error in converting model results to the CRF table was addressed. EPA initiated a peer review of the model and has incorporated results in the current Inventory (i.e., 2018 submission). EPA will continue to incorporate peer review results, including any related to the assumption that there are no emissions in the product manufacture stage, as we further review the information provided.
40.	(I.31)	IPPU	2.F.2 Foam blowing agents – HFCs and PFCs	The ERT noted that in the NIR (table A-175), the sum of model losses for extruded polystyrene sheet foam totals 90 percent, whereas for all other foams (with the exception of insulation that is assumed to be landfilled) 100 percent leakage is estimated. Further, the ERT noted that the model assumes that no foam products are collected at the end of their use and the F-gases are either recovered or destroyed to	Completed. Additional information has been obtained and implemented regarding extruded polystyrene sheet foam. Losses now total 100 percent.

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				avoid release. During the review, the United States clarified that the reason for the extruded polystyrene sheet foam total of 90 percent is not known, and confirmed that the model does not take into account the recovery or destruction of blowing agents at end of life, because this is not required by federal regulations and because, at end of life, foam insulation is removed from decommissioned buildings and typically landfilled. The United States further noted that there are several incentive schemes to promote the recovery of HFC blowing agents in building insulation foams, and destruction facilities that recover blowing agents from domestic refrigeration foam, for example through the EPA's voluntary Responsible Appliance Disposal Program. The model does not account for these activities as they are not regarded as widespread in the United States. The ERT recommends that the United States review the model assumptions and QA/QC of the model to eliminate the unexplained inconsistencies regarding the fate of foam blowing agents, and update assumptions to reflect national practices (e.g. to recover or destroy foam blowing agents). Furthermore, the ERT recommends that the United States include in the NIR clarifications regarding how the model accounts for end-of-life practices for foam blowing agents.	Data provided under the Responsible Appliance Disposal Program were reviewed and support the simplifying assumption that HFC foam blowing agent recovery and destruction is negligible. Annex 3.9 indicates how the model accounts for end-of-life emissions from the foams sector. See for instance Steps 3 and 4 in the Foam Blowing methodology and the information contained in Table A-151.
41.	(I.32)	IPPU	2.F.5 Solvents – HFCs and PFCs	The ERT noted that, in the method description for emissions from solvents provided in Annex 3.9 (p. A-247) to the NIR, the United States applies an assumption that only 90 percent of solvents are emitted. This is not consistent with the *2006 IPCC Guidelines* (section 7.2.2, chapter 7), which indicate that emissions from solvent applications are typically 100 percent emitted within two years of initial use. In order to estimate emissions in such cases, it is necessary to determine the total amount of each HFC or PFC chemical sold in solvent. Furthermore, the ERT noted that the use of the notation key "NA" to report emissions from solvents in the CRF tables is not correct. The ERT recommends that the United States either review and update its assumptions regarding solvent emissions or provide country-specific information to justify the assumption that only 90 percent of solvents are emitted, and revise the reporting of emissions from solvents within the CRF tables.	Completed. The 90 percent assumption has been reviewed and confirmed. The Inventory indicates that the other 10 percent become entrained in waste products that are then destroyed.
42.	(I.33)	IPPU	2.F.6 Other applications (product uses as substitutes for ozone depleting substances) – HFCs and PFCs	The ERT noted that CRF table 2(II) of the 2016 submission reports emissions from an unspecified mix of HFCs and PFCs in the subcategory other applications (2.F.6) under the category product uses as substitutes for ODS (2.F.6) for which no details are provided in the NIR, and that these emissions constitute about 5.8 percent of the total for the highest-emitting key category in the IPPU sector in 2013. Furthermore, the ERT noted that the emissions data presented for each of the subcategories under product uses as substitutes for ODS (2.F) in CRF table 2(I)s2 are not consistent with the subtotals presented in table 4-96 of the NIR, and that this inconsistency appears to be caused (at least in part) by the reporting of the "unspecified mix" of gases in the CRF table. During the review, the United States clarified that the "unspecified mix" of gases are aggregated and treated as confidential information because they are produced or	Completed. Certain gases within the unspecified mix of HFCs and PFCs are only used in one particular sector or subcategory; and, therefore, publishing the unspecified mix of HFCs and PFCs at the subcategory level would reveal confidential business information.

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				imported by a small number of chemical providers and in such small quantities or for such discrete applications that reporting national data would result in disclosure of confidential information. The ERT recommends that the United States provide in the NIR detailed information including the, quality checks for all gases and sources included in the unspecified mix of HFCs and PFCs in the subcategory other applications under the category product uses as substitutes for ODS.	
43.	(I.34)	IPPU	2.F.6 Other applications (product uses as substitutes for ozone depleting substances) – HFCs and PFCs	The ERT recommends that the United States improve the consistency between its NIR and CRF tables for the reporting of subcategories of product uses as substitutes for ODS.	See row 42.
Agriculture					
44.	(A.2)	Agriculture	3.B Manure management – CH_4 and N_2O	Investigate the reasons for the differences between the trends of volatile solid (VS) daily excretion and nitrogen excretion (Nex) rates per animal type for sheep and swine. This information was not provided in the 2016 submission. During the review, the United States explained that the manure management inventory team obtains its data from the Cattle Enteric Fermentation Model (CEFM), and that the team will work with the enteric fermentation inventory team to clarify the reasons for the different trends of VS values and Nex rates for sheep and swine.	Completed. The United States added additional text to Annex 3.11 (Methodology for Estimating CH_4 and N_2O Emissions from Manure Management) of the previous Inventory (i.e., 2017 submission) to clarify this trend.
45.	(A.3)	Agriculture	3.B.1 Cattle – CH_4 and N_2O (71, 2013)	Include explanations for the trends of VS daily excretion and Nex rates per animal for dairy cattle. This information was not provided in the 2016 submission. During the review, the United States explained that the manure management inventory team obtains its data from the CEFM, and that the team will work with the enteric fermentation inventory team to clarify the reasons for the different trends of VS values and Nex rates of dairy cattle.	Completed. The difference in the VS daily excretion and Nex rate trends between dairy cattle animal types is due to milk production. Milk production by cow varies from state to state and is used in calculating net energy for lactating, which is used to calculate VS and Nex for dairy cows. Milk production is zero for dairy heifers (dairy heifers do not produce milk since they have not yet had a calf). Over time, the differences in milk production are also a big driver for the higher variability of VS and Nex rates in dairy cows. This trend explanation has been added to Annex 3.11 for the current Inventory (i.e., 2018 submission).

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46.	(A.4)	Agriculture	3.D.a.6 Cultivation of organic soils (i.e. histosols) – N_2O (74, 2013)	Revise the AD and emission estimates for cultivation of histosols in agricultural soils and revise the QC process in order to ensure consistency in the inventory, and provide information on these improvements. The United States did not provide information on the revision or the recalculation to address the recommendation, and the ERT noted that an inconsistency in the area of cultivated organic soil between CRF table 3.D (1,352,082.22 ha) and the NIR (1.21 million ha) (annex p. A-332) still exists in the 2016 submission. During the review, the United States explained that it has experienced multiple problems importing data from its country-specific methods into the new CRF Reporter agriculture modules. The United States indicated that it is investigating options to solve the problems.	Completed. The United States addressed this issue in the CRF tables for the current Inventory (i.e., 2018 submission).
47.	(A.8)	Agriculture	3.D.a.3 Urine and dung deposited by grazing animals – N_2O (77, 2013) (92, 2012)	Resolve the inconsistency in the total N excretion on pasture, range and paddock between CRF table 4.B(b), N_2O emissions from manure management, and CRF table 4.D, agricultural soils. The total N excretion on pasture, range and paddock reported in CRF table 3.B(b) and in CRF table 3.D are inconsistent. In addition, the ERT noted that the total N excretion on pasture, range and paddock was reported as 4,265,716,593.73 kg/year in CRF table 3.D, while 3,672 kt N was provided in the NIR (annex table A-223). During the review, the United States explained that it had experienced problems in importing data from its country-specific methods in to the new CRF Reporter agriculture modules, and it was investigating options to solve the problems that it continues to experience with CRF Reporter.	Completed. The discrepancy between the total N excretion on pasture, range and paddock reported in CRF tables 3.D and in the NIR has been resolved. The United States addressed the discrepancy between CRF tables 4.B(b) and 4.D in the CRF tables in the current Inventory (i.e., 2018 submission).
48.	(A.9)	Agriculture	3.D.a.3 Urine and dung deposited by grazing animals – N_2O (77, 2013) (92, 2012)	Improve QC procedures to avoid inconsistencies in the total N excretion on pasture, range and paddock between CRF tables 4.B(b) and 4.D and provide information on these improvements. There is some information on QC improvement in the NIR, but inconsistencies in the total N excretion on pasture, range and paddock between CRF table 3.B(b) and CRF table 3.D still exist. During the review, the United States explained that it had experienced problems in importing data from its country-specific methods in to the new CRF Reporter agriculture modules, and it was investigating options to solve the problems that it continues to experience with CRF Reporter.	Completed. See response to the comment above. The United States is improving QC procedures to resolve many issues experienced with the CRF Reporter.
49.	(A.11, A.15)	Agriculture	3.A.1 Cattle – CH_4 3.B.1 Cattle – CH_4	In CRF table 3.As1 of the 2016 submission, the United States chose option C for reporting CH_4 emissions under enteric fermentation. As for enteric fermentation, the United States chose option C for reporting CH_4 emissions from cattle manure management in CRF tables 3.B(a)s1 and 3.B(a)s2. According to footnote 4 of CRF table 3.As1, 3.B(a)s1, and 3.B(a)s2, option C should be used when Parties want to report a more disaggregate livestock categorization compared with option A and option B. However, the United States reported only dairy cattle and non-dairy cattle emissions under option C, and the cells for all other subcategories of cattle were reported as "IE",	Completed. The United States addressed this issue in the CRF tables in the current Inventory (i.e., 2018 submission) to reflect the previous recommendations made by the ERT. The United States is reporting more disaggregated data, where available and applicable, within the CRF tables.

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				except for location in warm regions, which was reported as "NO". Further, the ERT noted that, in CRF table 9 in which emissions reported as "IE" are allocated should be explained by the United States, information is not complete. During the review, the United States stated that it can investigate updating the information provided in the CRF tables. The United States also explained that it had made attempts to present disaggregated data during the initial CRF input phase of the 2016 submission. However, since it experienced problems in data input, it took the approach of previous years of inputting those data as "IE". If the United States does not use more disaggregate livestock categorization in estimating emissions, the ERT recommends the United States use option A in reporting data and emissions for cattle.[178]	
50.	(A.12)	Agriculture	3.A.1 Cattle – CH_4	The United States applied a tier 2 methodology with regional feed digestibility and Y_m to estimate enteric CH_4 from dairy cattle and beef cattle, and in the NIR 2015 (p. A-255), it stated that daily EFs were estimated for each animal type and state regions. Information such as cattle population, typical animal mass, weight gain at country level, dairy lactation rates, feed digestibility and Y_m at state level and regional level was included in the NIR and/or its annexes. However, the ERT considers that the transparency could be further improved by including the average gross energy intake and EFs for each animal type, by state. In addition, in the NIR (pp. A-266–A-267) the United States explained that Y_m values were determined for 1990 using the Donovan and Baldwin model (1999), and the values for 1990 were used as the baseline to estimate for 1991 and beyond by scaling Y_m values for each diets with the COWPOLL model. The scaling factor is shown as $Y_m = Y_m(1990)EXP[1.22/(YEAR–1980)]/EXP[1.22/(1990–1980)]$, but the NIR does not provide information on the development of the scaling factor equation and related verification. During the review, the United States stated that it will include in the NIR population, average gross energy intake and EFs for each animal type, by state, and provide information on Y_m, which will include detailed procedures for and verification of the development of Y_m. The ERT recommends that the United States include in the NIR the values of population, average gross energy intake and EFs for each animal type, by state, as well as information on the procedure.	Completed. In Annex 3.10 (beginning on page A-239) of the previous Inventory (i.e., 2017 submission), cattle population, gross energy intake and emission factors by animal type, by state were provided. In addition, additional information on Y_m was included.
51.	(A.13)	Agriculture	3.A.1 Cattle – CH_4	In the NIR (p. 5-4), the United States stated that the CEFM was used to estimate CH_4 emissions from cattle enteric fermentation. It also indicated that significant scientific literature exists and, in its emission estimations, the United States incorporated information and analyses of livestock population, feeding practices and production characteristics. In Annex 3 to the NIR 2016, the United States explained that the CEFM was developed based on recommendations provided in the *2006 IPCC*	Completed. The CEFM uses the methods in the *2006 IPCC Guidelines* to estimate enteric emissions. The CEFM then tracks the populations and weights of these animals more accurately through a transition matrix, so the

[178] The UNFCCC ERT also raised a similar comment on 3.B.1 Cattle – CH_4. To streamline review, both comments are consolidated here.

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				Guidelines. However, the NIR does not provide information that explains how the CEFM is compatible with the methodologies in the *2006 IPCC Guidelines*, as required by paragraph 10 of the UNFCCC Annex I inventory reporting guidelines. During the review, the United States stated that it will provide information on the compatibility of the CEFM with the methodologies provided by the *2006 IPCC Guidelines.* The ERT recommends that the United States report in its NIR on the compatibility of estimates obtained using the CEFM with estimates obtained using methodologies from the *2006 IPCC Guidelines.*	United States can develop more refined estimates based on the methods in the *2006 IPCC Guidelines*. More information on CEFM is provided in Annex 3.
52.	(A.14)	Agriculture	3.B Manure management – CH_4 and N_2O	The ERT noted that in the NIR (p. 5-11) and its Annex 3.11 (pp. A.286–A.288), the amount of manure management system (MMS) usage has not been updated for several years (e.g. the most recent data for cattle are from a publication dated 2000, and those for swine are dated 2007). In the NIR 2015 (p. 5-15) the United States stated that the 2012 Agricultural Census data will be incorporated into the inventory and will be used to update county-level animal population and MMS estimates. During the review, the United States stated that it plans to update the MMS data in future inventories, and that EPA is working with the United States Department of Agriculture to obtain updated data. The ERT recommends that the United States obtain updated MMS data and estimate emissions using the updated MMS usage data in its submission. If this is not possible, the ERT recommends that the United States report on progress in its effort to update the MMS data.	Completed. The United States updated the waste management system (WMS) data within the previous Inventory (i.e., 2017 submission) with data from the 2012 U.S. Department of Agriculture, Agricultural Census. These updated data are noted in the chapter and annex of the 2017 submission.
53.	(A.17)	Agriculture	3.D.a.3 Urine and dung deposited by grazing animals – N_2O	The ERT noted an inconsistency between CRF table 3.D and the NIR regarding the N input from manure applied to soils (table A-223) and N input from sewage sludge applied to soils (table A-227). During the review, the United States explained that it has experienced multiple problems importing data derived from its country-specific methods into the new CRF Reporter agriculture modules. The United States also indicated that it is investigating options to solve the problems. The ERT recommends that the United States ensure consistency between the data provided in CRF table 3.D and the data provided in the NIR regarding the N input from manure applied to soils and N input from sewage sludge applied to soils.	Completed. The United States has resolved the issue of consistency between N input from manure applied to soils and N input from sewage sludge applied to soils reported in the NIR and CRF table 3.D in the previous Inventory (i.e., 2017 submission).
54.	(A.18)	Agriculture	3.D.b Indirect N_2O emissions from managed soils – N_2O	The ERT noted that the United States, in response to a previous recommendation to include weighted national averages for the fractions listed in CRF table 4.D, corrected the AD and provided a documentation box in CRF table 3.D in the 2016 submission, explaining in the NIR that "N fixation, volatilized N, and N leached and run-off do not strictly represent AD because they are calculated by the process-based model (DAYCENT). Fractions were not used because a process-based model was used to calculate emissions." During the review, the United States explained that it estimated the N volatilized and N lost through leaching and run-off using the DAYCENT model, and it reported these values in the inventory worksheets, which could be made	Addressing. The DAYCENT model is a Tier 3 approach, consistent with the *2006 IPCC Guidelines* and the NIR/annex provides a very detailed explanation of how the DAYCENT model works and cites further literature that can be reviewed if the ERT would like more detail. The United States will continue efforts to improve the

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				available to the ERT during an in-country review, and that these values can be included in the next NIR in Annex 3.12 (methodology for estimating N_2O emissions). In addition, the United States stated that indirect soil N_2O emissions are estimated using a tier 1 method for a small percentage of the N inputs, such as fertilization and organic amendments to vegetable and perennial crops, as well as federal grasslands. The ERT recommends that the United States provide an explanation of how its methodology and the use of the DAYCENT model to estimate N volatilized and N loss is both compatible with the *2006 IPCC Guidelines* and based on science.	transparency of the NIR in future submissions, specifically, the Annex will be revised for the next Inventory (i.e., 2019 submission) to improve transparency.
55.	(A.19)	Agriculture	3.J Other (CO_2 emissions from liming, urea application and other carbon-containing fertilizers) – CO_2	In CRF table 3G-I, the United States reported CO_2 emissions from liming and urea application as "IE", and information on CO_2 emissions from liming and urea application was included under the LULUCF sector in the NIR. During the review, the United States stated that emissions from liming and urea fertilization will be reported under the agriculture sector in the 2017 submission. The ERT recommends that the United States report CO_2 emissions from liming and urea fertilization under the agriculture sector.	Completed. For the previous Inventory (i.e., 2017 submission), the United States began reporting emissions from liming and urea fertilization under the Agriculture chapter.
Land Use, Land-Use Change, and Forestry					
56.	(L.1)	LULUCF	4. General (LULUCF) – CO_2, CH_4 and N_2O (80, 2013) (103, 107, 109, 2012)	Estimate emissions from the carbon stock changes from mineral soils under forest land, living biomass under cropland and grassland, dead organic matter (DOM) under land converted to cropland and land converted to grassland, land converted to wetlands, soil organic carbon (SOC) under land converted to settlements and land converted to other land; N_2O emissions from disturbance associated with land-use conversion to cropland; CH_4 and N_2O emissions from biomass burning (land converted to forest land, cropland, grassland and wetlands); and CO_2 emissions from biomass burning (excluding forest land remaining forest land). The United States has newly included, in CRF 2016, estimates for mineral soils under lands converted to forest land and living biomass for forest land converted to non-forest land. However, emissions from living biomass have only been estimated for forest land converted to grassland and cropland. In addition, the following are reported as "NE": estimates of DOM under land converted to cropland, grassland, wetlands, settlements and other land; SOC for land converted to settlements and other lands; and CO_2, N_2O and CH_4 associated with biomass burning in land converted to forest land, cropland, grassland and wetlands.	Addressing. The United States is continuing to address these missing carbon stock changes and non-CO_2 emissions by accessing additional data sources and incorporating them into our methods. Additional refinements will be provided in the next Inventory (i.e., 2019 submission).
57.	(L.2)	LULUCF	4. General (LULUCF) – CO_2 (81, 2013)	Conclude the technical work under way to be able to provide estimates for the carbon stock changes in the living biomass and DOM pools for each conversion category from forest land to any other land use for each year based on a reliable Land-Use Change (LUC) matrix, and report on the achievements made. The United States has made considerable progress towards a reliable land tracking system and has provided a complete description of the underlying accounting	See response above.

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				framework in the NIR (chapter 6.1). However, emissions from DOM have not been estimated, except for forest land remaining forest land. Further improvements regarding the implementation of the new accounting framework for land use are necessary.	
58.	(L.3)	LULUCF	4. General (LULUCF) – CO_2, CH_4 and N_2O (82, 2013) (97, 2012)	Include all managed federal lands in the inventory and improve the consistency of the time series of national areas and report on the achievements made. Not all managed federal lands are included in the inventory. The ERT notes that in document FCCC/ARR/2013/USA the United States explained that the inconsistencies arose as a portion of the managed land not included in the CRF tables, although it was reported in the NIR. The ERT notes that the total area reported in the CRF tables in the 2016 submission for all land uses (4.A to 4.E) still fluctuates throughout the period, and an explanation for this has not been provided in the NIR.	Addressing. The United States is continuing to improve our ability to estimate emissions/removals from all federal lands through collection of additional data. The major missing component of federal land is in Alaska where data are sparse. The United States will ensure future submissions have consistent areas reported in the NIR and CRF, or an explanation will be provided to explain why there is a difference.
59.	(L.5)	LULUCF	Land representation – CO_2, CH_4 and N_2O (84, 2013) (97 and 98, 2012)	Check the coherence of reported data on land-use areas reported in the NIR and those reported in the CRF tables, applying the appropriate QC checks. The lack of consistency between the NIR (table 6-6) and CRF table 4.E remains in the 2016 submission.	The United States will ensure future submissions have consistent areas reported in the NIR and CRF, or an explanation will be provided to explain why there is a difference.
60.	(L.10)	LULUCF	4.A.1 Forest land remaining forest land – CO_2 (90, 2013)	Make every effort to report the carbon stock changes in the mineral soils and organic soils pools separately. During the review, the United States stated that this issue has not yet been addressed. However, the United States expects that organic soil emissions will be minimal in forest land remaining forest land.	Completed. In the previous Inventory (i.e., 2017 submission), the United States reports mineral and organics soil pools separately for *Forest Land Remaining Forest Land*.
61.	(L.14)	LULUCF	4.B.1 Cropland remaining cropland – CO_2 (93, 2013) (107, 2012)	Estimate the carbon stock changes in living biomass in perennial crops for all years in the time series. Living biomass has not yet been estimated in cropland remaining cropland. During the review, the United States explained that it plans to include herbaceous and perennial cropland biomass using the IPCC default carbon stock values and, depending on resources, it will develop country-specific carbon stock values in the next two to three years.	Addressing. The United States has identified this as an improvement but due to other major ongoing improvements identified in the Planned Improvement section, the United States will not have the resources to implement it for several years.
62.	(L.15)	LULUCF	4.E. Settlements – CO_2 (94, 2013)	Eliminate the overlap between the urban forest inventory and the forest inventory. The United States explained this problem in the improvement plan in the NIR (p.6-84).	Addressing. The United States intends to utilize Forest Inventory and Analysis (FIA) plots on Urban lands to resolve the overlap problem between forest lands

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					and urban forests. This will take place over the next 2 to 3 years.
63.	(L.17)	LULUCF	4.H Other (LULUCF) – CO_2 (96, 2013) (112, 2012)	Reflect the intersectoral linkages and document the differences in the decay values for yard trimmings and food scraps. The United States provided information on decay factors in the NIR and also introduced correction factors. However, it remains unclear to the ERT how the correction factors apply to the decay factors and, as such, how consistency with the waste sector is ensured.	Partially completed. The United States has provided detailed information on how the correction factor relates to the decay factors in the Methodology section of Landfilled Yard Trimmings and Food Scraps as well as how the decay rate relates to the Landfills in the Waste sector. The United States will continue to work towards developing greater consistency with the Waste sector over the next several years as resources allow.
64.	(L.21)	LULUCF	4. General (LULUCF) – CO_2, CH_4 and N_2O	The ERT noted discrepancies between land-use areas in the time series reported in the CRF tables. For instance, in CRF table 4.1, the final area at the end of year and the initial area on the subsequent year are different for all land categories except for unmanaged forest land. The ERT also noted that in the 2016 submission the United States introduced a new Forest Carbon Accounting Framework (FCAF) (Woodall et al., 2015*d*) for land tracking of areas of land use and land-use change for the entire time series. Further, the ERT noted that in the NIR (chapter 6.1), the United States stated that approximately 46,213 kha are considered unmanaged, whereas in CRF table 4.1, the total unmanaged land (46,213.27 kha) does not match the sum of unmanaged forest land (9,634.34 kha), grassland (25,782.12 kha) and wetlands ("IE"). During the review, the United States explained that this problem would be resolved and clarified in the 2017 submission. The ERT recommends that the United States resolve the inconsistencies in land-use areas in the time series reported in the CRF tables and the inconsistences in information on land-use areas between the NIR and CRF table 4.1 by subcategorizing the managed lands for which estimates are calculated in order to separate them from those for which there are currently no methodologies available, noting that the United States can use the notation keys "NE" or "NA" for the latter subcategory.	The United States is implementing additional QA/QC checks to ensure consistency between the NIR and CRF. Explanations have been updated where CRF structure is inconsistent with format of U.S. data. This is reflected in the current Inventory (i.e., 2018 submission).
65.	(L.22)	LULUCF	Land representation – CO_2, CH_4 and N_2O	The United States in the NIR that the total area of forest land remaining forest land in table 6-12 (271,719 kha) does not correspond with the total area reported in chapter 6.1 (table 6-7) (294,051 kha for 2014) under the land representation for forest land, explaining that this is due to the fact that a part of the managed land of Alaska (interior of Alaska) and all of Hawaii's forest lands have not been estimated owing to limited data on land management in the interior of Alaska and on all of Hawaii's forests. In CRF table 4.A, the reported area is 271,719 kha. The ERT considers that this discrepancy could be prevented in the future by including the different territories (49	Completed. The United States corrected this for the previous Inventory (i.e., 2017 submission) by providing additional explanation in the NIR and CRF.

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				states, Hawaii and Alaska) and by using the notation keys "NA" or "NE" for carbon fluxes for Alaska and for all of Hawaii's forests in CRF table 4.A. The ERT recommends that the United States augment the transparency of the NIR and CRF table 4.A by reporting the territories not included separately as "NA" or if it is not possible, provide the additional documentation to explain why there is a discrepancy between the areas shown in CRF table 4.A and NIR table 6-12.	
66.	(L.23)	LULUCF	Land representation – CO_2, CH_4 and N_2O	The ERT noted that the total national area, as reported in CRF table 4.1 for all land uses, is not constant in the period 1990–2014, fluctuating between 719,564.15 kha (1990) and 714,948.55 kha (2010), which is a variation of 5,227.59 kha (7 percent). As identified in document FCCC/ARR/2011/USA, the United States used several data sources to construct the land area representation: a National Resources Inventory (NRI) survey for 1998 data; available data from FIA (years of which are different for the various states, ranging from 2002 to 2012); and the National Land Cover Dataset (NLCD), a land cover classification scheme, with data available for 1992, 2001 and 2006. The United States explains in the NIR 2016 that the NRI and FIA have different criteria for classifying forest land in addition to different sampling designs, leading to discrepancies in the resulting estimates of land area for non-federal land. Similarly, there are discrepancies between the NLCD and the FIA data for defining and classifying forest land on federal lands. FIA has the main database for forest statistics, and data from the NRI and NLCD are adjusted to achieve consistency with FIA estimates of forest land. In the NIR 2016 the United States specified that, for harmonization purposes, the non-forest land-use area had been updated in proportion to the total forest land area from FIA. However, the ERT noted that the information is not sufficient for it to understand how the data referring to various years, coverage and resolution, with different classification systems, have been harmonized and used to classify the territory according to the IPCC land-use categories. During the review, the United States explained that cropland areas were based solely on the NRI data for non-federal lands, on NLCD data for federal lands, and that cropland areas were not adjusted in the harmonization process. The ERT recommends that the United States, when providing detailed information in the NIR on how the different data sources were harmonized, provide explicit information on how the model ensures consistent integration of the three data sources; for example, by including a visual flow chart of data processing during the harmonization process.	Addressing. The United States is in the process of updating the land representation analysis to incorporate new datasets. This work will be completed in time for the next Inventory (i.e., 2019 submission). As a part of this process the United States will provide additional explanation in the NIR on how the different databases are combined to create the U.S. land representation matrix. This will be incorporated into the next Inventory (i.e., 2019 submission).

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67.	(L.24)	LULUCF	4. General (LULUCF) – CO_2	The United States introduced the new FCAF[179] to estimate consistent and reliable land-use change in the 2016 inventory submission. The United States mentioned in the annex 8 to the NIR (table A-304) that verification measurements have been implemented for the majority of the underlying methodology, calculations and models that are contained in the NIR. During the review, the United States explained that the FCAF has been previously used for a regional analysis, and provided the reference to the peer reviewed paper (Coulston et al., 2015[180]) of that regional analysis. Furthermore, the United States explained that the model used for the FCAF has not been compared with similar models used by other countries. During the review, the ERT did not receive information on the type of verification measures that have been implemented (e.g. information on peer reviews or sensitivity analysis of the model implemented on a national scale). The ERT recommends that the United States include the information on the use of the model for the regional analysis in the QA/QC and verification section of chapter 6.1 of the NIR.	Addressing. The United States is working to implement a new system for estimating C stock changes on forest lands that will replace the FCAF (see Planned Improvements section for *Forest Land Remaining Forest Land*). As part of this effort, the United States will incorporate available information on verification into the NIR. The new forest accounting system will be implemented in the next Inventory (i.e., 2019 submission).
68.	(L.25)	LULUCF	4. General (LULUCF) – CO_2	The ERT noted that, in the NIR (p.6-57), the United States reported the difference between the stocks reported as the stock change under the assumption that the change occurred in the year of the conversion, and those areas are also reflected in CRF tables 4.B and 4.C. However, the area in CRF tables 4.B and 4.C and NIR table 6 should cover the entire area lost from forest land conversion to cropland or forest land conversion to grassland over a 20-year timespan according to footnote 2 of CRF table 4.B, which indicates that areas for land converted to cropland shall be reported as the cumulative area (over 20 years) remaining in the category in the reporting year. In response to a question raised by the ERT, the United States explained that because the 2016 submission was the first to include forest land conversions, many of the noted issues were identified at a point where it was not possible to correct them. The United States indicated that these issues have been addressed and the corrections will be applied in the 2017 submission. The ERT recommends that the United States estimate emissions from forest land converted to another land use over a 20-year timespan by subdividing the conversion category into area actually converted and area converted during the past 19 years. The ERT also recommends that the United States ensure consistency in reporting of land area between the NIR and CRF tables 4.B and 4.C.	The U.S. Inventory does include the cumulative area of forest conversion to cropland and forest conversion to grassland over a 20-year time span. However, EPA assumes all losses of biomass and dead organic matter occur in the first year of the conversion. However, there is a small difference in the area between Table 6-7 in the Land Representation section and CRF. This difference is because croplands in Alaska and federally-managed lands are not included in the inventory, and grasslands in Alaska are not included in the inventory. The EPA is working to compile the activity data and address C stock changes for these areas as part of a future submission.

[179] Woodall CW, Coulston JW, Domke GM, Walters BF, Wear DN, Smith JE, Andersen H-E, Clough BJ, Cohen WB, Griffith DM, Hagen SC, Hanou IS, Nichols MC, Perry CH, Russell MB, Westfall J and Wilson BT. 2015. *The US Forest Carbon Accounting Framework: Stocks and Stock change 1990–2016.* Gen. Tech. Rep. NRS-154. Newtown Square, PA: United States Department of Agriculture, Forest Service, Northern Research Station.

[180] Coulston JW, Wear DN and Vose JM. 2015. Complex forest dynamics indicate potential for slowing carbon accumulation in the southeastern United States. *Scientific Reports.* 5: p.8002.

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69.	(L.26)	LULUCF	4.A.1 Forest land remaining forest land – CO_2	The United States explained in the NIR that the FCAF is fundamentally driven by the annual forest inventory system conducted by FIA programme, and the FCAF system comprises a forest dynamics module and a land-use dynamics module. The forest dynamics module assesses forest sequestration, forest ageing and disturbance effects. The land-use dynamics module assesses carbon stock transfers associated with afforestation and deforestation. The required inputs are estimated from more than 625,000 forest and non-forest observations in the FIA national database. Model predictions for before or after the annual inventory period are constructed from the FCAF system using the annual observations. However, since carbon density estimations (tonnes per hectare) for live trees, by type and by region, are not explicitly mentioned in the NIR, the ERT was not able to verify the accuracy of the estimations for carbon stocks and CO_2 fluxes. During the review, the United States provided the ERT with background information on the FIA survey methods, specifically on age classes, classification, and classification by forest and non-forest for the sample plots. The ERT recommends that the United States include in the NIR the background information provided to the ERT on the FIA survey methods, specifically on age classes, classification, and classification by forest and non-forest for the sample plots, in order to allow the ERT verify the accuracy of the estimations for carbon stocks and CO_2 fluxes. The ERT also recommends that the United States annex to the NIR detailed tables on average carbon fluxes by region and type (e.g. the region and forest type classifications described in Smith et al. (2006)[181] and used for estimates for downed deadwood and understory, which might better reflect the diversity of forest types and age classes). Furthermore, the ERT recommends that the United States disaggregate the carbon fluxes by region and type in the CRF tables, which will ensure transparency and repeatability of methods.	The United States will include in the NIR the background information provided to the ERT on the FIA methods, specifically on age classes, classification, and classification by forest and non-forest for the sample plots. All FIA data used to compile estimates in the NIR are publicly available and were specifically referenced in the NIR (Table A-236). Detailed tables on average carbon fluxes by region and forest type, and carbon pool will be included in forthcoming U.S. Department of Agriculture (USDA) Forest Service publications and referenced in the NIR. The United States is currently working on a compilation system that will provide more spatially and temporally resolved estimates for the NIR. Once completed and vetted this system will be used to produce state-level estimates for inclusion in the NIR (see Planned Improvements in the *Forest Land Remaining Forest Land* section).
70.	(L.27)	LULUCF	4.A.2 Land converted to forest land – CO_2	The United States has not estimated removals in the biomass pool from regrowth (reforestation/afforestation) in CRF table 4.A and states in its NIR that research is under way to include those removals. The United States also clarifies the need to revise the length of time a land remains in a conversion category after change. The ERT noted that the calculation of carbon stock change in living biomass in land converted to forest land is mandatory under the *2006 IPCC Guidelines*. In the NIR (p.6-27), the United States explained that the forest dynamics module assesses carbon stock transfers (removals) associated with afforestation. However, during the review, the United States clarified that those removals from afforestation have not been reported in forest land remaining forest land, and in CRF table 4.A, "NA" is reported under all land converted to forest land.	Completed. The United States has reported the net change in biomass in CRF Table 4.A in the previous Inventory (i.e., 2017 submission).

[181] Smith JE, Heath LS, Skog KE and Birdsey RA. 2006. *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States.* Gen. Tech. Rep. NE-343. Newtown Square, PA: United States Department of Agriculture, Forest Service, Northeastern Research Station.

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				The ERT recommends that the United States complete the emission estimates of living biomass for land converted to forest land in accordance with the *2006 IPCC Guidelines*.	
71.	(L.28)	LULUCF	4.A.2 Land converted to forest land – CO_2	The ERT noted that the United States reported "NA" for deadwood and litter in its reporting for land converted to forest land. These pools are mandatory under the *2006 IPCC Guidelines*. During the review, the United States explained that it elected to remove the estimates from the submission because of a problem identified shortly before submission. Emissions and removals for all carbon pools in the category land converted to forest land will be included in the 2017 submission and will be based on a 20-year default using a conversion matrix. The ERT recommends that the United States estimate carbon stock change for deadwood and litter in land converted to forest land in accordance with the *2006 IPCC Guidelines*.	Completed. Emissions and removals for all carbon pools in the category *Land Converted to Forest Land* are included in the previous Inventory (i.e., 2017 submission).
72.	(L.29)	LULUCF	4.B Cropland – CO_2	In the NIR (table 6-23), the United States clarifies in a footnote that estimates after 2010 are based on projections using NRI data for 2010 and therefore may not fully reflect changes occurring in the latter part of the time series. The United States explained that more recent information is currently available but data were not available in time to incorporate them into the 2016 inventory submission. The ERT recommends that the United States apply the most recent information and data obtained since 2010 for the emission estimates under this category.	Completed. The previous Inventory (i.e., 2017 submission) utilized the NRI with data through 2012. An updated NRI will be available in Spring of 2018 that will be used for the 2020 or 2012 submission as resources allow.
73.	(L.30)	LULUCF	4.B.1 Cropland remaining cropland – CO_2	In the NIR (p.6-43), the United States explains that NRI survey locations are classified according to land-use histories starting in 1979; consequently, the classifications are based on fewer than 20 years from 1990 to 1998, and this may have led to an overestimation of the area of cropland remaining cropland. The ERT considers that this is not in line with the *2006 IPCC Guidelines*, which indicate the default land transition value to be 20 years. Further, the ERT notes that an overestimation of cropland in the remaining class may underestimate emissions if higher carbon stocks occurred in the previous land use before 1979. During the review, the United States explained that additional carbon losses would likely be minimal because cropland area has been declining over the past three decades owing to the expansion of forests and urban areas. During the review, the United States further informed the ERT of the on-going effort to develop a land representation dataset from early generation Landsat imagery to investigate the possibility of extending the time series for the land use data from 1979 to 1970. The United States also indicated alternative options for extrapolating the trends in land use back to the 1970s using agricultural and forestry statistics or other relevant information. Noting that it is important to avoid potential overestimation or underestimation of estimates in all IPCC categories, the ERT recommends that the United States progress its efforts to obtain data of land-use histories starting from 1971 or earlier for	Addressing. The United States intends to utilize the Landsat imagery to inform the land use data prior to 1979. This will be a multi-year process that will be implemented in a future Inventory submission.

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				input to the land-use change matrices for cropland, and apply those data for the emission estimates.	
74.	(L.31)	LULUCF	4.B.1 Cropland remaining cropland – CO_2	The ERT noted that the areas of mineral and organic soils reported in CRF table 4.B (616.61 kha and 151,388.48 kha, respectively) have been interchanged for cropland remaining cropland (a total of 152,005.09 kha) compared with the areas reported in the NIR (Annex 3.12, table A-217) (151.39 Mha for mineral soils and 0.62 Mha for organic soils). In response to a question raised by the ERT, the United States acknowledged the error and stated that QC measures are in place but had not been completed prior to the submission of the CRF tables. The ERT recommends that the United States apply the appropriate QC check to ensure consistency of the areas of mineral and organic soils reported in CRF table 4.B and the NIR.	Completed. The United States has modified the compilation schedule of the Inventory in order to allow more time to perform QC measures on the CRF tables. This has been implemented for the current Inventory (i.e., 2018 submission).
75.	(L.32)	LULUCF	4.B.2.1 Forest land converted to cropland – CO_2	The ERT noted that in CRF table 4.B the implied carbon stock change factor for 2014 for living biomass for forest land converted to cropland (–65.53 t C/ha) is high compared with other implied carbon stock change factors from neighbouring countries. For instance, Canada has reported –0.95 t C/ha, which is 50 times lower than the factor reported by the United States. The ERT also noted that, in the NIR (p.6-57), the United States explained that it calculates the difference between the stocks reported as the stock change under the assumption that the change occurred in the year of the conversion. The ERT recommends that the United States include a transparent explanation of how the losses (–3,129 kt C in CRF table 4.B for forest land converted to cropland) have been calculated based on carbon densities in forest land, and amend the information on biomass carbon stock changes in the NIR (p.6-57).	First, the estimates from Canada may not be comparable to those in the United States given markedly different climates, forest types, compilation methods, and management systems. That said, the Canadian estimates seem unrealistically low given that conversions for Forest Land to Cropland (at least in the United States) are typically on productive sites that would support crop production and warrant the cost of conversion from forest land. These sites typically had or have the potential to support high tree biomass. In the United States the implied carbon stock change factor for 2014 for living biomass for forest land converted to cropland was estimated directly from FIA plots that were Forest land at the measurement period prior to 2014 and classified as cropland at the subsequent measurement period; these are based on actual field observations. Additionally, the implied carbon stock change factor for 2014 for living biomass for forest land converted to cropland was -12.90 t C/ha not -65.53t

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					C/ha as suggested in the ERT description.
76.	(L.33)	LULUCF	4.C.2 Land converted to grassland – CO_2	The ERT noted, in CRF table 4.C, an implied carbon stock change factor for mineral soils under forest land converted to grasslands of 0.13 t C/ha in 2013. For the conversion from grasslands to forest land an implied carbon stock change factor for mineral soils increases annually by 0.10 t C/ha. Both conversions would lead to an increase in carbon stock. In the planned improvements provided in the NIR, the United States explains that different tier level methods are used for estimating carbon stock changes in forest land, grassland and cropland. The ERT noted that this could result in inconsistent implied carbon stock factors for mineral soils for those categories. Recognizing this, the United States indicates in the NIR that it plans to update and revise the estimates of emissions and removals from mineral soils in conversions from forest land to grasslands. The ERT recommends that the United States revise the estimates for carbon stock change in mineral soils under forest land converted to grasslands using the updated data for mineral soils and report the result in the NIR.	The United States does apply a consistent method to all lands that are undergoing land use change (using a Tier 2 method). The differences between forest land converted to grassland and grassland converted to forest land is the management on the grassland. For example, improved grassland will have a larger stock than an unimproved grassland. Regardless, the United States plans to update and revise the estimates of emissions and removals from mineral soils in conversions from forest land to grasslands in subsequent NIRs with the goal of providing more accurate results with the latest experimental results.
77.	(L.34)	LULUCF	4.D.1 Wetlands remaining wetlands – CO_2, CH_4 and N_2O	The United States reported an area of peatland remaining peatland in CRF table 4.D for 2014 of 5.31 kha. The ERT notes that the United States reported the data for peat production in Alaska separately from the data for the other 48 states reporting areas of peatland in the NIR, due to methodological differences in data collection and calculation. The areas of peatland are not reported separately in the NIR and CRF table 4.D, with only the national total being reported. The ERT also noted that in CRF table 4(II), "NE" is reported for the areas of peat extraction lands, although N_2O and CH_4 emissions from drained organic soils are reported, for which the ERT considers that the same area should be used for on-site CO_2 and estimating CO_2 emissions during peat extraction, according to information in the NIR (p.6-76). The ERT recommends that the United States provide consistent information on the calculation of the total managed peatland and on how the calculation relates to the extracted area in the CRF tables and in the NIR. Noting that the United States is aware of the need for determining the quantity of peat harvested per hectare and the total area undergoing peat extraction, the ERT recommends that the United States provide the respective AD and IEFs for on-site CH_4 and N_2O emission estimates in CRF table 4(II) for organic soils under peat extraction.	Completed. The United States reports peat production data for Alaska separately from other states in the NIR because of a difference in calculation methodology between Alaska and the remainder of the United States Alaska conducts its own mineral survey and reports peat production by volume, rather than by weight. Volume production data are used to calculate off-site CO_2 emissions from Alaska applying the same methodology but with volume-specific C fraction conversion factors from *2006 IPCC Guidelines*. The United States reports total U.S. peat production in the CRF tables, instead of reporting Alaska separately. This is also the case for peat area and emissions. Reporting Alaska separately from the rest of the United States seems to be inconsistent, as most sources

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					present total U.S. values in the CRF tables. CRF table 4(II) is updated for the current Inventory (i.e., 2018 submission) to include CO_2 values for areas of peat extraction lands instead of "NE".
78.	(L.35)	LULUCF	4.D.2.3 Land converted to wetlands – CO_2, CH_4 and N_2O	The United States has not estimated emissions for wetlands remaining wetlands separately from land converted to wetlands. The United States explained in the NIR that it was not able to separate CH_4, CO_2 and N_2O emissions for wetlands remaining wetlands and land converted to wetlands. The United States also explained in the NIR that research to track GHG fluxes across wetlands remaining wetlands and land converted to wetlands is ongoing, and until such time that reliable and comprehensive estimates of GHG fluxes across these LULUCF categories can be produced, it is not possible to separate CO_2, CH_4 and N_2O fluxes on land converted to wetlands from fluxes on wetlands remaining wetlands. The ERT recommends that the United States use the AD reported in table 6-7 of the NIR to separate CO_2, CH_4 and N_2O emissions from land converted to wetlands and wetlands remaining wetlands.	Addressing. In the previous Inventory (i.e., 2017 submission), the United States has improved on the reporting of emissions for wetland remaining wetlands and land converted to wetlands and will continue to refine the estimates for future Inventory submissions.
79.	(L.38)	LULUCF	4.E.1 Settlements remaining settlements – CO_2	The United States reported changes in the carbon stocks in landfills relating to yard trimming and food scraps under settlements remaining settlements in CRF table 4.E. In the NIR (chapter 6.14, "Other (IPCC Source category 4.H)"), the United States included details on which methodologies were used for these subcategories, but no reference is given in chapter 6.10 ("Settlements remaining settlements"). During the review, the United States explained that, for its next submission, it will report the information for carbon stocks in landfills relating to yard trimming and food scraps under the section on settlements in the NIR. The ERT recommends that the United States check the coherence of reported data, applying the appropriate QC checks, in order to ensure consistency between the CRF tables and the NIR.	Completed. The United States began reporting the carbon stock changes from Landfilled Yard Trimmings and Food Scraps in the Settlements sections of both the NIR and CRF in the previous Inventory (i.e., 2017 submission).
80.	(L.39)	LULUCF	4.E.2.5 Other land converted to settlements – CO_2	The United States reports carbon stock changes as "NE" for all pools under land converted to settlements, and explains in the NIR that, given the lack of available information, it is not possible to separate CO_2 or N_2O fluxes on land converted to settlements from fluxes on settlements remaining settlements at this time. Noting that CO_2 from landfilled yard trimming and food scraps and urban tree soils under settlements remaining settlements is a key category, the ERT finds that land converted to settlements might become a key category if the United States were to estimate these emissions because according to the NIR (p.6-86), land under a number of uses undergoes urbanization in the United States each year.	Partially completed. In the previous Inventory (i.e., 2017 submission) the United States reports carbon stock changes for *Land Converted to Settlements* separately from *Settlements Remaining Settlements*. However, at this time it is not possible to report the N_2O fluxes in this way due to lack of activity data. The United States will also apply the notation key IE for

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				The ERT recommends that the United States estimate carbon stock changes in living biomass and dead organic matter. If this is not possible, the ERT recommends that the United States use the notation key "IE" for area under land converted to settlements in order to be consistent with the information in the NIR stating that other lands converted to settlements cannot be separated from settlements remaining settlements.	those situations where it is not possible to separate the emissions into land use and land use conversion categories.
81.	(L.40)	LULUCF	4(I) Direct N_2O emissions from nitrogen inputs to managed soils – N_2O	In CRF table 4(I), the United States reports, for the entire time series, N_2O emissions from land converted to forest land as "IE" and "NA", from wetlands as "NA", and from land converted to settlements as "NA". However, the ERT noted that the direct and indirect N_2O emissions from managed soils under land converted to forest land have been included in forest land remaining forest land (NIR, table 6-19). Similarly, the NIR states that N_2O fluxes for lands converted to settlements are reported under settlements remaining settlements. Under flooded wetlands, N_2O emissions have not been estimated. The United States provided, during the review, information showing that it avoids double counting for N in peat that is used as fertilizer in horticulture peat (applied to agricultural soils). The ERT recommends that the United States use the notation key "NE" and/or "IE" in reporting AD and N_2O emissions from land converted to forest land, wetlands, and land converted to settlements, as appropriate, in order to be consistent with the explanation provided in the NIR, and provide information showing how it avoids double counting for N, without omitting N input in peat.	Completed. In the previous Inventory (i.e., 2017 submission) the United States has modified the use of notation keys in Table 4(I) to better reflect how the emissions are reported in the NIR.
82.	(L.41)	LULUCF	4 (III) Direct N_2O emissions from N mineralization/ immobilization – N_2O	The ERT noted that in CRF table 4(III) the United States reported direct N_2O emissions from mineralization/immobilization for all land categories as "NA", but the LULUCF chapter of the NIR does not include a section that provides information on the use of the notation key "NA" for reporting the direct N_2O emissions resulting from land use or management of mineral soils The ERT recommends that the United States include an explanation in the NIR for the reporting of "NA" for all land categories for direct N_2O emissions from mineralization/immobilization.	Addressing. Direct N_2O emissions from mineralization/immobilization are reported from croplands and grasslands in agricultural soil management, and therefore the notation key should be "IE". Direct N_2O emissions from mineralization/immobilization are not reported for other land uses, but will be investigated and reported in a future submission based on the recommendation of the ERT.
83.	(L.42)	LULUCF	4 (V) Biomass burning – CO_2, CH_4 and N_2O	The ERT noted that the United States has provided CH_4 and N_2O emissions from forest fires in forest land remaining forest land only. Emissions from biomass burning under other land categories are reported as "NE" or "NA", except for N_2O emissions from cropland remaining cropland and from grassland, which are reported as "IE". For the category forest land remaining forest land, the United States has mentioned in the improvement plan the use of country-specific combustion factors to calculate emissions from burning and stated that the information is provided by the Monitoring Trends in Burn Severity data summaries. Currently those data are unused for the emission estimates for this category. During the review, the United States stated that it	Partially complete. In the previous Inventory (i.e., 2017 submission), the United States began reporting biomass burning for forestland and grassland. In both cases, it is not possible to separate emissions by conversion categories.

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				is working on research for country-specific factors and the work will be used as it matures. Noting that CH_4 and N_2O emissions from forest fires are key categories, the ERT recommends that the United States estimate CH_4 and N_2O emissions from biomass burning in land converted to forest land, land converted to wetlands, cropland, grassland, and settlements, and populate CRF table 4(V) to improve completeness.	
84.	(L.43)	LULUCF	4.G Harvested wood products (HWP) – CO_2	The United States used the production accounting approach to report CO_2 emissions relating to HWP. Under the production approach, carbon in exported wood was estimated as if it remains in the United States, and carbon in imported wood was not included in the estimates. A tier 3 approach based on the use of country-specific data and methods to estimate HWP variables was used for the emission estimates. During the review, the United States explained that the criteria in the WOODCARB II model that were used to estimate the HWP contribution to forest carbon sinks and emissions are fixed and were developed using country-specific data. The United States also stated that exports represent an estimated 9 percent of total production in the United States. The ERT noted that the United States has not provided the AD on production, imports and exports of wood needed to estimate the HWP variables (i.e. HWP in products in use – domestic consumption (1.A), HWP in products in use – domestic harvest (2.A), carbon in annual imports of HWP (PIM), carbon in annual exports of HWP (P_{EX}) and carbon in annual harvest of roundwood (H)) for 1961 to the present, which is not in line with the good practice in the *2006 IPCC Guidelines*, which require this information to be provided in CRF table 4.Gs2. The ERT recommends that the United States provide in the NIR information showing that data on the life cycle of exported HWP for those countries to which most of its products are exported are comparable with country-specific data, or adjust the data accordingly.	Completed. These data are available for the United States and are included in the CRF tables for the current Inventory (i.e., 2018 submission).
Waste					
85.	(W.2)	Waste	5.A Solid waste disposal on land – CH_4	Report on the trend of total waste generated, provide explanations, and revise the data, if necessary. Some information is provided in the NIR.	Completed. The methodology is based on national waste generation from 1990 to 2004 and then switches to directly reported net emissions for 2005 to 2016, meaning we are no longer using national waste generation data as the basis for emissions. We include details on the national waste generation data in the Methodology portion of Section 7.1 in the NIR and explain year-to-year variations.

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86.	(W.3)	Waste	5.A Solid waste disposal on land – CH_4	Revise the estimates of emissions from solid waste disposal on land by incorporating the revised degradable organic carbon (DOC) values into the emission estimation. The United States reports some effort to address the issue in the NIR (e.g. revision of the DOC value for landfilled pulp and paper on p. 7-11). However, during the review, the United States confirmed that the constant value is used in the entire time series. The ERT considers that if a constant value is used, the emission estimation does not capture the changing waste composition over the time series.	Addressing. The DOC value applied to industrial waste landfills is constant for the entire time series. The United States is investigating facility-specific DOC data reported under Subpart TT (Industrial Waste Landfills) of EPA's GHGRP to determine whether the pulp and paper and food and beverage waste composition has changed in recent years. Industrial waste composition tends to remain consistent from year to year when looking at single industries. The industrial waste composition and consequently DOC will change when the input material changes, or when a process changes. With regard to municipal solid waste (MSW) landfills, the United States has collected all publicly available and online MSW characterization study data since 1990 and is reviewing them to determine the impact of a changing waste composition. The level of detail in individual waste composition studies varies significantly. If applicable, EPA may revise the DOC value from 1990 to 2004. The methodology for 2005 to 2016 uses directly reported methane emissions to the GHGRP, a regulation that defines DOC values that can be applied. Updates to DOC value(s) for 2005 to 2016 must be considered in context of updates to methods in the GHGRP.
87.	(W.4)	Waste	5.A Solid waste disposal on land – CH_4	Report the composition of waste landfilled, with the amounts/shares and corresponding coefficients, including DOC. No relevant information on the composition of waste landfilled is provided in the NIR. In the NIR (p.7-8), the United States explains that the information on the amount and composition of waste placed in every MSW and industrial waste landfill for each year of a landfill's operation is not available. In the NIR (p.7-9), the United States also reports that it is currently compiling the waste composition studies and data that have been performed in the past decade and may	Addressing. See comment above; the United States is investigating waste characterization studies completed across the United States since 1990 to better define the composition over the time series.

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				revise the default waste composition applied to MSW landfilled in the first order decay (FOD) model in future inventory estimates.	The current Inventory includes a national estimate of waste composition at the end of Section 7.1 – Landfills. The United States can include more detail on the waste composition applied by the Waste Model in the 1990 through 2017 NIR. The composition of MSW landfilled is generally not available for many of the 1,500 active MSW landfills in the United States, which is why the composition is estimated at a national level. The United States is investigating variations from the national composition to landfill-specific waste composition studies and will summarize this information in a future Inventory submissions.
88.	(W.5)	Waste	5.D.2 Industrial wastewater – CH_4	Include information on the non-estimation of CH_4 emissions from sludge under industrial wastewater**.** No information is provided in the NIR. During the review, the United States explained that continuous efforts are under way to ensure the completeness of the United States inventory.	Addressing. Efforts are continuing to ensure completeness of the United States inventory.
89.	(W.8)	Waste	5.C.1 Waste incineration – CH_4 and N_2O	Make efforts to collect the necessary AD for the emission estimation of CH_4 and N_2O from non-hazardous industrial waste and medical waste incineration, and to include these estimates in future inventory submissions, providing all necessary explanations in the NIR. In the NIR (p.7-32) the United States indicated that data are not readily available to estimate emissions from incineration of non-hazardous industrial waste, while annual emissions from medical waste incineration would be below 500 kt CO_2 eq. During the review, no justification was provided for the insignificance of emissions from medical waste.	Completed. See Annex 5.
90.	(W.9)	Waste	5. General (waste) – CO_2, CH_4, and N_2O	In previous review reports the ERTs recommended that the United States provide descriptions of the waste management practices used in the country. During the current review the United States explained that boxes 7-3, 7-4 and 7-5 of the NIR with accompanying tables, graphs and charts describe and depict the waste management practices in the United States. The ERT commends the United States for its efforts. The ERT noted that, as described in the NIR (Box 7-3), the United States uses two sources of data on solid waste management: BioCycle and Earth Engineering Center of Columbia University's State of Garbage in America surveys and the EPA's Municipal Solid Waste in the United States Facts and Figures. The United States indicates that the data on waste management, waste composition and the recovery of degradable waste presented in the NIR (Box 7-4) are taken from an EPA Facts and Figures report that is not consistent with the State of Garbage surveys, which the United States indicates in the NIR is the preferred data source for estimating waste generation and	Addressing. The United States understands this comment and is working to rectify the inconsistency between the two data sources. Since this comment was made, the United States has transitioned away from the BioCycle data and is now using facility-specific, directly reported information. The United States is also investigating facility-specific waste composition studies and trends and will investigate differences between facility-specific data and the MSW Facts and Figures data

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				disposal amounts in the inventory. The ERT considers that this has created an inconsistency issue within the NIR. For example, the United States reported in chapter 7 of the NIR that landfilling accounts for 53 percent of total waste management practices while in Annex 3.14 to the NIR the same information is reported as 63 percent. The reported trend for landfilled waste from 1990 to 2013 is also different. The ERT recommends that the United States provide background information that is consistent with the data actually used for the emission estimates, including the waste management practices, in a clear manner.	(now called Sustainable Materials Management Report).
91.	(W.10)	Waste	5.A Solid waste disposal on land – CH_4	The United States provided in its NIR some information explaining the trend of total waste generated. In response to a question from the ERT during the review, the United States also provided a memorandum, "Review of State of Garbage data used in the U.S. Non-CO_2 Greenhouse Gas Inventory for Landfills", which helped the ERT to review the trend of generated waste. The ERT recommends that the United States include in the NIR a summary of information on the actual trend of total waste generated as contained in the memorandum "Review of State of Garbage data used in the U.S. Non-CO_2 Greenhouse Gas Inventory for Landfills", which was provided to the ERT during the review.	Completed. The United States has included this information in the Methodology section of Section 7.1 in the current Inventory (i.e., 2018 submission). Please note that the information included in the memorandum ("Review of State of Garbage data used in the U.S. Non-CO_2 Greenhouse Gas Inventory for Landfills") only applies to a portion of the time series (1990 to 2004) due to a methodological / activity data change for 2005 to 2016.
92.	(W.11)	Waste	5.A.1.a Anaerobic – CH_4	The ERT identified that the United States reported total MSW generated and not total waste landfilled in CRF table 5.A. During the review, the United States explained that issues with data import to the CRF Reporter software are under investigation in order to improve the consistency of the CRF tables. The ERT recommends that the United States strengthen its QA/QC procedures related to consistency checks between information reported in CRF table 5.A on AD and the NIR, in order to avoid similar errors in future submissions.	Addressing. The information presented in the Landfills workbook CRF Table 5A in the previous NIR was solid waste generated. This has been changed to MSW landfilled in the current Inventory (i.e., 2018 submission). The solid waste disposed by year is also presented in the "Inv Tables" worksheet in row 48. The main Landfills chapter presents emissions and recovery estimates only, while the Annex presents the activity data, including the amount of MSW landfilled by year. Note that the data sources have changed for the time series and the United States is no longer relying on the BioCycle State of Garbage reports to estimate the amount of MSW generated and landfilled. The United States is still

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					presenting estimates of MSW generated and landfilled in the NIR, but the United States does not directly use this information to estimate net emissions. In the next Inventory (i.e., 2019 submission), the United States will attempt to address this inconsistency so that the data used for waste disposal amounts reflects the source used for the emissions estimates.
93.	(W.12)	Waste	5.A.1.a Anaerobic – CH_4	The NIR states that the United States assumes over 99 percent of the organic waste placed in industrial waste landfills originates from the food processing (meat, vegetables, fruits) and pulp and paper industries (EPA, 1993), and therefore estimates of industrial landfill emissions focused on these two industries. The ERT noted that in the section on planned improvements in the NIR (p.7-12), the United States includes a possible revision to the waste disposal factor currently used for the pulp and paper industry to use production data from pulp and paper facilities obtained from GHGRP, and the possible addition of other industries (e.g. metal foundries, petroleum refineries and chemical manufacturing facilities). The ERT considers that the share of organic waste placed in industrial landfills may be different from that assumed in 1993. Therefore, the ERT recommends that the United States obtain up-to-date data on the type and fractions of organic waste placed in industrial waste landfills and revise the CH_4 estimates from all major industrial waste landfills.	Addressing. EPA plans to document the assumptions regarding the percentage and composition of industrial waste landfilled and compare this information to that reported to the EPA's GHGRP in a technical memorandum. The GHGRP data contains the most up-to-date and comprehensive information available about industrial waste.
94.	(W.14)	Waste	5.B.2 Anaerobic digestion at biogas facilities – CH_4	The United States reports the notation key "IE" for CH_4 emissions from anaerobic digestion at biogas facilities. During the review, the United States explained that disaggregated data are not available and it is assumed that CH_4 emissions are included in the aggregated data reported under the category managed waste disposal sites (5.A.1). The ERT noted that, according to the *2006 IPCC Guidelines* (volume 5, chapter 5, section 4.1), the emissions from unintentional leakages during anaerobic digestion should be reported in the waste sector and, also according to the *2006 IPCC Guidelines*, in the absence of further information, it is recommended to use a default value of 5 percent. The ERT recommends that the United States estimate and report CH_4 emissions from unintentional leakages using the default value of 5 percent provided by the *2006 IPCC Guidelines.*	Addressing. The United States will investigate the data sources and practices of anaerobic digestion in more detail and will assess the addition of a 5 percent factor to account for unintentional leakages in a future Inventory (targeting the 1990 through 2017 Inventory).
95.	(W.15)	Waste	5.C.1 Waste incineration – CO_2, CH_4, and N_2O	The ERT identified a few inconsistencies within the NIR. For example, the United States reported in figure 7-2 of the NIR that 13 percent of waste was incinerated in 2013 while NIR tables 3-26s and A-272 of the NIR both report 7.6 percent for the same year. During the review, the United States explained that multiple references were utilized to estimate CO_2 emissions from waste incineration (focused on fossil-derived waste) and then for	Addressing. The United States is investigating additional sources of information on waste incineration including the GHGRP and plans to

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				CH_4 and N_2O emissions from waste incineration (based on total mass). The United States stated that steps will be taken to better coordinate waste references across all categories in the next inventory submission. The ERT recommends that the United States provide in the NIR consistent information on the data that are used for the estimation of emissions from waste incineration.	update waste references (targeting the 1990 through 2017 Inventory).
96.	(W.16)	Waste	5.C.1 Waste incineration – CO_2, CH_4, and N_2O	In the previous review report the ERT recommended that the United States estimate emissions from the incineration of non-hazardous industrial waste and medical waste. In the current NIR, the United States indicated that data are not readily available to estimate emissions from the incineration of non-hazardous industrial waste and that, based on a report from RTI, medical waste incineration would be below 500 kt CO_2 eq per year, which the United States considered to be insignificant for the purpose of inventory reporting. The ERT recommends that the United States provide in Annex 5 to the NIR a specific reference to the RTI report justifying the insignificance of the emissions from the incineration of medical waste, in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Completed. See Annex 5.
97.	(W.17)	Waste	5.D Wastewater treatment and discharge – CH_4	The United States reports the notation key "IE" for CH_4 flared from domestic wastewater (5.D.1) and other (5.D.3). During the review, the United States explained that aggregated data were reported under "amount of CH_4 for energy recovery". The ERT recommends that the United States provide information in CRF table 9 to indicate where all emissions reported as "IE" are included.	Completed. The United States has clarified that the notation key for CH_4 flared from domestic wastewater is IE because CH_4 flared values are not directly estimated, rather combined with CH_4 energy recovery, due to a lack of available activity data.
98.	(W.18)	Waste	5.D.1 Domestic wastewater – N_2O	The ERT noted that the equation used to estimate $N_{EFFLUENT}$ explained in the NIR is not consistent with the method provided in the *2006 IPCC Guidelines* (volume 5, chapter 5, box 6.1) for estimating emissions from advanced centralized wastewater treatment plants. During the review, the United States explained that it uses the equation to estimate emissions from domestic wastewater effluent (equation 6.7) with the total annual amount of N in the wastewater effluent estimated using equation 6.8 provided in the *2006 IPCC Guidelines*. To reflect the N_2O emissions from domestic wastewater treated in the centralized treatment plant prior to discharge as effluent, the United States subtracted the N associated with such plant emissions from the total $N_2O_{EFFLUENT}$ which was estimated using equation 6.8. During the review, the United States agreed that, in applying equation 6.8 provided in the *2006 IPCC Guidelines*, an adjustment should be made to the $N_2O_{EFFLUENT}$ equation used to estimate emissions so as to properly back-calculate and subtract N associated with N_2O emissions from centralized treatment plants, and suggested a revised equation which considers the underestimation of N treated by biological denitrification. Further, the United States explained that the revised equation, which adjusts the over-deduction of N treated by biological denitrification, still does not consider N discharge from the percentage of the population which uses a septic system because the septic systems in the United States do not discharge to aquatic environments. The ERT recommends that the United States estimate the N_2O emissions	Completed. Beginning with the previous inventory (i.e., 2017 submission), the United States implemented revisions to the calculation of $N_{EFFLUENT}$ that subtracts N associated with N_2O emissions from centralized treatment plants.

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				using the revised equations and report the emissions with the background information in the next submission.	

NA (Not Applicable)