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 U.S. Greenhouse Gas 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.

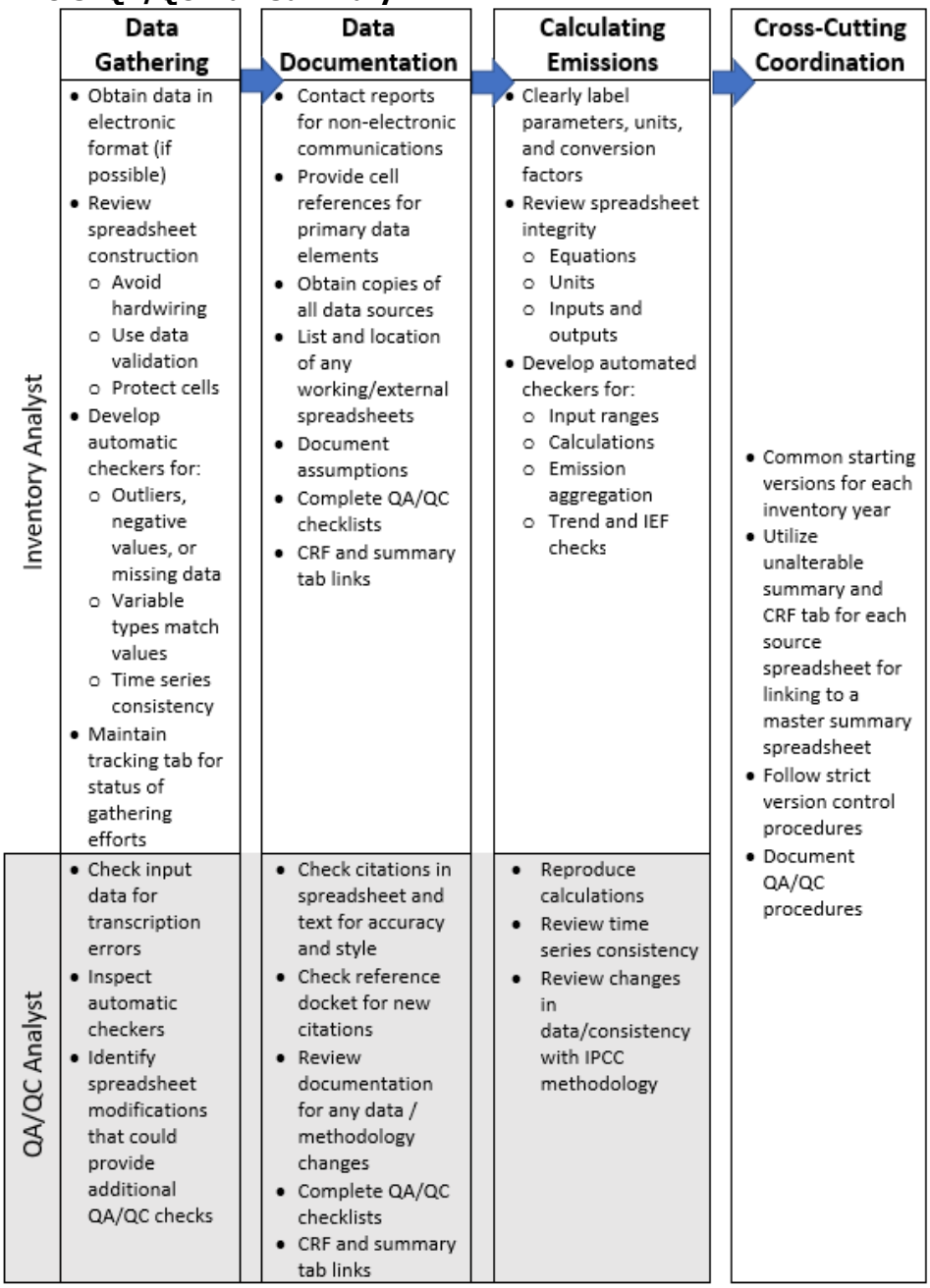
Key attributes of the QA/QC Management Plan are summarized in Figure A-21. These attributes include:

- *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 QA good practice and the *2006 IPCC Guidelines* (IPCC 2006).
- *Quality Control*: application of *General (Tier 1) and Category-specific (Tier 2)* quality controls and checks, as recommended by *2006 IPCC Guidelines* (IPCC 2006), along with consideration of secondary data and category-specific checks (additional 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.
- *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-21: 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* [152] and *A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information.* [153] This includes evaluating the data and models used as inputs into the Inventory against the five general assessment factors: soundness, applicability and utility, clarity and completeness, uncertainty and variability, evaluation and review. Table A-270 defines each factor and explains how it was considered during the process of creating the current Inventory.

Table A-270: Assessment Factors and Definitions[154]

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	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*

[152] 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>.
[153] 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 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>.

	organizations and analyzes employed to generate the information are documented.	*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, 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 to Review Processes

EPA is continually working to improve transparency, accuracy, completeness, comparability, and consistency of emission estimates in 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

Petroleum and Natural Gas Systems source categories (Section 3.6 and 3.7), 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. During the annual preparation of the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, In considering and prioritizing improvements, EPA reviews the significance of the source and sink category (i.e., key categories), along with QC, QA, and uncertainty assessments. Identified planned improvements to methods (including data, emissions factors, and other key parameters), along with QA/QC and uncertainty assessments are documented within each source and sink category to complement the Recalculations and Improvements chapter. Additionally, the Executive Summary, also highlights key changes in methodologies from previous Inventory reports.

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.[155]

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[156]
- UNFCCC Review Process and Guidelines for annual national greenhouse gas inventories[157]
- Inventory Review reports of annual submissions (latest reviews).[158]

The draft review report with findings from the UNFCCC expert review of the April 2019 Inventory submission completed October 7-12, 2019 was only received by EPA on March 17, 2020. EPA was unable to provide accurate responses on how ERT recommendations have been reflected in this Inventory when submitted to UNFCCC in April 2020. Following receipt of the final review report on August 21, 2020 from the UNFCCC, this Annex was updated to include Table A-271 to summarize areas of improvement identified through UN review. The table includes responses to the latest recommendations to facilitate future reviews.

155 See <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>.
156 Available online at: <https://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2>.
157 Available online at: <https://unfccc.int/resource/docs/2014/cop20/eng/10a03.pdf#page=3>.
158 Available online at: <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-271: Response to UN Review of the 2019 Inventory Submission

ID#	*Issue classification*	*Recommendation made in previous review report including ERT assessment and rationale*	*Response on status of issue*
General			
G.1	Completeness (G.1, 2018) (G.1, 2016) (G.1, 2015) (9, 2013) (8, 2012)	Improve the completeness of the inventory, in particular for those categories for which there are methodologies in the 2006 IPCC Guidelines. Addressing. The United States improved the completeness of the inventory. The Party still reports "NE" for a number of categories (see annex II for a list of the completeness issues identified by the ERT). The ERT noted that the Party's planned improvements include incorporating some of these categories into future submissions and/or providing additional information on the likely level of emissions and removals in annex 5 to the NIR (see also ID# G.2 below).	Still addressing. The United States reiterates that planned improvements include incorporating these categories into future submissions and/or providing additional information on the likely level of emissions and removals in annex 5 to the NIR. These improvements will be made over time as data becomes available and prioritized with other improvements to make best use of available resources.
G.2	Annual submission Completeness	The United States reported in the NIR (annex 5, table A-247, p.A-416) a summary of sources and sinks not included in the inventory. This table covers both sources and sinks for which methodologies are provided in the 2006 IPCC Guidelines and those without methodologies. The ERT commends the Party for the transparency provided by the table but notes that a numerical value was not provided in the "Estimated 2017 emissions" column for all sources and sinks that occur in the United States and for which there are methodologies in the 2006 IPCC Guidelines. During the review, the Party stated that, in some cases, approximated AD are currently unavailable to derive a likely level of emissions or removals. Further, the effort to develop a proxy estimate is better invested in developing estimates to include in the inventory itself as part of ongoing planned improvements. The ERT acknowledges the point made by the Party but notes that in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines, Parties should provide justifications for exclusions in terms of the likely level of emissions for all mandatory sources and sinks considered insignificant and the total national aggregate of estimated emissions for all gases and categories considered insignificant shall remain below 0.1 per cent of national total GHG emissions. The ERT recommends that the United States provide a justification in the NIR, based on the likely level of emissions as per paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines, for all sources and sinks that occur but are considered insignificant and excluded from the inventory and for which there are methodologies provided in the 2006 IPCC Guidelines. The ERT recommends that the Party provide in its next NIR evidence that the total national aggregate of estimated emissions for all mandatory gases and categories considered insignificant remains below 0.1 per cent	Still addressing. The Unites States reiterates that planned improvements include incorporating these categories into future submissions and/or providing additional information on the likely level of emissions and removals in annex 5 to the NIR. These improvements will be made over time as data becomes available and prioritized with other improvements to make best use of available resources. Annex 5 of the 2020 submission does include updates to both quantitative and qualitative assessments of significance for some categories.

		of national total GHG emissions.	
G.4	Uncertainty Analysis. Convention reporting adherence	The ERT noted that the uncertainty analyses provided in table A-265 (NIR annex 7, p.A-451) show the results for the latest inventory year (2017) but do not show the results for the base year (1990). According to paragraph 15 of the UNFCCC Annex I inventory reporting guidelines, the quantitative uncertainty analysis should be reported for at least the base year and the latest inventory year. During the review, the Party clarified that it performed an uncertainty analysis for the base year (1990), but was unable to incorporate the results in the final version of section 1 of and annex 7 to the NIR because the issue was identified late, and the Party decided to postpone their inclusion until the following submission year. The ERT recommends that the United States include the results of the uncertainty analysis for 1990 in the relevant tables of section 1 and annex 7 in its next submission.	See pp. 1-25 of 2020 NIR submission.
Energy			
E.2	1. General (energy sector) – gaseous fuels – CO_2 and CH_4 (E.18, 2018) Convention reporting adherence	Addressing. Examine if the uncertainty analysis needs to be updated to reflect the findings of the research on the natural gas combustion and document the findings in future submissions. The United States examined but did not include an explanation in the NIR to clarify whether the uncertainty analysis for natural gas needs to be updated owing to the update in the CO_2 EF and CH_4 content (see ID# E.1 above). In NIR table 3-17 reported uncertainty continues to range between –3 and 7 per cent for residential, commercial, industrial and transportation, –3 to 5 per cent for electric power and –13 to 17 per cent for United States territories. During the review, the Party explained that the uncertainty associated with the updated EFs (as discussed in ID# E.1 above) did not have an impact on the overall uncertainty, as the general findings regarding the carbon content of fuels still apply, meaning that the amount of carbon contained in the fuel per unit of useful energy can vary. The United States documented in broad terms (NIR p.3-33) that the impact of these uncertainties on the overall CO_2 emission estimates is considered to be minor. However, the information provided is not specific to the updates made to the natural gas CO_2 EF.	This issue was addressed in the latest submission. See 2020 NIR Report Section 3.1 pp. 3-35. "For the United States, however, the impact of these uncertainties on overall CO_2 emission estimates is believed to be relatively small. See, for example, Marland and Pippin (1990). See also Annex 2.2 for a discussion of uncertainties associated with fuel carbon contents. Even with recent updates to carbon factors for natural gas and coal, the uncertainty estimates are not impacted."

E.3	1. General (energy sector) – gaseous fuels – CO_2 and CH_4 (E.18, 2018) Transparency	Addressing..Research CO_2 EF data for fuel gas used by upstream oil and gas producers, and natural gas that has been processed and injected into downstream distribution networks, in order to determine whether a different CO_2 EF for fuel gas used in offshore oil and gas production than the CO_2 EF for the processed gas that enters the transmission, storage and distribution networks used in power and industrial plants and by other users is warranted and whether it can be determined; and document the findings of the research on the CO_2 EFs in the NIR. During the review, the Party noted that, as reported in the NIR (section 3, p.3-36 and annex 2.2), the annual natural gas carbon content was updated across the time series to reflect annual heat content data for natural gas obtained from EIA. The CO_2 EF was based on the heat content of natural gas. EIA also reports the heat content of natural gas produced as the same value as natural gas consumed, meaning that the same EF would be used in both upstream and downstream operations. However, the Party did not document the findings of this research on CO_2 EFs in the NIR.	This issue was addressed in the latest submission. See 2020 NIR Annex Section 2.2 pp. A-106. "Furthermore, as natural gas carbon content is based on the heating value of the gas, EIA also reports that the heat content of dry natural gas produced is the same value as natural gas consumed (EIA 2019). Therefore, the same carbon factor is used for all natural gas consumption including upstream operations."
E.4	Fuel combustion – reference approach – all fuels – CO_2 (E.3, 2018) (E.5, 2016) (E.5, 2015) (32, 2013) (41, 2012) Transparency	Addressing. Provide a more transparent clarification of how the difference in emissions between the reference and the sectoral approach is determined and which fuels are subtracted as NEU and feedstocks. The comparison between the reference approach and the sectoral approach is provided in annex 4 to the NIR. The energy data presented in the NIR (table A-244) for the reference approach fuel consumption of gaseous and petroleum fuels match the data presented in CRF table 1.A(c). The ERT noted, however, that values for the apparent energy consumption and apparent energy consumption excluding NEU are still the same in CRF table 1.A(c). During the review, the Party explained that the total amount of carbon stored in products produced from NEU of fossil fuels is subtracted from the emissions in both the sectoral and reference approaches (NIR table A-243). Emissions from carbon that was not stored during NEU of fuels are subtracted from the sectoral approach and reported under the NEU of fossil fuels source category (NIR section 3.2). These emissions, however, are not subtracted in the reference approach and are reported as their own line item in CRF table 1.A(b) (lubricants and petrochemical feedstocks). As a result, the reference approach emission estimates are comparable to those of the sectoral approach, with the exception that the NEU source category emissions are included in the reference approach. The ERT noted that this explanation was not provided in the NIR.	The United States refers the ERT to the 2020 NIR (annex 4, starting on pp. A-481) describing the different treatments of NEU under the reference and sectoral approaches. Further clarification is in the 2020 NIR chap. 3 (pp. 3-38) and additional language was added to the 2020 submission to address this issue, see annex 4 pp. A-482 under Step 3 of the Reference Approach description: "As a result, the Reference Approach emission estimates are comparable to those of the Sectoral Approach, with the exception that the NEU source category emissions are included in the Reference Approach and reported separately in the Sectoral Approach."

E.5	Feedstocks, reductants and other NEU of fuels – all fuels – CO_2 (E.4, 2018) (E.7, 2016) (E.7, 2015) (38, 2013) (47, 2012) Comparability	Not resolved. 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). The Party explained during the review that it does not currently collect or hold data to be able to disaggregate overall NEU emissions into categories that can be reported under IPPU (such as emissions from calcium carbide, lubricants and paraffin waxes). The ERT acknowledges that reallocating the emissions to IPPU may not improve the overall accuracy of the Party's inventory, but it would improve the comparability against other reporting Parties. The ERT notes that if emissions cannot be reported under NEU owing to national circumstances, this should be clarified in the NIR.	The United States reiterates that it 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 has improved the explanation of its country specific approach to the allocation of NEU of fuels in the introduction of the IPPU chapter 4 and Annex 2 of the NIR. The United States continues to evaluate ways to update this approach and provides more clarification as applicable in the current Inventory (i.e., 2020 submission).
E.6	Feedstocks, reductants and other NEU of fuels – CO_2 (E.19, 2018) Accuracy	Not resolved. Continue to research the data for the emissions from NEU of fuels reported under the energy and IPPU sectors mass-balance method used across petrochemical production to estimate CO_2 emissions from NEU of fuels and the method based on process emissions reported under facility- level reporting used to estimate emissions from feedstock consumption under IPPU, and further clarify the country-specific approach used in the NIR consistently with paragraph 10 of the UNFCCC Annex I inventory reporting guidelines. The Party continues to use a mass-balance method across petrochemical production to estimate CO_2 emissions from NEU of fuels, in conjunction with reporting separate emissions from feedstock consumption under IPPU, which may lead to double counting of emissions. See ID# E.5 above.	This issue was addressed in the latest submission. See 2020 NIR Report Section 4.13 pp. 4-64 for the following discussion: "Some degree of double counting may occur between CO2 estimates of non-energy use of fuels in the energy sector and CO2 process emissions from petrochemical production in this sector. This is not considered to be a significant issue since the non-energy use industrial release data includes different categories of sources than those included in this sector and the non-energy use estimates are roughly 20 percent of the emissions captured here. As noted previously in the methodology section, data integration is not feasible at this time as feedstock data from the EIA used to estimate non-energy uses of fuels are aggregated by fuel type, rather than disaggregated by both fuel type and particular industries."
E.7	International aviation – liquid fuels – CO_2, CH_4 and N_2O (E.5, 2018) (E.6, 2016) (E.6, 2015) (35, 2013) Transparency	Not resolved. Harmonize and reconcile the data between the reference and the sectoral approach for the reporting of jet kerosene consumption between CRF tables 1.A(b) and 1.D or furnish an adequate explanation of inconsistencies, where appropriate. There are still inconsistencies in the reporting of jet kerosene consumption between CRF tables 1.A(b) (–1,158,833.17 TJ) and 1.D (1,163,988.07 TJ) for 2017. During the review, the Party explained that this is due to different data sources used for the values reported in the tables: its country-specific values for the consumption of fuels under the reference approach (CRF table 1.A(b)) come from EIA,	This issue was addressed in the latest submission. See 2020 NIR Annex 4, Footnote 6 to Table A-244 on pp. 4-487 for the following discussion: "Jet fuel used in bunkers has a different heating value based on data specific to that source. When physical values are converted based on a combined heating value across all sources of jet fuel (as shown in Table 1.A(b) of CRF) it will not necessarily match jet

		which is responsible for gathering the official fuel production and consumption statistics for the country, and are the most appropriate AD for the energy sector of the Party's inventory. The Party also clarified that the inventory relies on data on individual flights to determine the split between domestic and international fuel use in the sectoral approach and further explanation of the calculation used is included in the NIR (annex 3.3, p.A-189). According to the Party, the approach used could be leading to differences in the consumption of jet kerosene in international aviation (CRF table 1.D). The Party further clarified that the above information will be included in the next NIR.	fuel bunker data (as shown in Table 1.D of CRF)."
E.9	1.A Fuel combustion – sectoral approach – biomass – CH_4 and N_2O (E.20, 2018) Completeness	Not resolved. Advance the research on CH_4 and N_2O emissions from the combustion of landfill gas, sewage gas and other biogas in order to review data sources for biogas, review the reporting of non-CO_2 emissions in the waste sector and assess the need to add new estimates. The United States did not review the data sources for biogas to determine the completeness of non-CO_2 emissions reported in the waste sector. The planned improvements described in the NIR (p.3-109) continue to indicate that the Party intends to research data on biogas for future inclusion in the inventory.	The United States is investigating sources of data on biogas use and combustion for energy and confirming whether these emissions are not reported elsewhere. Updates will be implemented as needed and described in future submissions.
E.12	1.A.2.g Other (manufacturing industries and construction) – liquid fuels – CO_2, CH_4 and N_2O (E.22, 2018) Transparency	Addressing. Document the impacts of the new model and the validity of the outputs and transparently document the recalculations in the NIR when the latest version of the model (MOVES2014b) is incorporated in the inventory. The Party applied the MOVES2014b model in the 2019 submission. The NIR (section 3.1, p.3-43) describes the recalculations and the impact on CH4 and N2O emissions. The Party made no reference to CO2 emissions but the ERT noted that they increased across the time series following the recalculation. Documentation on the validity of the model was not included in the NIR.	The use of the MOVES model in the development of the Inventory is limited primarily to the estimation of CH4 and N2O emissions from non-transportation mobile sources. The model is also used to generate vehicle age distributions that are used to estimate CH4 and N2O emissions from Transportation sources. The model is not used to derive CO2 emissions from Transportation sources. The United States plans to incrementally improve the discussion of the validity of the MOVES model in future submissions.
E.13	1.A.2.g Other (manufacturing industries and construction) – liquid fuels – CO_2, CH_4 and N_2O (E.23, 2018) Comparability	Not resolved. Research whether data are available to accurately reallocate emissions from fuel use by agricultural mobile machinery from subcategory 1.A.2.g to 1.A.4.c.ii and fuel use for fishing vessels to 1.A.4.c.iii in order to improve the comparability of the submission and ensure that emissions of all gases from a given source are reported under the same IPCC category. If data are not available to accurately reallocate emissions to the different categories, clarify, in the NIR, the country-specific approach taken consistently with paragraph 10 of the UNFCCC Annex I inventory reporting guidelines. The NIR did not state that such data are not available or clarify the use of the country-specific approach. The Party stated during	The United States is researching and comparing various AD sources, in addition to updating the MOVES model inputs (see ID# E.12 above). This will include researching the availability of data for addressing the allocation of emissions from fuel use by agricultural mobile machinery from subcategory 1.A.2.g (other) to 1.A.4.c.ii (off-road vehicles and other machinery) and fuel use for fishing vessels to 1.A.4.c.iii (fishing).

		the review that it is researching and comparing various AD sources, in addition to updating the MOVES model inputs (see ID# E.12 above). This will include researching the availability of data for addressing the allocation of emissions from fuel use by agricultural mobile machinery from subcategory 1.A.2.g (other) to 1.A.4.c.ii (off-road vehicles and other machinery) and fuel use for fishing vessels to 1.A.4.c.iii (fishing).	
E.14	1.A.2.g Other (manufacturing industries and construction) – liquid fuels – CO_2, CH_4 and N_2O (E.24, 2018) Accuracy	Not resolved. Research data by non-road mobile machinery vehicle type across the different data sets, including the Federal Highway Administration and MOVES model outputs, to determine the optimum AD estimate for each subsource under non-road mobile machinery, and improve inventory accuracy, as necessary, including for CO_2, CH_4 and N_2O emissions from industrial, commercial, agricultural machinery and fishing vessels. The United States did not provide information on the optimum AD estimate for each subsource under non-road mobile machinery for improving the accuracy of the inventory. The Party continued to estimate emissions for this category using AD from different sources (NIR p.3-30).	See pp. 3-40 of the April 2020 NIR where it states "EPA also tested an alternative approach that uses MOVES on-road fuel consumption output to define the percentage of the FHWA consumption totals (from MF-21) that are attributable to on-highway transportation sources, and applying this percentage to the EIA total, thereby defining gasoline consumption from on-highway transportation sources (such that the remainder would be defined as consumption by the industrial and commercial sectors). Results from this testing revealed differences between fuel consumption calculated by MOVES and fuel consumption data from FHWA. Given this inconsistency, no changes have been made to the methodology for estimating motor gasoline consumption for non-road mobile sources." The United States. is researching and comparing various AD sources, in addition to planning to update the MOVES model inputs to address this issue (see also responses to AR ID#s E.12 and E.13 above). Updating the MOVES model inputs is a longer-term effort.
E.15	1.A.3 Transport – liquid fuels – CO_2, CH_4 and N_2O (E.25, 2018) Accuracy	Not resolved. Advance the research in order to implement as soon as practicable the following improvements indicated during the review: (a) Updating on-road diesel CH_4 and N_2O EFs; (b) Developing improved methodology and data sources to estimate emissions from class II and III (short-line and regional) rail locomotives; (c) Applying a consistent methodology over time to estimate vehicle miles	Items (a) and (b) were addressed in the 2020 submission (see the Recalculations section of Chapter 3 of NIR). Onroad diesel CH_4 and N_2O EFs were updated using manufacturer certification data compiled and made publicly available by EPA. This update underwent Expert Review during the 2020 compilation cycle. The methodology for

		travelled for on-road vehicles by vehicle type, defined by wheel base; Including ongoing research and documentation of minor emissions sources currently not included in the inventory, such as urea use in trucks, bio jet fuel, and compressed natural gas or liquefied petroleum gas use in shipping.	estimating fuel consumption and emissions from Class II and II rail sources was updated to use surrogate carload data reported by RailInc. (2014 onwards). Additional improvements will be undertaken in stages over the 2021 and 2022 submissions, pending data availability.
E.16	1.A.3.b Road transportation – liquid fuels – CO_2 (E.26, 2018) Accuracy	Not resolved. Review and update the time series of diesel and gasoline CO_2 EFs, including, where necessary, the data on fuel densities and carbon share by fuel grade, and report on progress, or document in the NIR that the EFs applied are accurate and representative of emissions across the time series, and update the uncertainty analysis as needed to reflect the findings of the research. The United States did not recalculate CO_2 emissions from diesel and gasoline for the 2019 submission and continues to use constant EFs for gasoline (67.62 t CO_2/TJ) for 2008–2017 and for diesel (70.10 t CO_2/TJ) for the entire time series.	The update of the time series of diesel and gasoline is under way. EPA sought expert input during the 2020 compilation cycle which identified additional considerations that extended development of this update. The U.S. anticipates addressing the gasoline and diesel EF in the 2021 submission.
E.17	1.A.3.b Road transportation – liquid fuels – CO_2 (E.27, 2018) Completeness	Either present information in the NIR to justify the omission of any fossil carbon component in the CO_2 EF for biofuel use (e.g. fatty acid methyl ester use) or update the inventory estimates to account for emissions from the fossil carbon component of biofuels and explain the estimations in the NIR. The Party added a footnote in the NIR (p.3-21) clarifying that biofuel estimates are presented in the energy sector and that carbon fluxes from changes in biogenic carbon reservoirs in croplands are accounted for in the estimates for LULUCF. However, this does not fully justify the omission of emissions from the combustion of the fossil fraction of the biodiesel. According to the 2006 IPCC Guidelines (vol. 2, chap. 3, p.3.17), biodiesel produced using methanol as a feedstock will contain fossil carbon if the methanol is produced from a fossil fuel (such as natural gas). In addition, the tier 1 method used for estimating emissions for the production of methanol (in CRF table 2(I).A-Hs1) does not account for the carbon stored in products (in this case, methanol that is later combusted in the transport sector). Moreover, the Party did not clarify whether imports of methanol are used in the production of biodiesel or whether there are imports of pre-blended liquid fuels. During the review, the Party clarified that the NIR (section 4.13, p.4-51) explains that, owing to national circumstances, natural gas for non-fuel purposes in the production of petrochemicals (such as methanol) is accounted for in the NEU calculations. While the NIR does not explicitly mention methanol as part of the NEU calculations for carbon storage from petrochemical feedstocks, it is implied that it is part of those calculations. The Party also explained that it has recently become a net exporter of methanol and that the import-export analysis conducted for NEU provides an	This issue was addressed in the latest submission. See the 2020 NIR Report, Chapter 3, footnote 97 on pp. 3-114. “CO2 emissions from biodiesel do not include emissions associated with the C in the fuel that is from the methanol used in the process. Emissions from methanol use and combustion are assumed to be accounted for under Non-Energy Use of Fuels. See Annex 2.3 – Methodology for Estimating Carbon Emitted from Non-Energy Uses of Fossil Fuels.” See also the 2020 NIR Annex 2.3, footnote 26 on pp. A-134. “Natural gas used as a petrochemical feedstock includes use in production of methanol. The storage factor developed for petrochemical feedstocks includes emissions from the use of products. Therefore, it is assumed that emissions from the combustion of methanol used in biodiesel are captured here and not reported as part of biodiesel combustion emissions.”

		adjustment for methanol imports and exports. The ERT considers that the Party should explain clearly in the NIR how the fossil fraction of the biodiesel in road transportation is estimated and allocated. The ERT believes that future ERTs should consider this issue further to ensure that emissions from this category are not underestimated.	
E.18	1.A.3.b Road transportation – liquid fuels – CH_4 and N_2O (E.28, 2018) Convention reporting adherence	Not resolved. Include descriptions of the MOVES model used to estimate CH_4 and N_2O emissions from road transportation and the 2016 GREET model used to generate EF inputs for alternative fuel vehicles, and information to verify that the models have been tested and calibrated to be representative of the United States fleet, fuels, driving conditions, road types and vehicle types. The Party did not include a description of the MOVES model in the NIR indicating the process used to evaluate and improve the model in order to ensure adherence to the UNFCCC Annex I inventory reporting guidelines for tier 3 model verification. The ERT noted that the time series of CH_4 EFs for biofuel use in alternative fuel vehicles, derived from the 2016 GREET model, was updated and no longer shows a large increase beginning in 2011 (NIR annex 3.2, table A-113). During the review, the Party explained that it plans to improve the discussion incrementally in future submissions, including by adding more descriptive text to annex 3 (section 3.2) and providing cross-references to the annex throughout section 3 (energy) of the NIR.	The United States plans to incrementally improve the discussion of the validity of the MOVES model in future submissions.
E.21	1.A.5.b Mobile – solid and gaseous fuels, and biomass use – CO_2, CH_4 and N_2O (E.31, 2018) Transparency	Not resolved. The Party reported CO_2, CH_4 and N_2O emissions from solid and gaseous fuel and biomass use in 1.A.5.b (other mobile (military)) as "NA". During the review, the Party indicated that these activities do not occur. Report AD and emissions of activities not occurring as "NO" instead of "NA". The Party explained during the review that this change will be made in the 2020 submission.	See CRF Table1.A(a)s4 in 2020 Inventory Submission, the CO2, CH4 and N2O emissions from solid and gaseous fuel and biomass use in 1.A.5.b (other mobile (military)) are reported as NO.

E.22	1.B.2 Oil, natural gas and other emissions from energy production – all fuels – CO_2, CH_4 and N_2O (E.32, 2018) Accuracy	Addressing. Implement the planned improvements for this category discussed during the review, including the following: (a) Estimating emissions from natural gas gathering systems using component-level annual data instead of whole-facility study data; (b) Estimating emissions from hydraulically fractured oil well completions using annually reported facility emission data instead of production-based estimates; (c) Estimating fugitive emissions releases from liquefied natural gas storage and transfer using GHGRP data rather than data from an older reference; Estimating emissions from natural gas transmission pipeline blowdowns using GHGRP data rather than data from an older reference, ensuring that the recalculations are described transparently and that a consistent time series of estimates is maintained. For item (a) the United States did not estimate emissions from natural gas gathering systems using component-level annual data instead of whole-facility study data. During the review, the Party explained that a new data source has been identified for item (a) and is expected to be used for the 2020 submission. For items (b), (c) and (d), the United States implemented the planned improvements and explained the recalculations undertaken in the NIR (section 3.7, pp.3-88–3-98).	This update was implemented in the 2020 submission. See more information on updates and recalculation related to emissions from gathering systems in Section 3.7 on pp. 3-91. For additional information, please see https://www.epa.gov/sites/production/files/2020-04/documents/2020_ghgi_update_-_gb_stations_final.pdf.
E.23	1.B.2.c Venting and flaring – CO_2 and CH_4 (E.16, 2018) (E.20, 2016) (E.20, 2015) Transparency	Addressing. Enhance transparency in reporting CH_4 emissions from petroleum systems from venting and flaring, in accordance with the UNFCCC Annex I inventory reporting guidelines. The Party provided new estimates for venting and flaring (NIR section 3.7, pp.3- 88–3-98) (see ID# E.22 above). The ERT noted that the descriptions of additional recalculations, using improved data and methods including several data tables, indicate that increasing levels of detail in the data are available on emissions from several venting and flaring sources in the oil and gas sector across the time series, even though the Party still reports "IE" for venting and flaring in CRF table 1.B.2. During the review, the Party clarified that providing an estimate of disaggregated flaring emissions would involve the application of many assumptions and would result in inconsistent reporting and potentially decreased transparency. The Party stated that there are inconsistencies in data availability across subcategories (such as gathering) within oil and gas, and noted that EF data available for activities that include flaring (such as heavy fuel oil well completions with flaring) include emissions from multiple sources (flaring, venting and leaks).	The United States reiterates previous clarification and response provided during previous reviews.
E.25	1.C CO2 transport and storage – CO2 Yes. Transparency	The ERT noted in the NIR (box 3-7, p.3-79) that emissions of CO2 from EOR are treated differently depending on the source of CO2. When CO2 from naturally occurring CO2 reservoirs is used in EOR, the subsequent leakage of injected CO2 from the EOR site is not reported separately for injection and storage under	The United States continues to review new data from GHGRP and other sources for consideration in updating emissions estimates from transport of CO2 (category 1.C.1), injection (category 1.C.2.a), and

		category 1.C.2 (injection and storage) and, as described in the NIR (box 3-7), is assumed to be fully sequestered. When the CO2 is sourced from anthropogenic sources (such as gas processing or post-combustion capture at a coal-fired power station), it is assumed that complete loss of the CO2 occurs at the point of capture. While dedicated CCS sites are subject to GHGRP methods for estimating emissions from the geological storage formation, it is not clear whether the permanence of CO2 sequestration at EOR sites is assessed. When naturally occurring CO2 is sourced and injected into a geological formation as part of EOR operations, there is the potential for subsequent long-term leakage and loss of CO2 through pathways, as described in the 2006 IPCC Guidelines (vol. 2, table 5.3, p.5.12), and therefore the ERT could not identify whether this emission category is being accounted for in the inventory. During the review, the Party explained that it continues to review new data from the GHGRP and other sources for consideration in updating emission estimates for categories 1.C.1 (transport of CO2), 1.C.2.a (injection) and 1.C.2.b (storage). The ERT recommends that the United States report on the progress on the research to enable estimation of emissions for category 1.C.2, and provide a description of emission pathways associated with EOR and CCS processes for all relevant categories, including how leakage from CO2 geological storage formations is assessed for both EOR and CCS projects. The ERT recognizes that there is no method in the 2006 IPCC Guidelines and encourages the Party to report emissions under category 1.C.2, including emissions from naturally occurring CO_2.	storage (category 1.C.2.b). The Party will provide an update as appropriate in future submissions in recalculations and, where feasible in planned improvements. This improvement will be made over time as data becomes available and prioritized with other improvements to make best use of available resources.
E.26	1.C CO_2 transport and storage – CO_2 Comparability	In addition to ID# E.25 above, the ERT noted that the notation keys in CRF table 1.C are not used consistently. For example, the total amount of CO2 injected at storage sites and the total leakage from transport, injection and storage are reported as “NA”, while category 1.C.1 (transport of CO2) and category 1.C.2 (injection and storage) are reported as “IE”. The ERT recommends that the United States change the total amount of CO2 captured for storage to “IE” in line with the Party’s existing approach of reporting EOR and CCS emissions in the sectors where the emissions are captured for use in EOR. The ERT also recommends that the Party report the total amounts of CO2 injected at storage sites and the total leakage from transport, injection and storage as “IE”.	The United States will review notation keys and correct as appropriate in a future submission.
IPPU			

I.1	2. General (IPPU) – CO_2 (I.26, 2018) Accuracy	Not resolved. Review the basis of EFs applied and, where appropriate, apply consistent carbon content factors to ensure consistency across the energy and IPPU sectors, reflecting any annual variations in the factors. The Party did not update the EFs in order to improve consistency across the energy and IPPU sectors. The Party explained during the review that it is reviewing the basis of EFs and will report on any applicable updates as part of recalculations in the 2020 submission. The Party clarified that it does not expect updates to have a discernible impact on emissions	This issue was addressed in the latest submission. See the 2020 NIR Report, Chapter 4, Section 4.5 on pp. 4-31. "the carbon factors used to determine the amount of natural gas used for ammonia feedstock were updated to be consistent with the factors used in the fossil fuel combustion estimates. This update did not have an impact on process-related ammonia emissions presented here but did impact the amount of natural gas subtracted from energy use as part of the CO2 Emissions from Fossil Fuel Combustion calculations." See also the 2020 NIR Report, Chapter 4, Section 4.17 on pp. 4-85. The C content of coking coal was updated to be more consistent with factors used in the Energy calculations of the Inventory. Other updates are pending ongoing review and are anticipated to be included as appropriate in future submissions.
I.2	2.A.1 Cement production – CO_2 (I.28, 2018) Transparency	Not resolved. Justify the applicability of the 2 per cent value of the cement kiln dust factor to national circumstances or investigate further the availability of the data required to derive a country- specific cement kiln dust factor for cement production and report on the outcome of this investigation. The 2006 IPCC Guidelines (vol. 3, chap. 2.2.1.2, pp.2.11–2.13) allow the use of the default cement kiln dust factor for the tier 2 approach if data are unavailable. However, the ERT noted that the Party did not justify the applicability of the 2 per cent cement kiln dust factor for this key category in the NIR. During the review, the United States confirmed that it will explain the use of the default cement kiln dust factor in the next submission.	This was addressed in 2020 NIR submission, see p. 4-10 (footnote 10).
I.3	2.A.4 Other process uses of carbonates – CO_2 (I.5, 2018) (I.17, 2016) (I.17, 2015) Completeness	Addressing. 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 for estimating emissions from ceramics, non- metallurgical magnesium production and from other limestone and dolomite use; and report on progress in the NIR. The Party continues to report "NE" for categories 2.A.4.a (ceramics) and 2.A.4.c (non-metallurgical magnesium production) in CRF table 2(I).A-Hs1. The Party partially addressed this recommendation in its 2018 NIR by providing information on how unspecified uses are accounted for within the estimates (NIR section 4.4, p.4-20). During the review, the Party explained that further outreach work continues with trade associations,	See Annex 5 of 2020 NIR, pp. A-495. No reportable progress in identifying data to estimate emissions based on further outreach. Efforts continue under current cycle.

		including consultation with current data providers. At this time, the research has not yielded any alternative data on national levels of carbonates to verify United States Geological Survey data or provide information on carbonates consumed in these industries. The Party further explained that ceramics and non-metallurgical magnesia are currently not included in the United States Geological Survey. The Survey currently allows respondents to enter magnesia (dolomite) data but no data were reported.	
I.4	2.B.1 Ammonia production – CO_2 (I.7, 2018) (I.19, 2016) (I.19, 2015) Comparability	Addressing. 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. The Party included in the NIR (section 4.5) an explanation of the use of the country-specific methodology to estimate emissions from ammonia production consistently with paragraphs 10–11 of the UNFCCC Annex I inventory reporting guidelines. The Party indicated in the NIR (p.4- 28, under planned improvements) that it has been obtaining data (since 2018) on feedstock quantities from ammonia production facilities via GHGRP and it is verifying these data to use in future inventories. During the review, the Party clarified that it was not able to address this issue in the 2019 submission and that it continues to work on collecting data to improve the inventory.	The United States reiterates that it currently uses a country specific methodology for ammonia production emissions consistent with para. 10, Decision 24/CP.19 to most accurately portray U.S. emissions from ammonia production. 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 national ammonia production to estimate emissions from feedstock consumption, excluding consumption of fuel for energy purposes to avoid double counting and compatibility with methods in 2006 IPCC GL. The United States will continue to review the use of GHGRP data to better understand energy use for ammonia production and any information will be included as appropriate in future submissions.
I.6	2.B.3 Adipic acid production – CO_2, CH_4, N_2O and PFCs (I.30, 2018) Transparency	Not resolved. Include a trend analysis of the IEF in order to explain observed inter-annual changes and irregularities in these trends for adipic acid production (2.B.3). The Party did not include a trend analysis to explain the IEF variations in the NIR. During the review, the Party explained that inter-annual changes or trends in emissions are associated with the use of abatement equipment at the largest production facility. The Party indicated that the requested information will be	See Section 4.8 of the 2020 NIR Submission, p. 4-40 for information on trends.

		included in the next submission as part of QA/QC and verification activities.	
I.7	2.B.4 Caprolactam, glyoxal and glyoxylic acid production – N_2O (I.31, 2018) Completeness	Not resolved. Gather the necessary data and report N_2O emissions from glyoxal and glyoxylic acid production. The Party still reports AD and N_2O emissions from glyoxal and glyoxylic acid production as "NE" in CRF table2(I).A-Hs1. During the review, the Party clarified that it has been researching available data sources but has not yet obtained any usable information for addressing this issue (either for estimating and reporting these emissions or for continuing to report "NE" and providing justification for exclusion in terms of the likely level of emissions in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines). The Party also stated that it was not able to invest resources in this review in 2019 and that it hopes to update planned improvements and the annex listing the emissions not estimated for the 2020 submission.	See Annex 5 of 2020 NIR, pp. A-495. We have identified potential data sources for glyoxal, and glyoxylic acid based on ongoing research efforts. We hope to report more progress in the April 2021 submission, but anticipate the earliest reflection of this data, if useful, would be the April 2022 submission as it may not provide time series data.
I.8	2.B.5 Carbide production – CO_2 (I.32, 2018) Comparability	Not resolved. Allocate CO_2 emissions from production of calcium carbide to the IPPU sector in line with the 2006 IPCC Guidelines or provide clarity in the NIR as to the country-specific approach taken. The Party did not allocate the CO_2 emissions from the production of calcium carbide (category 2.B.5.b) to the IPPU sector. The NIR (p.4-42) stated that CO_2 from calcium carbide is accounted for within the NEUs of petroleum coke in the energy chapter. During the review, the Party stated that, overall, it is continuing to look for data enabling it to disaggregate and reallocate CO_2 emissions from calcium carbide.	The United States reiterates that a country-specific approach was taken for CO_2 emissions from production of calcium carbide. Footnote 16 in the 2020 NIR Report pp. 4-16 indicates calcium carbide is produced from quicklime and petroleum coke. Any emissions from quicklime production are included in lime production emissions (Section 4.2). Furthermore, Section 4.10 pp. 4-48 in the 2020 NIR Report, indicates that carbon dioxide (from petroleum coke used in calcium carbide production) is implicitly accounted for in the storage factor calculation for the non-energy use of petroleum coke in the Energy chapter. Table A-65 on pp. A-133 of the 2020 NIR Annexes indicates a storage factor of 30% for petroleum coke used in non-energy uses. This indicates effectively that 70% of any CO_2 emissions associated with petroleum coke used in calcium carbide production is released and accounted for under NEU emissions in the Inventory. There is no way to disaggregate and report emissions specifically associated with petroleum coke used in calcium carbide production

			(like is done for silicon carbide) since production data is not available for calcium carbide to estimate emissions directly.
I.9	2.B.8 Petrochemical and carbon black production – CH_4 and N_2O (I.10, 2018) (I.22, 2016) (I.22, 2015) Completeness	Addressing. Progress with plans to analyse new data reported by facilities (i.e. GHGRP data) and include emissions from combustion and flaring from installations not currently included in the inventory. The United States reported in the NIR (p.4-53) that a preliminary analysis of aggregated annual reports shows that flared CH_4 and N_2O emissions are less than 500 kt CO_2 eq/year. The Party also reported that the GHGRP is still reviewing these data across reported years to facilitate an update of category-specific QC documentation and EPA plans to address this more fully in future submissions.	The United States also points to pp. 4-57 of 2019 NIR Report on QA/QC and Verification, that "The CH_4 emissions from ethylene production under the GHGRP have not been included in this chapter because this approach double counts carbon (i.e., all of the carbon in the CH_4 emissions is also included in the CO_2 emissions from the ethylene process units). So, it is not just an issue that the flaring emissions are small but that the C at least is already included in CO_2 emission estimates. The US continues to assess the GHGRP data for ways to better disaggregate the data and incorporate it into the inventory and any information will be included as appropriate in future submissions.
I.10	2.B.8 Petrochemical and carbon black production – CO_2 and CH_4 (I.12, 2018) (I.25, 2016) (I.25, 2015) Comparability	Not resolved. Develop a methodology that is consistent with the 2006 IPCC Guidelines as soon as is practicable, allocating relevant fuel and feedstock emissions within the IPPU sector. The United States did not update the methodology for allocating the relevant fuel and feedstock emissions within the IPPU sector. During the review, the Party stated that it is reassessing data with EIA and the GHGRP to assess possible options. The Party also stated that, given how data are reported under the GHGRP and how data for the energy sector were received from EIA, this would require a longer-term effort. The Party further highlighted that the NIR (section 4.13) explains the use of the country-specific methodology for estimating emissions from petrochemical and carbon black production consistently with paragraphs 10–11 of the UNFCCC Annex I inventory reporting guidelines.	The United States reiterates that it uses an approach for calculating emissions associated with petrochemical and carbon black production that is consistent with the 2006 IPCC guidelines. Also, as per question E.6 the issue of potential double counting was addressed in the latest submission. See 2020 NIR Report Section 4.13 pp. 4-64 for the following discussion: "Some degree of double counting may occur between CO_2 estimates of non-energy use of fuels in the energy sector and CO_2 process emissions from petrochemical production in this sector. This is not considered to be a significant issue since the non-energy use industrial release data includes different categories of sources than those included in this sector and the non-energy use estimates are roughly 20 percent of the emissions captured here. As noted previously in the methodology section, data integration is not feasible at this time as feedstock data from the EIA used to estimate non-energy uses of fuels are aggregated by fuel type, rather than disaggregated

			by both fuel type and particular industries."
I.11	2.B.8 Petrochemical and carbon black production – CO_2 (I.33, 2018) Accuracy	Addressing. Review the backcasting methods to estimate the CO2 EF for the period 1990–2009 for subcategories 2.B.8.b (ethylene), 2.B.8.c (ethylene dichloride and vinyl chloride monomer), 2.B.8.d (ethylene oxide) and 2.B.8.f (carbon black) with improved accuracy; and report transparently on the backcasting methodology for the CO2 EF that it chooses to apply. The United States explained in the NIR (p.4-57) that the CO2 EF for 1990–2009 for category 2.B.8.d (ethylene oxide) was updated using data for 2010–2013, rather than data for 2010–2016. As the EF decreased after 2013, the ERT considers this to be a good approach to characterizing the emissions for 1990–2009. During the review, the Party explained that this approach was not extended to other petrochemical production subcategories (2.B.8.b (ethylene), 2.B.8.c (ethylene dichloride and vinyl chloride monomer) and 2.B.8.f (carbon black)) because GHGRP data for 2017 were not available to the inventory staff until after the 2019 submission had been compiled.	This issue was addressed in the latest submission. See 2020 NIR Report Section 4.13 Recalculations Discussion pp. 4-63 – 4-64. The use of GHGRP data for 2010-2013 to develop EFs was applied for all petrochemical types.
I.12	2.B.8.b Ethylene – CO_2 (I.13, 2018) (I.26, 2016) (I.26, 2015) Transparency	Addressing. Provide an explanation for the country-specific approaches using the EFs for ethylene production 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. The United States reported in the NIR (pp.4-53–4-55) that a country-specific approach was taken to estimate emissions from ethylene production. The description in the NIR addresses the data sources and methods used over the reporting period and the Party added further information on quality checks, taking into account data from production facilities (pp.4-56–4-57). However, the Party did not refer specifically to the outcome of other quality checks comparing country-specific GHGRP data with other data (e.g. data from trade association surveys).	This issue was addressed in the latest submission. See 2020 NIR Report Section 4.13 QA/QC and Verification section pp. 4-62 – 4-63. Additional text was added describing the verification procedures for use of the GHGRP data. Further checks relying on data from outside groups is not a necessarily part of the UNFCCC reporting guidelines.

I.13	2.C.1 Iron and steel production – CO_2 (I.16, 2018) (I.27, 2016) (I.27, 2015) Completeness	Not resolved. 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. The United States reported in its NIR (p.4-72) that data on natural gas use and coke oven gas production at merchant coke production plants were not included in the emission estimates owing to data being unavailable. The Party indicated during the review that it has begun an analysis, the first step being to assess and gather relevant data related to iron and steel merchant coke plants. The Party indicated that this planned improvement is unlikely to occur before the 2021 submission.	The United States reiterates that the carbon associated with all coking coal used in merchant and integrated coking facilities is accounted for in the Inventory in the Energy Sector emissions, see for example Table A-65 in the 2020 NIR Report Annex 2.3 pp. A-133. Furthermore, all natural gas used in merchant coke facilities would be captured under the Energy Sector natural gas Industrial category. The United States will continue to gather relevant data to better understand the mass and energy balance around all coking facilities and any information will be included as appropriate in future submissions.
I.14	2.C.1 Iron and steel production – CO_2 (I.17, 2018) (I.28, 2016) (I.28, 2015) Transparency	Addressing. 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 Party uses to compile and quality check the inventory estimates). The United States did not report a carbon balance supporting the allocation of emissions from coke production or iron and steel production across both the energy and IPPU sectors. However, the Party reported transparently in its NIR (pp.4-68–4-77) on the allocation of emissions and carbon stored from iron and steel production. The ERT noted that, to enhance the transparency of the NIR, the Party still needs to include all the conversion factors to allow the reported CO_2 emission estimate to be reproduced. During the review, the Party explained that it is reviewing ways to improve the presentation of information, but it currently seems unlikely that a full update will be included in the 2020 submission.	The United States reiterates that the Party has transparently reported in its NIR, see for example the 2020 NIR Annex 2.1 pp. A-56 – A-57, how emissions and carbon stored from iron and steel production have been allocated between the energy and IPPU sectors. The Party has also documented emission factors used in the Iron and Steel and coke production emissions estimates. See for example Table 4-66 on pp. 4-80, Table 4-69 on pp. 4-81 and Tables 4-70 and 4-71 on pp. 4-82 of the 2020 NIR Report. The United States will continue to review ways to improve the presentation of data and any updates will be included as appropriate in future submissions.
I.15	2.C.4 Magnesium production – SF_6 (I.35, 2018) Consistency	Addressing. Investigate the reasons for the SF_6 IEF increase between 2009 and 2011 and report in the NIR on the outcome of the investigation and on any recalculations of AD, IEF or emissions resulting from those investigations. The United States recalculated SF_6 emissions from die casting for 2009–2017 in CRF table 2(I).A-Hs2. In the NIR (p.4-90) the Party explained that the emissions were updated on the basis of revised AD. However, the Party did not report on the outcomes of the investigation explaining the reasons for the SF_6 IEF increase	Adjustments to the activity data are discussed in the recalculation sections of the 2019 and 2020 NIRs in Section 4.20. The 2021 NIR will include a discussion on the trends in the SF6 IEF. The revised activity data more accurately reflects the change in production that occurred during the recession. The large increase in SF6 emissions from 2010 to 2011 is due in part to 1 facility reporting anomalously high

		between 2009 and 2011 and how the new AD used in the recalculations improved the trend in the SF_6 IEF between 2009 and 2011. The ERT notes that the AD and EF are reported as confidential in the CRF table and that SF_6 emissions in 2011 are still considered as an outlier (an increase of 41 per cent between 2010 and 2011).	emissions in 2011 and also partially due to increased production.
I.16	2.D Non-energy products from fuels and solvent use – CO_2 (I.36, 2018) Comparability	Not resolved. Estimate separately CO_2 emissions from lubricants and paraffin wax use and report them under category 2.D. The United States continues to report CO_2 emissions from lubricants and paraffin wax use under the energy sector and to report "IE" under category 2.D (non-energy products from fuels and solvent use). During the review, the Party explained that it uses a country-specific methodology to portray as accurately as possible the emissions from this category and stated that reallocating emissions will not necessarily produce a more accurate or comparable result. However, the ERT is of the view that reporting these emissions under category 2.D will improve comparability across Parties.	As per ID # above E.5, The United States reiterates that it 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 has improved the explanation of its country specific approach to the allocation of NEU of fuels in the introduction of the IPPU chapter 4 and Annex 2 of the NIR.
I.17	2.F Product uses as substitutes for ozone-depleting substances – HFCs and PFCs (I.19, 2018) (I.29, 2016) (I.29, 2015) Transparency	Addressing. Improve the documentation of the refrigeration and air-conditioning model by including the clarifications on model assumptions, data sources and calculation methodologies provided to the ERT during the 2016 review, including (a) the assumed linear substitution trend between "start" and "full penetration" dates for substitution gases; (b) additional information on the annual growth rates cited in the NIR; (c) the model calculation approach for overlapping equipment technology substitutions; (d) details of country-specific circumstances and key references for the annual emission rates for servicing and leaks applied; and (e) information on assumed recovery, reuse and recycling of fluids at end of life (e.g. for fire extinguishers). The United States improved the documentation and described in the NIR (annex 3.9, pp.A-227–A-237) (a) the assumed linear substitution trend between "start" and "full penetration" dates for substitution gases; (b) the average annual growth rates for individual market sectors; and (c) the calculation approach relevant to overlapping equipment. Related to (d) the Party also provided information on country-specific circumstances and key references in the NIR (p.4-120). Related to (e), in annex 3.9 (pp.A-238–A-247), the Party provided information on assumed recovery, reuse and recycling in various subcategories. However, specific information on recovery and reuse of agents at end of life in fire extinguishers is not provided. During the review, the Party explained that all remaining fire protection agent from equipment reaching disposal (i.e. the full amount less the assumed annual emission rate) is recovered and reused, and indicated that it will provide this information in annex 3.9 to its 2020 submission.	The U.S. has included in the 2020 NIR the sentence "At end-of-life, remaining agent is recovered from equipment being disposed and is reused." In the 2020 NIR, see pp. A-285

I.19	2.F.5 Solvents – HFCs and PFCs (I.22, 2018) (I.32, 2016) (I.32, 2015) Transparency	Addressing. Either review and update the assumptions regarding solvent emissions, or provide country- specific information to justify the assumption that only 90 per cent of solvents are emitted. The United States added a reference to a report (EPA, 2004) to justify the sentence in the NIR (annex 3.9, p.A-239) that 10 per cent of solvents are not emitted. The Party stated in the NIR that, since the previous submission, the remainder of the consumed solvent is assumed to be entrained in sludge or waste and disposed of by incineration or other destruction technologies without being released into the atmosphere. However, the ERT checked the information in the EPA report (2004) and found that, in addition to the information provided in the NIR, the annual release rate is assumed to be 90 per cent on the basis of expert opinion (EPA, 2001), which assumes that, during the cleaning process, the solvent is recycled or is continuously reused through a distilling and cleaning process until it is eventually almost entirely emitted. However, no further detail or documentation was provided to clarify the expert judgment assumptions, for example by means of a mass balance assessment or details of common practice in the industry or demonstration of how the 90 per cent assumption was calculated (see the document found by the ERT at https://www.epa.ie/pubs/advice/air/emissions/air%20advise%20no%201.pdf).	We appreciate sharing of the study. We consider this issue addressed as we have reported the basis for the assumption. At this time, U.S. EPA does not have the authority to commence a study at U.S. solvent industry facilities and therefore has relied on the expert opinion from those in the U.S. solvent industry. As conveyed to prior ERTs, this has been an area for review, with effort into further studies, etc. to inform consideration of updates. This effort has, to date, not identified new or additional documentation to supplement the expert judgement. Given the significance of 2.F.5 with respect to other 2.F subcategories and other IPPU emissions, consistent with continuous improvement principles, updates will be made over time as data becomes available and prioritized with other improvements to make best use of available resources.
I.20	2.F.5 Solvents (I.23, 2018) (I.32, 2016) (I.32, 2015) Comparability	Not resolved. Revise the reporting of emissions from solvents in the CRF tables (reported as "NA"). Emissions from solvents are still reported as "NA" in CRF tables 2(I)s2 and 2(II). During the review, the Party explained that, for the 2020 submission, fluorinated gas emissions from solvents will be reported as "IE" in CRF table 2(II)B-Hs2, because solvents only consist of confidential gases and therefore will be reported within the unspecified mix of HFCs and PFCs.	See 2030 CRF Submission, CRF tables 2(I)s2 and 2(II) and see revision of notation key to IE.
I.21	2.F.6 Other applications (product uses as substitutes for ozone-depleting substances) – HFCs and PFCs (I.24, 2018) (I.33,2016) (I.33, 2015) Transparency	Not resolved. 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 ozone-depleting substances. The United States did not provide in the NIR detailed information including the quality checks for the unspecified mix of HFCs and PFCs. During the review, the Party explained that it will add a section on QA/QC and verification procedures discussing QA/QC efforts for all gases and sources under the category product uses as substitutes for ozone- depleting substances and, in particular, for the unspecified mix of HFCs and PFCs in the subcategory other applications.	Addressed in 2020 NIR submission on pp. 4-130. The QA/QC and verification process for individual gases and sources in the Vintaging Model includes regular review against up-to-date market information, including equipment stock estimates, leak rates, and sector transitions. In addition, comparisons against published emission and consumption sources by gas and by source are performed when available, including atmospheric measurements of HFC emissions for the United States and EPA's GHGRP, described further below. Independent peer reviews of the Vintaging Model are periodically performed, including one conducted in 2017 (EPA 2018), to confirm Vintaging

			Model estimates and identify updates. The HFCs and PFCs within the unspecified mix of HFCs and PFCs are modelled and verified individually in the same process as all other gases and sources in the Vintaging Model. The HFCs and PFCs are grouped in the unspecified mix of HFCs and PFCs category only for the purposes of reporting emissions to protect Confidential Business Information (CBI).
I.22	2.G.2 SF_6 and PFCs from other product use – SF_6 (I.37, 2018) Completeness	Addressing. Investigate possible SF6 emissions from airborne warning and control systems, particle accelerators and radars and include them in the next submission, providing a description of the identified sources, the SF6 emissions from them for the entire time series, a methodology description and an uncertainty analysis, in accordance with the 2006 IPCC Guidelines (vol. 2, chap. 8, pp.8.23–8.25 and 8.26–8.30). The United States stated in the NIR (annex 5, p.A-411) that the Government reported 1.8 Mt CO2 eq (or 1,800 kt CO2 eq) of fugitive fluorinated gases and other fugitive emissions, including SF6 and HFC emissions, for 2017 to the Federal Energy Management Program. EPA is still reviewing the reported emissions and methods used by reporters to ensure consistency with the 2006 IPCC Guidelines. The Party also stated that EPA is planning to investigate these emissions further to determine the fraction that actually consists of SF6. The ERT believes that future ERTs should consider this issue further to ensure that emissions from this category are not underestimated.	See Annex 5 of the NIR on pp. A-496. EPA's analysis was updated per ongoing review of reported data and EPA is continuing to review the available reported data and the methods used to estimate emissions.
I.23	2.H Other (IPPU) – N_2O (I.38, 2018) Transparency	Not resolved. Increase the transparency of the reporting of N_2O emissions from semiconductor manufacturing by including in both the NIR and the CRF tables a clear indication of where the emissions are reported and explaining that this is because CRF table 2(I).A-H does not allow for reporting N_2O emissions under category 2.E.1. The ERT noted that there is no footnote added to table 2(I)A-Hs2 or additional text included in the NIR regarding the reporting of N_2O emissions from semiconductor manufacturing.	This has been addressed in the 2020 NIR submission. See note in both the CRF tables and the NIR. See documentation box in Table2(I)s2 and NIR Section 4.23.

I.24	2.B.1 Ammonia production – CO2 Transparency	The ERT identified significant changes in the CO2 IEF for category 2.B.1 (ammonia production) between 2000 (1.20 t/t) and 2001 (1.24 t/t), and between 2015 (1.27 t/t) and 2016 (1.32 t/t). The ERT noted that these outliers represent an increase in the CO2 IEF across the time series. For example, from 1990 to 2000, the CO2 IEF was constant (1.20 t/t), and increased by 3.4 per cent (1.24 t/t) in 2001. Between 2001 and 2015, the values of the CO2 IEF were in a similar range and increased again between 2015 and 2016 by 4.0 per cent (to 1.32 t/t). During the review, the United States explained that this might be because the CO2 IEF values in CRF table 2(I).A-Hs1 are based on the combined total of CO2 emissions and recovery emissions compared with production values and the change in annual recovery levels alters the CO2 IEF value in CRF table 2(I).A-Hs1. The ERT commends the Party for the information but notes that between 2000 and 2001 the AD, CO_2 emissions and recovery values decreased while the CO_2 IEF increased, and between 2015 and 2016, the AD, CO_2 emissions, recovery values and CO_2 IEF values increased. The ERT recommends that the United States further investigate the reasons behind the trends in the CO_2 IEF and underlying AD and emission and removal trends and report on the matter in its next submission.	This issue was addressed in the latest submission. See 2020 NIR Report Section 4.5 pp. 4-29. The Party has identified the differences in IEFs as coming from changes in production of ammonia from the different feedstocks used. The following text was included in the 2020 NIR: "The implied CO_2 emission factor for total ammonia production is therefore a combination of the emissions factor for ammonia production from natural gas and from petroleum coke. Changes in the relative production of ammonia from natural gas and petroleum coke will impact overall emissions and emissions per ton of total ammonia produced. For example, between 2000 and 2001 and 2015 and 2016 there were increases in the amount of ammonia produced from petroleum coke which caused increases in the implied emission factor across those years."
I.25	2.B.2 Nitric Acid production – N2O Transparency	The ERT noted that the AD for nitric acid production decreased by 6 per cent, from 7.7 to 7.2 Mt, between 2014 and 2015 but increased by 8 per cent to 7.8 Mt between 2015 and 2016. The ERT noted that N2O emissions follow the opposite trend and increased in 2015 by 6 per cent, from 36.7 to 38.8 kt. During the review, the United States explained that the changes are driven by the use of abatement technologies and that it will include information on the trends in the 2020 submission. The ERT recommends that the United States include in the NIR an explanation of the trends observed for N2O emissions and AD for nitric acid production.	This will be addressed in the 2021 submission.
I.27	2.B.5 Carbide production – CO2 Comparability	The ERT noted that the United States reported AD, CO_2 and CH4 emissions from category 2.B.5.b (calcium carbide production) as "NE" in CRF table 2(I).A-Hs1. However, as noted in ID# I.8 (in table 3), emissions from calcium carbide are allocated in the energy sector (NEU of petroleum coke) and therefore "IE" should be reported for AD and CO2 emissions in CRF table 2(I).A-Hs1. For CH4 emissions, "NE" should continue to be reported, as there is no method for its calculation under the tier 1 method applied by the Party for this non-key category. The ERT acknowledges the recommendation in ID# I.8 in table 3 for the United States to allocate CO_2 emissions from category 2.B.5.b to the IPPU sector. However, until this is possible, the ERT recommends that the Party report the correct notation key "IE" for AD and CO2 emissions in CRF table 2(I).A-Hs1 and provide the necessary explanation in CRF table 9.	See update in CRF tables 2(I).A-Hs1 and IE explanation in CRF Table 9.
Agriculture			

A.2	3.A Enteric fermentation – CH_4 (A.16, 2018) Convention reporting adherence	Not resolved. Undertake a quantitative uncertainty assessment in conjunction with future planned methodological updates. During the review, the Party indicated that a quantitative uncertainty assessment for CH_4 emissions from enteric fermentation will be undertaken as soon as methodological improvements are completed in the inventory in order to prioritize the use of resources. During the review, the Party acknowledged that this assessment should be updated (consistently with good practice) but, owing to resource constraints, the current focus is to improve AD. The ERT noted that the last quantitative uncertainty analysis for CH_4 emissions for the category was undertaken for the 2003 GHG inventory submission.	The United States reiterates previous response that updates will be considered with methodological refinements planned and underway in future submissions.
A.4	3.A.1 Cattle – CH_4 (A.18, 2018) Accuracy	Not resolved. Improve the accuracy of the milk fat percentage, for example by investigating the possibility of using additional data sources for information on milk fat percentage values, such as creameries and agricultural extension services. The Party continues to use the default value of 4 per cent for milk fat percentage for dairy cattle (NIR p.A-263). During the review, the Party explained that it has identified one potential data source and plans to update the calculation of emission estimates for future submissions. However, it is unlikely that the improvement will be made before the 2021 submission.	As noted in the comment, the US had obtained a source of milk fat percentages and expects to include these new values in the 2022 submission.
A.5	3.A.1 Cattle – CH_4 (A.19, 2018) Accuracy	Not resolved. Investigate the possibility of using additional data sources (e.g. farm extension services) to derive country-specific information on calf births from dairy cows throughout the year and report on the results of this investigation in the NIR. The Party continues to assume an even distribution of dairy calf births throughout the year (NIR p.A-253). During the review, the Party indicated that it is considering potential sources of information on the distribution of dairy calf births throughout the year and plans to use any available data in the calculation of emission estimates for future submissions. However, it is unlikely that the improvement will be made before the 2021 submission.	Work is underway to investigate sources of data. So far, the primary data source identified did not provide monthly data on calf births. This is a longer-term improvement and the earliest this could be incorporated would be the 2023 submission.
A.6	3.A.1 Cattle – CH_4 (A.20, 2018) Accuracy	Not resolved. Regional diet data are reported in the NIR (p.5-5) and in more detail in annex 3.10. The Party lists in its planned improvements section (NIR p.5-8) that it is investigating the availability of annual data for the digestible energy, Ym and crude protein values of specific diet and feed components for grazing and feedlot animals and dairy cattle but there is no clarity in the NIR on the progress made to date. The Party explained during the review that it is working to update regional diet data for future inventories. In response to the draft report, the Party explained that it continuously assesses available diet data and is working to incorporate these data into the inventory. The Party also indicated that it will be unable to obtain state- and/or farm-specific data because many of the diets are likely to be proprietary; in addition, farm surveys are not conducted on an annual basis, but periodically. The ERT commends the Party for this additional information but considers that the issue remains unresolved as the diet characteristics have not been updated as recommended. Update regional diet characterization data used in the estimation of CH_4 emissions from cattle in order to more accurately reflect the differences in diets across farms and states.	Work is underway to address this in future submissions, earliest will be 2022 submission.

A.7	3.A.2 Sheep- CH_4 (A.21, 2018) Accuracy	Not resolved Update the sheep population distribution as data availability allows, focusing resources as appropriate, in line with the 2006 IPCC Guidelines. The ERT noted that the AD for sheep were not recalculated. During the review, the United States clarified that it is assessing the availability of data and anticipates reporting estimates on the basis of available updated sheep population distribution data in the 2021 submission.	The United States expects to update sheep populations, as well as sheep EF from the 2019 IPCC refinements, in the 2022 submission.
A.11	3.B Manure management – CH_4 (A.25, 2018) Convention reporting adherence	Not resolved. Update the quantitative uncertainty assessment. During the review, the Party indicated that a quantitative uncertainty assessment for CH_4 emissions from manure management will be undertaken as soon as methodological improvements are completed in the inventory in order to prioritize the use of resources. During the review, the Party acknowledged that this assessment should be updated (consistently with good practice) but, owing to resource constraints, the current focus is to improve AD. The ERT noted that the last quantitative uncertainty analysis for CH_4 emissions for the category was undertaken in the 2003 GHG inventory submission.	The United States reiterates previous response that updates will be considered with methodological refinements planned and underway in future submissions.
A.12	3.B Manure management – CH_4 and N_2O (A.5, 2018) (A.14, 2016) (A.14, 2015) Accuracy	Addressing. The ERT noted that in the 2016 NIR (p.5-11) and its annex 3.11 (pp.A.286–A.288), the amount of 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 Party 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. Obtain updated MMS data and estimate emissions using the updated MMS usage data; if this is not possible, report on progress in the effort to update the MMS data. The Party reported in the [2019] NIR (annex 3.11) updated MMS data for cattle (p. A-291) and swine (p.A-293) but other livestock types, such as sheep, have not been updated since 2001. During the review, the Party informed the ERT that it aims to include further updated information in future submissions as it becomes available. In addition, the Party reported in its planned improvements (NIR p.5- 16) its aim of continuing to obtain and incorporate existing data sources (such as the 2016 Department of Agriculture agricultural resource management survey dairy data) to update MMS distributions.	The ERT notes that U.S. utilized updated WMS data for swine and dairy cattle in previous submissions. The U.S. also plans to update WMS data for poultry and beef cattle in the 2022 submission. The 2020 submission provides information on the progress of data implementation, including the 2012 and 2017 Ag Census. Other progress will be reported in the 2021 submission.
A.14	3.B Manure management – N_2O (A.26, 2018) Accuracy	Addressing. Investigate other potential data sources of animal MMS data, such as extension services (i.e. agricultural advisory services). During the review, the Party informed the ERT that it held an internal workshop where aspects of the United States manure management method and AD sources were discussed. No new data sources were identified at this workshop. The Party also informed the ERT that the Department of Agriculture is working to collect additional MMS data through its surveys (see ID# A.12 above).	Please see response to A.12, work is currently underway to obtain and incorporate updated data.
A.16	3.B.1 Cattle – CH_4 (A.7, 2018) (A.15, 2016)	Addressing. If not using a more disaggregated livestock categorization in estimating emissions, use option A in reporting data and emissions for cattle in the CRF tables; if applying option C, report the values for population size, allocation by climate region to cool and temperate regions, typical animal mass, volatile solid daily excretion and	The United States reiterates previous response that updates will be considered with methodological refinements planned and underway in future submissions. We are still investigating the

	(A.15, 2015) Transparency	CH_4 producing potential for all other cattle subcategories of option C in CRF tables 3.B(a)s1 and 3.B(a)s2. The United States applied option C in CRF table 3.B(a)s1. Between the 2017 and 2018 submissions, the Party increased the disaggregation of the cattle characterization in CRF table 3.B(a)s1 for livestock population, typical animal mass, volatile solid daily excretion and CH_4 producing potential, but has not yet reported disaggregated information on allocations to climate regions in CRF table 3.B(a)s2. Information in CRF table 3.B(a)s2 is still reported according to dairy and non-dairy cattle only. During the review, the Party informed the ERT that it is assessing the possibility of reporting climate parameters for certain individual non-dairy subcategories currently reported as "IE" and plans to update the CRF table in a future submission.	possibility of reporting disaggregated climate parameters in the CRF.
A.17	3.B.1 Cattle – CH_4 (A.27, 2018) Comparability	Not resolved. Report MMS that are not used as "NO" instead of "NE" in CRF table 3.B(a)s2 or, if they occur but are not estimated, replace "NE" with the appropriate estimate. The Party indicated that it is considering the most appropriate notation key for the MMS data reported in CRF table 3.B(a)s2 and will update the table accordingly in the 2020 submission.	See CRF table 3.B.(a)s2 in 2020 CRF submission. The notation keys applied reflect the U.S. national circumstances. For those WMS types listed as "NE" for sheep and swine, there is a possibility that those WMS types exist for those two livestock categories but there is currently no data to confirm "NE" or "NO" or to provide an estimate.
A.19	3.D Direct and indirect N_2O emissions from agricultural soils – N_2O (A.30, 2018) Completeness	Not resolved. Include all N_2O emissions from the States of Alaska and Hawaii in the emissions reported under this category or clearly outline in the improvement plan steps for including those emissions in the inventory. The Party did not report N_2O emissions from N inputs from manure, sewage sludge and biosolids, crop residue, N mineralization or the cultivation of organic soils for Alaska or Hawaii. During the review, the Party informed the ERT that it will include these estimates in the future as resources allow, but not before the 2020 submission. This issue is identified in the Party's planned improvements in its NIR (p.5-42). During the previous review, the Party had explained that the impact of N inputs on N_2O emissions had not been estimated for either Alaska or Hawaii, and that those emissions were likely to be less than 0.05 per cent of the total GHG emissions for the country, but may exceed the 500 kt CO_2 eq threshold defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (see ID# A.11 in this table).	Work is underway to assemble this data for inclusion in the Agricultural Soils N2O estimates. This will be provided either in the 2021 or 2022 submission.
A.20	3.D Direct and indirect N_2O emissions from agricultural soils – N_2O (A.32, 2018) Transparency	Not resolved. Provide additional information in the NIR on the quantities and N content of commercial organic amendments (e.g. biosolids, dried blood and compost) applied to agricultural soils. There is no additional disaggregated information on the commercial organic amendments included in the NIR (section 5.4). The ERT notes that a footnote to NIR table 5-17 explained that organic amendment inputs include managed manure, daily spread manure and commercial organic fertilizers (i.e. dried blood, dried manure, tankage, compost and other). The Party explained during the review that it will include further information on commercial organic amendments in future inventories provided that the unique N content of each of the commercial organic amendments can be determined.	As noted in the previous review we will include this information in a future inventory if unique N contents of each of the non-commercial organic amendments can be found.

A.24	3.D.b Indirect N_2O emissions from managed soils – N_2O (A.12, 2018) (A.18, 2016) (A.18, 2015) Transparency	Addressing. Provide an explanation of how the methodology and the DAYCENT model used to estimate N volatilized and N loss are both compatible with the 2006 IPCC Guidelines and based on science. The United States included in the 2018 NIR a detailed explanation of how the DAYCENT model is used. During the review, the Party explained that methods are described in the publications that are referenced in the NIR and that the DAYCENT model volatilization (~1 per cent) and leaching (~1 per cent) factors are within the confidence intervals of the respective IPCC default tier 1 factors. However, the ERT was unable to identify any additional explanation in the NIR on how the methodology and the DAYCENT model used to estimate N volatilized and N loss are both compatible with the 2006 IPCC Guidelines and based on science. The Party could include the above information provided during the review along with clear references to the documents (e.g. relevant chapters) to explain the methodology of the DAYCENT model for estimating N volatilized and N loss.	Additional information will be added to the NIR in either the 2021 or 2022 submission.
A.25	3. General (agriculture) – CH4 and N2O Completeness	The ERT noted that the United States reported in the annex 5 to the NIR (p. 5-40) on the uncertainty associated with an incomplete estimation of N2O emissions for Alaska and Hawaii. During the review, the Party clarified that N2O emissions from inorganic mineral fertilizer, N additions for pasture, range and paddock in Alaska and Hawaii, and drained organic soils in Hawaii are reported in the inventory and that other sources are small and the emissions are likely to be insignificant. However, the ERT could not clearly deduce from the information in the NIR which other N sources are not estimated in the inventory for Alaska and Hawaii or whether they are insignificant. The ERT further noted that CH4 and N2O emissions for category 3.F (field burning of agricultural residues) for Alaska and Hawaii are also not estimated in the inventory (NIR p.5-50). The ERT recommends that the United States include in the NIR (e.g. in annex 5) an indication of the sources and categories not estimated for Hawaii and Alaska. If the emissions are insignificant, the ERT recommends that the Party justify their exclusion on the basis of the likely level of emissions in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Work is underway to assemble this data for Alaska and Hawaii for inclusion in the NIR. This will be provided either in the 2021 or 2022 submission.
A.26	3. General (agriculture) – CH4 and N2O Consistency	In response to a previous review recommendation (see ID# A.1 in table 3) the United States reported in CRF tables AD for category 3.C.1 (rice cultivation, irrigated) and for all subcategories under categories 3.D.a and 3.D.b (direct and indirect N2O emissions from managed soils) and 3.F (field burning of agricultural residues) for all years of the time series (2013–2017) for which emissions were estimated using surrogate data, trend analysis and statistical approaches. The Party included in the NIR (pp.5-21 and 5-34) information on the approaches used for reporting AD for those categories for 2013–2017: it used a surrogate data method for categories 3.C, 3.D.a and 3.D.b, and linear regression for category 3.F. However, the ERT noted that the AD reported in CRF tables 3.C, 3.D and 3.F for 2013– 2017 are simply the figures for the most recent years for which NRI data are available (2012 for the current submission) held constant for the remainder of the time series (2013–2017). During the review, the Party informed the ERT that it may be possible to use alternative data sources such as the United States agricultural resource management survey, Landsat-based products or	We will continue to seek out alternative data sources to drive the inventory estimates for the portion of the time series not covered by the NRI. This is a medium to long-term update.

		other data sets to inform the derivation of AD where NRI data are not available. The ERT recommends that the United States explore the use of alternative data sources to derive AD for the years of the time series where no DAYCENT data are available (2013–2017). If alternative data sets are not available, the ERT recommends that the Party use proxy data or extrapolation methods to derive AD.	
A.27	3.A Enteric fermentation - CH4. Convention reporting adherence	The ERT noted that the average GE for heifer feedlot cattle in CRF table 3.As1 is incorrectly reported for 2000 (161.01 MJ/head/day). For the other years of the time series, the reported GE value is 0.17 MJ/head/day. The ERT noted that the CH4 emissions and IEF are not affected by the reporting of 161.01 MJ/head/day in CRF table 3.As1. The ERT recommends that the United States correct the value of the GE reported in CRF table 3.As1 for 2000 for heifer feedlot cattle.	This transcription error was resolved with the 2020 submission. See CRF table 3.As1
A.28	3.A Enteric fermentation -CH4 Convention reporting adherence	In the NIR (annex 3.10, table A-160, p.A-253), the United States reported the monthly average population from the calf transition matrix. The ERT noted that the populations in the table for each cohort remain constant, for example the population for calves aged 0 years old in January was the same as for calves aged 1 year old in February (2,431 units). However, populations should be declining each month, on the basis of losses due to mortality and slaughter, rather than remaining constant. During the review, the Party clarified that the values in table A-160 were reported incorrectly and provided a new table with the correct values to the ERT, where, for example, there are 2,562 calves aged 0 years old in January and 2,560 calves aged 1 year old in February. The ERT recommends that the United States correct the values reported in table A-160 of the NIR to reflect the correct values of the monthly average calf population by including losses due to mortality and slaughter.	This was resolved with the 2020 NIR submission, please see NIR Annex Table A-160
A.29	3.B.1 Cattle – N2O Transparency	The ERT noted discrepancies in the values of the Nex rate in CRF table 3.B(b) for beef calves, dairy calves and beef replacements. When multiplying the population by the Nex rates reported in the CRF table, the result does not match the value of the total Nex reported in CRF table 3.B(b). For example, if the beef calf population (15,970,718) is multiplied by the Nex rate (20.07 kg N/head/year), the result is 320,510,941 kg N. However, the value reported in CRF table 3.B(b) (cell N31) is 309,748,493 kg N. During the review, the Party explained that it calculates Nex for each state using a state-specific Nex rate factor and then adds together the totals for all states to calculate and report the total national Nex value shown in CRF table 3.B(b). Therefore, the values will not be the same as if the average rate reported for each animal class were used to calculate the total Nex. The ERT recommends that the United States report the correct Nex values for beef calves, dairy calves and beef replacements in CRF table 3.B(b) so that they reflect the true average Nex rate.	We are currently investigating the possibility of providing the Nex values for these disaggregated cattle types in either the 2021 or 2022 submission.
A.30	3.B.1 Cattle – N2O Transparency	The ERT noted that the United States used “IE” to report the Nex rate for heifer stockers and beef replacements in CRF table 3.B(b) without providing an explanation as to where the Nex rates were included. During the review, the Party clarified that the Nex rate for non-dairy cattle was used for heifer stockers and beef replacements. However, the ERT noted that although the Nex rate was reported in CRF table 3.B(b)	We are currently investigating the possibility of updating the Nex values for these disaggregated cattle types in either the2021 or 2022 submission.

		for non-dairy cattle (52.81 kg N/head in 2017), the population and total Nex were reported as "IE". This is also the case for dairy cattle, where the Nex rate is 100.09 kg N/head in 2017 and the population and total Nex is reported as "IE". The Party explained that the total Nex for dairy and non-dairy cattle is reported against individual cattle subcategories. The ERT recommends that the United States replace "IE" for the Nex rate for heifer stockers and beef replacements with the actual Nex rates applied for those individual animals in CRF table 3.B(b). The ERT further recommends that the Party replace the Nex rates for dairy cattle and non-dairy cattle with "IE" and explain in the documentation box of CRF table 3.B(b) that the Nex rates are reported against individual livestock classes.	
A.31	3.B.1 Sheep–CH4 and N2O Transparency	The United States provided information on MMS distribution among waste management systems by operation in annex 3.11 to the NIR (tables A-188–A-189, pp. A-291 and A-293). However, the ERT noted that table A-189 does not include information on manure management allocations for sheep. During the review, the Party informed the ERT that this was due to the small level of emissions from manure management for sheep. The ERT considers that this information would enhance the transparency of the NIR and recommends that the United States include information on MMS distribution for sheep in NIR table A-189.	We are currently working on including these values for the 2022 submission.
A.32	3.D Direct and indirect N2O emissions from agricultural soils – N2O Convention reporting adherence	The United States reported in box 5-3 of its NIR that the DAYCENT model (tier 3 method) is used to estimate N2O emissions from tobacco crops while in a following sentence it is reported that the DAYCENT model is not applied to estimate N2O emissions and a tier 1 method is used for other crops including tobacco (p.5-34). During the review, the Party clarified that tobacco crops are included in the DAYCENT model (tier 3 method) and stated that it would correct the information in the next submission. The ERT recommends that the United States correct the text in its NIR to reflect the actual method applied, namely that N2O emissions from tobacco crops are estimated using the DAYCENT model (tier 3 method).	Clarification will be addressed in the 2021 submission.
A.33	3.D.a Direct N2O emissions from managed soils – N2O. Convention reporting adherence	The ERT noted that recalculations were performed for N2O emissions for categories 3.D.a.1 (inorganic fertilizers), 3.D.a.4 (crop residues), 3.D.a.5 (mineralization/immobilization associated with loss/gain of soil organic matter) and 3.D.a.6 (cultivation of organic soils). However, these recalculations were not described in the recalculations section of the NIR (p.5-41) in accordance with paragraphs 43–45 of the UNFCCC Annex I inventory reporting guidelines. During the review, the United States explained that it will investigate the reasons why the data for these categories were not updated. The ERT checked the CRF tables and found that the values reported for those categories in the 2019 submission are different from those reported in the 2018 submission. In CRF table 8s2, the recalculation for category 3.D reduced emissions by 5.63 per cent. The ERT was not able to check the changes that occurred in the AD, methods or EFs used and if these changes were made in response to the review process. The ERT recommends that the United States include in the NIR an explanation of the AD, methods and EFs used to estimate emissions under categories	Future recalculations will be further explained in the recalculation section.

		3.D.a.1, 3.D.a.5 and 3.D.a.6 and explain why the new N2O emission values are more accurate than the previous ones. The ERT also recommends that the United States report on the recalculations in accordance with paragraphs 43–45 of the UNFCCC Annex I inventory reporting guidelines, if the Party performs recalculations for those categories in the next submission.	
A.34	3.D.a.3 Urine and dung deposited by grazing animals – N2O Transparency	In response to a question raised by the ERT relating to ID# A.23 in table 3, the United States explained the approach to allocating N deposited in urine and dung to each county. The Party clarified during the review that N deposited on pasture, range and paddock MMS is provided at the county level but, owing to QC issues, the data are aggregated to the state level. The data are then applied to NRI survey locations at the same rate for a state (dividing the total N deposited in pasture, range and paddock by the total area of grassland in the state). The total input of N deposited for individual survey locations in the NRI was determined by multiplying the rate by the weight. The ERT considers that this information should be included in the NIR to increase transparency and that the Party should explain that emission estimates are performed using the DAYCENT model by using data of N deposited by soil types. The ERT recommends that the United States include in the NIR the information provided to the ERT explaining the approach used to allocate N deposited in urine and dung to each county and how the DAYCENT model uses these data in the estimation of N2O emissions.	The United States plans to include additional explanation on the approach used to allocate N deposited in the 2021 submission.
LULUCF			
L.1	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.2, 2018) (L.2, 2016) (L.2, 2015) (81, 2013) Completeness	Addressing. 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 matrix, and report on the achievements made. The United States reported carbon losses in the living biomass and DOM pools for categories 4.B.2.1 (forest land converted to cropland), 4.C.2.1 (forest land converted to grassland), 4.D.2.3.1 (forest land converted to other wetlands) and 4.E.2.1 (forest land converted to settlements). Categories 4.D.2.2.1 (forest land converted to flooded land) and 4.F.2.1 (forest land converted to other land) are still reported as "NE".	The Unites States does not currently include estimates for the categories of forest land converted to other land. These categories will be included in a future inventory submission and will contain the estimates of carbon stock loss as a result of converting forest to these lands The United States does not currently include estimates for the categories of flooded land/land converted to flooded land or other land/land converted to other land. With respect to flooded lands, the US is planning to include these when it applies the updated guidance on flooded lands from the 2019 Refinement to the 2006 IPCC Guidelines. Plans are to include this for the 2022 submission.

L.2	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.3, 2018) (L.3, 2016) (L.3, 2015) (82, 2013) (97, 2012) Completeness	Addressing. Include all managed United States lands in the inventory; improve the consistency of the time series of national areas; and report on the achievements made. The land-use matrix of CRF table 4.1 and the land representation tables in the NIR (tables 6-6–6-7, pp.6-9–6-10) include all areas of managed and unmanaged land in the United States, except for United States territories (see ID# L.41 in table 5). In addition, the "Total area" columns of CRF background tables 4.A, 4.B, 4.C, 4.D, 4.E and 4.F do not include managed land areas where emissions or removals do not occur. Instead, this information is provided in a documentation box for each CRF background table. During the review, the Party explained that the result of initial testing including all managed land in the CRF tables caused issues with the calculated IEFs. Therefore, the Party plans to improve transparency in the 2020 submission to indicate more clearly the areas of managed land that are not estimated in order to clarify why there is a difference between the areas reported in CRF table 4.1 and the CRF background land-use tables.	See the following tables included in 2020 NIR: Table 6-33: Area of Managed Land in Cropland Remaining Cropland that is not included in the current Inventory (Thousand Hectares) Table 6-37: Area of Managed Land in Land Converted to Cropland that is not included in the current Inventory (Thousand Hectares) Table 6-41: Area of Managed Land in Grassland Remaining Grassland in Alaska that is not included in the current Inventory (Thousand Hectares) Table 6-49: Area of Managed Land in Land Converted to Grassland in Alaska that is not included in the current Inventory (Thousand Hectares) Annex Table A-231: Forest Land Area Estimates and Differences Between Estimates in 6.1 Representation of the U.S. Land Base (CRF Category 4.1) and 6.2 Forest Land Remaining Forest Land (CRF Category 4A1) (kha) Annex Table A-233: Forest Land Area Estimates and Differences Between Estimates in 6.1 Representation of the U.S. Land Base and 6.3 Land Converted to Forest Land (kha) Area (Thousand)
L.3	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.36, 2018) Convention reporting adherence	Not resolved. Until the Party is able to report anthropogenic emissions and removals from the entire national managed land area, report non- estimated managed land as a subdivision in the relevant CRF tables (i.e. tables 4.A, 4.B, 4.C, 4.D and 4.E), so that the managed land area for each land category reported in CRF table 4.1 corresponds with that reported for the same category in CRF tables 4.A, 4.B, 4.C, 4.D and 4.E. The Party did not report non- estimated managed land as a subdivision in CRF tables 4.A, 4.B, 4.C, 4.D and 4.E. See ID# L.2 above for the Party's action regarding this issue. During the review, the Party explained that the addition of the subdivision will have an impact on the IEF and introduce inconsistencies within the CRF tables. However, the ERT considers that adding a subdivision for reporting non- estimated managed land and applying the correct use of notation keys will not introduce inconsistencies within the CRF tables and will be important in improving the understanding of the Party's GHG inventory. The ERT also notes that, if emissions are	The United States will consider this suggestion for the 2021 NIR and CRF submission (i.e. use of notation key, NE).

		insignificant, the Party can report "NE" and justify their exclusion in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	
L.4	Land representation – CO_2, CH_4 and N_2O (L.7, 2018) (L.21, 2016) Consistency	Not resolved. Resolve the inconsistencies in land-use areas in the time series reported in the CRF tables. The discrepancy between land-use areas in the time series reported in CRF table 4.1, where the final area at the end of a given year is not the same as the initial area of the subsequent year, remains unresolved. For example, the final area reported in CRF table 4.1 for 2016 is 278,948.81 kha, while the total initial area reported in CRF table 4.1 for 2017 is 281,666.66 kha. During the review, the Party explained that the land-use areas in CRF table 4.1 were entered according to the definitions of remaining land (land that remains in the same land use over 20 years) and converted land (the cumulative area of conversion over the past 20 years) and also explained that the heading of CRF table 4.1 can be understood to allow it to be compiled according to the IPCC definition (namely, using the 20-year conversion). The ERT notes that the UNFCCC Annex I inventory reporting guidelines do not clearly mention whether annual area changes or 20 years of cumulative area change should be used in CRF table 4.1, as indicated by the Party; however,the consistency of areas in CRF table 4.1 between the final area in a land matrix of a given year and the initial area in a land matrix of the subsequent year is only achieved when the matrices are prepared using annual area changes rather than 20 years of cumulative area change. The Party further clarified during the review that preparing the annual change area requires land representation to be reanalysed and so the Party will note in the documentation boxes what it is reporting in the interim.	See explanation included in NIR on p. 6-10 and documentation box in CRF Table 4.A.
L.6	Land representation – CO_2, CH_4 and N_2O (L.9, 2018) (L.23,2016) (L.22, 2015) Transparency	Addressing. 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. Three sets of land-use data are used: NRI, FIA and NLCD (see also ID# L.8 below). The Party updated land representation by including new FIA data in the 2019 submission and explained in the NIR (pp.6-17– 6-22) how the different land data sources are used and harmonized to classify their national land data into IPCC land-use categories. The Party further explained during the review that a figure showing the process of harmonizing the different data sources will be included in the submission for 2021 or 2022.	See section "Approach for Combining Data Sources" starting on p. 6-20 of 2020 NIR submission. In addition, the United States will be modifying its approach for developing the land representation over the next several years and will update the NIR text throughout this process.
L.8	Land representation – CO_2, CH_4 and N_2O (L.37, 2018) Accuracy	Addressing. Update the land representation with the latest available data from NRI, and proceed with plans to improve the coordination and timing of sharing data between federal agencies if necessary. The land-use data from NRI and NLCD were not updated in the 2019 submission and the land-use areas of cropland, grassland and settlements for 2013 onward were based on the land representation data from the previous submission. The ERT notes that the reporting of almost identical net emissions and removals from these land uses for 2013–2017 was affected by this land representation method. During the review, the Party explained that it will include new	In 2020 NIR submission, see "Recalculations Discussion" in section 6.1 Representation of the U.S. Land Base (see p. 6-23). The land-use data from NRI and NLCD were updated for the 2020 NIR submitted in April. The United States will continue to update these datasets as new versions are released.

		NRI data up to and including 2015, and updated land representation is planned for the 2020 submission. The Party further explained that data from NRI/NLCD currently used in its land representation are updated every two to four years, and that as part of the current compilation process and arrangements, it incorporates new NRI/NLCD data as soon they become available. There is currently no annual alternative to NRI for obtaining land-use/conversion and management data on croplands, grasslands or settlements, so the Party must continue to rely on these data until new annual data become available.	
L.10	4.A Forest land – CO_2 (L.39, 2018) Convention reporting adherence	Addressing. Report up-to-date information on the verification of the outputs of the model used to estimate SOC changes in mineral soils, for example, at the level of annual fluxes in single specific sites representative of the variability of the population or, as done for the DAYCENT model for agricultural soils (NIR figure A-12), at the level of the total cumulated (across the time series and the entire territory modelled) net flux. The ERT notes that the explanation of forest soil in the annexes to the NIR (A-361– A-366) has been updated but that the verification information on forest soil estimation by model is not provided in the NIR, despite a background research paper on the soil estimation approach being cited in the annexes to the NIR (p.A-361). During the review, the Party explained that it is currently analysing remeasurements of soil attributes from national forest inventory plots, which will be used to test and verify model results for SOC changes in mineral soils.	Additional detail will be included in the forest annex e.g., tables by broad forest types and average C stock per unit area, and stock changes. The discussion on uncertainty will also be expanded to discuss issue of consistency in soil depth across land use categories. We will also provide data on plot level soil carbon. We anticipate reporting this information in the April 2021 or 2022 submission.
L.11	4.A Forest land – CO_2 (L.40, 2018) Accuracy	Addressing. Apply as the carbon conversion factor for forest biomass either a country-specific value or the default value provided in the 2006 IPCC Guidelines (vol. 4, chap. 4, table 4.3), and, for mangrove forests, either a country-specific value or the default value provided in the Wetlands Supplement. In the estimation of living biomass for forest land, the Party applies the same carbon conversion factor (0.50 t C/t dead matter) as that used in the previous submission for all forest types. During the review, the Party explained that the carbon conversion factor of 0.50 was used as a country-specific value for living biomass, although this was not clearly explained in the NIR. As the use of 0.50 for the estimation of living biomass in forest land is not consistent with the 2006 IPCC Guidelines or the Wetlands Supplement (for mangrove forests), a further explanation is needed for the ERT to evaluate the use of 0.50 t C/t dead matter as a country-specific value. During the review, the Party explained that it will improve the relevant documentation in the NIR for the 2020 submission.	This has been addressed in the 2020 submission, see Annex 3, p. A-422.
L.13	4.A Forest land – CO_2 and N_2O (L.42, 2018) Transparency	Addressing. Calculate the carbon stock change in each carbon pool at the level of each single plot and then aggregate the results at the state and national level, and explain any recalculations in the NIR. The methodology applied in the stock-difference method for forest land has not changed since the previous submission. However, during the review, the Party provided additional information on the methodology in	The United States plans to include the supplemental information provided to the previous ERT in the Annex to the 2021 NIR.

		response to the concern about double counting of carbon raised during the previous review. The Party explained that plot-level national forest inventory information is used for land-use classification relating to forest land, and confirmed that the stock-difference method is applied at each land-use category level (e.g. forest land remaining forest land) instead of for the entire forest land area. The Party also explained that applying the stock changes at the plot versus population level will not change the result, given how the estimators and expansion factors are used in the national forest inventory and incorporated into the current compilation approach. Additionally, the Party explained that it is moving towards a more spatially and temporally resolved system for compiling emission and removal estimates for the forest land category and has already started testing the new system. The system will include tracking individual trees through remeasurements at plot level along with all other carbon pools. The transition will be noted in the planned improvements section in future submissions. The ERT noted that current methodology for calculating carbon stock change in forest land is considered appropriately applied taking into account the information provided by the Party. However, the ERT also noted that this understanding was not clear from the information provided in the NIR and considers that the Party should include information in the NIR to demonstrate that the stock-difference method for forest land is applied at each land-use category level.	
L.14	4.A.1 Forest land remaining forest land – CO_2 (L.13, 2018) (L.26, 2016) Transparency	Not resolved. Provide in an 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) and used for estimating downed deadwood and understory, which might better reflect the diversity of forest types and age classes). The United States did not provide tables with carbon stock changes disaggregated by region, state or forest type. During the review, the Party explained that this information will be included in future submissions.	We anticipate reporting this information in the April 2021 or 2022 submission.
L.16	4.B Cropland – CO_2 (L.18, 2018) (L.14, 2016) (L.14, 2015) (93, 2013) (107, 2012) Completeness	Not resolved. Estimate the carbon stock changes in living biomass in perennial crops for all years in the time series. The United States did not report the biomass carbon stock changes in perennial cropland for either cropland remaining cropland or land converted to cropland. The Party explained that data are currently not available for estimation.	Work is planned to report this information April 2021 submission, but due to some administrative delays it may only be included in the April 2022 submission.
L.17	4.B Cropland – CO2 (L.45, 2018) Accuracy	Check the quality of the data from which the land representation is derived, investigate the reasons for the sudden and temporary decrease in the area of organic soils by about 80 kha between 1999 and 2000 for cropland remaining cropland reported in CRF table 4.B, explain the result of this investigation in the NIR, correct any identified inconsistencies and explain any recalculations in the NIR. During the review, the Party explained that an investigation is under way and further information will be provided in the 2020 submission.	The area of organic soils for croplands remaining croplands was recalculated for the 2020 submission and this error has been corrected. See Recalculations Discussion on page 6-23 of the LULUCF chapter.

L.18	4.B.2.2 Grassland converted to cropland – CO_2 (L.46, 2018) Completeness	Not resolved. Estimate biomass carbon stock changes using the IPCC default method and factors or, where available, country-specific methods and factors, and report the estimations in the NIR. The Party did not provide estimates and "NE" was reported for carbon stock changes in biomass in grassland converted to cropland in CRF table 4.B. During the review, the Party explained that it is working to address completeness over time as improved data become available and to prioritize the work in line with other improvements to make best use of available resources.	Work is planned to report this information April 2021 submission, but due to some administrative delays it may only be included in the April 2022 submission.
L.19	4.B Cropland 4.C Grassland – CO_2 and N_2O (L.47, 2018) Convention reporting adherence	Not resolved. The Party reported in the NIR the same verification information comparing SOC changes with lower tiers (figure A-13) as in the previous submission. Therefore, the concern of the previous ERT remains regarding coverage of land categories (i.e. that verification of the DAYCENT model was implemented for carbon stock change in cropland remaining cropland, but not implemented for other land-use categories and gases). Regarding the issue of time series covered by the verification flagged in the previous review, the ERT believes that the Party would not be required to provide that information under verification, considering the exchange of views with the Party during the review and noting that covering the entire time series is not specifically mentioned in the 2006 IPCC Guidelines as a verification step. The ERT notes that, in terms of accuracy of the time series estimated by the model, the Party provided in the NIR (annex 3, p.A-342–A-345) detailed information on the calibration step as part of QA/QC of the model development. The ERT understands that recalibration of the model or modifications to the structure (i.e. algorithms) may be necessary if the model does not capture general trends or there are large systematic biases.	As noted to prior ERT, the United States plans to improve the documentation and calibration are ongoing as well as implementation of additional verification, in step with ongoing methodological refinements for estimating soil carbon, soil nitrous oxide and soil methane. This will be address in 2021 and 2022 submissions.
L.20	4.B Cropland 4.C Grassland – CO_2 and N_2O (L.48, 2018) Comparability	Not resolved. Report SOC changes and associated CO_2 and N_2O emissions from cropland and grassland mineral soils using a depth increment of at least 30 cm in line with the 2006 IPCC Guidelines (vol. 4, chap. 2). The Party did not estimate SOC changes using a depth increment of at least 30 cm. Instead, the estimate was made using a depth of 20 cm. During the review, the Party explained that it will implement this recommendation in the 2020 submission.	CO2 and N2O emissions from cropland and grassland mineral soils are estimated to 30 cm. See Recalculations section of Cropland Remaining Cropland of 2020 NIR
L.21	4.C Grassland – CO_2 (L.49, 2018) Transparency	Not resolved. Report woody grassland as a subdivision of the grassland category, estimate accordingly the area and carbon stock change for all carbon pools of woody grassland within the category grassland remaining grassland and within all land-use categories of conversion from and to grassland, and report the estimations in the NIR. The Party did not estimate carbon stock changes in woody grassland. The Party provided information on its progress in the NIR (box 6-6, p.6-71) and explained during the review that further work will be done to estimate the carbon stock changes in	Work is planned to report this information April 2021 submission, but due to some administrative delays it may only be included in the April 2022 submission.

		biomass and DOM in woody grassland. The Party clarified that it plans to provide the information in its 2021 submission.	
L.23	4.C.2 Land converted to grassland – CO_2 (L.23, 2018) (L.33, 2016) (L.26, 2015) Accuracy	Not resolved. Revise the estimates of carbon stock change in mineral soils under forest land converted to grassland using the updated data for mineral soils and report the results in the NIR. No updates were made in the estimation of mineral soils since the previous submission. During the review, the Party explained that the improvement of SOC estimation associated with land-use conversions is a planned improvement.	Work is planned to report this information April 2021 submission, but due to some administrative delays it may only be included in the April 2022 or 2023 submission.
L.24	4.C.2.2 Cropland converted to grassland – CO_2 (L.51, 2018) Completeness	Not resolved. Estimate biomass carbon stock change using the IPCC default method and factors or, where available, country-specific methods or factors, and explain the estimations in the NIR. The Party did not provide estimates and "NE" was reported for carbon stock changes in biomass in cropland converted to grassland. During the review, the Party explained that it will work to address completeness over time as improved data become available and to prioritize this work in line with other improvements to make best use of available resources.	Work is planned to report this information April 2021 submission, but due to some administrative delays it may only be included in the April 2022 submission.
L.25	4.D.1 Wetlands remaining wetlands – CO_2, CH_4 and N_2O (L.25, 2018) (L.34, 2016) (L.27, 2015) Transparency	Addressing. Noting the need to determine the quantity of peat harvested per ha and the total area undergoing peat extraction, provide the respective AD and IEFs for the on-site CH_4 and N_2O emission estimates in CRF table 4(II) for organic soils under peat extraction. The quantity of peat harvested per ha used for determining the peat extraction area (100 t/ha) is noted in the NIR (p.6-83) and has not changed since the previous submission. The Party added to the NIR (p.6-84) an explanation that the AD for on-site CH_4 emissions are the total peat extraction area and the AD for on-site N_2O emissions are the nutrient-rich peat production area. However, these AD were not included in CRF table 4(II). During the review, the Party explained that the omission will be addressed in the 2020 submission.	We started working on this issue during the 2020 submission cycle but are continuing progress. Documentation on our approach was provided in the documentation box in CRF Table 4(II) of the 2020 submission.
L.26	4.D.2.2 Land converted to flooded land – CO_2 (L.53, 2018) Completeness	Not resolved. Estimate carbon stock change in flooded land using the 2006 IPCC Guidelines (vol. 4, chap. 7) default method and factors or, where available, country-specific methods or factors, and explain the estimations in the NIR. Carbon stock changes in all carbon pools for land converted to flooded land are reported as "NE". During the review, the Party explained that improvements are planned for future inventory submissions. See ID# L.1 above for the case of forest land converted to flooded land.	The United States reiterates that improvements are underway to report these emissions in the April 2022 submission.
L.27	4.D.2.3 Land converted to wetlands – CO_2 (L.54, 2018) Completeness	Not resolved. Estimate biomass and DOM carbon stock changes for forest land converted to other wetlands as planned for the 2020 submission, and explain the estimations in the NIR. Carbon stock changes in DOM for land (forest land) converted to other wetlands (vegetated coastal wetlands) were not estimated. During the review, the Party explained that improvements are planned for future inventory submissions.	Work is planned to report on this information in a future submission.

L.28	4.D.2.3 Land converted to wetlands – CO_2 (L.54, 2018) Completeness	Not resolved. Estimate carbon stock changes in biomass for the conversion of cropland and grassland to other wetlands using IPCC default methods and factors (2006 IPCC Guidelines, vol. 4, chap. 7) or, where available, country-specific methods or factors, and explain the estimations in the NIR. Carbon stock changes in biomass for land (cropland and grassland) converted to other wetlands (vegetated coastal wetlands) are estimated for one year of removals after conversion. During the review, the Party explained that improvement by including biomass losses due to land conversion to other wetlands is planned for future inventory submissions.	Work is planned to report on this information in a future submission.
L.29	4.E Settlements – CO_2 (L.27, 2018) (L.15, 2016) (L.15, 2015) (94, 2013) Accuracy	Addressing. Eliminate the overlap between the urban forest inventory and the forest inventory. The tree cover area in settlements (urban forest area) has been updated in the 2019 submission, even though the Party indicated its plan to address the overlap between forest and urban forest in the NIR (planned improvements in settlements, p.6-112). During the review, the Party indicated that there may be a minor overlap with forest and urban forest and this will be considered when new NLCD data become available.	This overlap is still being investigated with new NLCD data. We anticipate reporting an update status of this consideration in the 2021 or 2022 submission.
L.30	4.E.1 Settlements remaining settlements – CO_2 (L.55, 2018) Comparability	Not resolved. Remove the reporting of the carbon stock change associated with yard trimmings and food scraps from under the settlements category and allocate it to the category other under the relevant sector. The Party continues to report carbon stock changes associated with yard trimmings and food scraps under the settlements category instead of 4.H (other). During the review, the Party indicated that this reallocation will be addressed in the 2020 submission.	We will plan on reporting these carbon stock changes under CRF category 4.H (other) in the 2021 submission.
L.31	4.E.1 Settlements remaining settlements – CO_2 (L.55, 2018) Comparability	Not resolved. Report information on the long- term stored carbon stock of yard trimmings and food scraps, as well as on its annual changes, in the memo item in CRF table 5. The Party did not report on the memo items on the long-term storage of carbon in waste disposal sites or on the annual change in total long-term carbon storage in CRF table 5. During the review, the Party indicated that this will be addressed in the 2020 submission.	We will plan on reporting these carbon stock changes under CRF category 4.H (other) in the 2021 submission.
L.32	4.E.2.2 Cropland converted to settlements 4.E.2.3 Grassland converted to settlements – CO_2 (L.56, 2018) Completeness	Not resolved. Estimate biomass carbon stock change for cropland converted to settlements (category 4.E.2.2) and grassland converted to settlements (category 4.E.2.3) using the IPCC default method and factors (2006 IPCC Guidelines, vol. 4, chap. 8) or, where available, country- specific methods or factors, and explain the estimations in the NIR. Carbon stock changes in biomass for cropland converted to settlements and grassland converted to settlements were not estimated. During the review, the Party explained that it will work to address completeness over time as improved data become available and to prioritize the work in line with other improvements to make best use of available resources.	Work is planned to report on this information in a future submission.

L.33	4.F.2 Land converted to other land – CO_2 (L.57, 2018) Completeness	Not resolved. Report estimates of carbon stock change for land converted to other land using the IPCC default method and factors (2006 IPCC Guidelines, vol. 4, chap. 9) or, where available, country-specific methods or factors, and explain the estimations in the NIR. The Party reported all carbon stock changes in all carbon pools as "NE". During the review, the Party explained that this will be improved in future submissions. See ID# L.1 above for the issue of forest land converted to other land.	Work is planned to report on this information in a future submission.
L.34	4.G HWP – CO_2 (L.58, 2018) Transparency	Not resolved. Complete CRF table 4.Gs2 with aggregated values in t carbon for each of the three HWP subcategories (solid wood, paper and paperboard, and other) and report in the NIR a table with all subcategories used by the model to calculate the HWP contribution as well as the conversion factors to carbon weight applied for each subcategory. The United States did not complete CRF table 4.Gs2 and only reported the values of paper and paperboard for 1990–2017 and changed the notation key from "NA" to "IE" for sawnwood and wood panels. During the review, the Party explained that the relevant information for HWP will be provided in its 2020 submission.	Work is planned to improve reporting of HWP in the CRF for the 2021 submission.
L.35	4.H Other (LULUCF) – CO_2 (L.31, 2018) (L.17, 2016) (L.17, 2015) (96, 2013) (112, 2012) Accuracy	Not resolved. Reflect the intersectoral linkages and document the differences in the decay values for yard trimmings and food scraps to ensure the consistent use of decay values across the whole inventory. The CH_4 emissions from yard trimmings and food scraps are reported in the waste sector as part of total CH_4 emissions from MSW. As disaggregated CH_4 emissions from yard trimmings and food scraps are not reported in the waste sector (NIR p.6-120), it is not possible to check the relationship or consistency between the carbon storage and the CH_4 emissions from yard trimmings and food scraps. During the review, the Party explained that the relevant information will be provided in future submissions. See also ID# L.36 below for information on documentation.	This issue was resolved with the 2020 NIR, see explanation starting on page 6-132.
L.36	4.H Other (LULUCF) – CH_4 (L.60, 2018) Transparency	Not resolved. Report the complete calculation of the decay rates applied to yard trimmings and food scraps as well as information on the impact that the calculation has on the CH_4 emission rates applied to other MSW. The Party did not provide in the NIR a complete description of the calculation of decay rates (including an explanation as to how the decay rates were derived), or information on the impact of these decay rates on the CH_4 emission rates applied to other MSW. During the review, the Party clarified that it will address this recommendation in the 2021 submission.	This issue is resolved with 2020 submission. Discussion of decay rates begins at the end of page 6-131 in NIR (2020 submission).
L.37	4(III) Direct N_2O emissions from N mineralization/ immobilization – N_2O (L.61, 2018) Completeness	Not resolved. Estimate N_2O emissions associated with the mineralization of the N content of SOC losses in mineral soils for forest land, wetlands, settlements and other land, as well as for their conversion to and from cropland and grassland, using the IPCC default method and factors (2006 IPCC Guidelines, vol. 4, chap. 11) or, where available, country-specific methods or factors, and report the estimations in CRF table 4(III) and the NIR. Direct N_2O emissions associated with the mineralization of the N content of SOC losses in mineral soils were not estimated. The Party continued to report "NE" in CRF table 4(III) for forest land remaining forest land and settlements (both remaining and converted) and "NA" for land converted to forest	Work is underway to report these emissions for all land categories in future submissions.

		land, land converted to cropland, grassland (both remaining and converted), wetlands (both remaining and converted) and other land. During the review, the Party acknowledged that the correct notation keys should be "IE" for land converted to cropland and grassland, and "NE" for land converted to forest land and other land. The Party also clarified that land converted to wetlands leads to a gain in soil carbon and so "NA" is the appropriate notation key to use.	
L.38	4(IV) Indirect N_2O emissions from managed soils – N_2O (L.62, 2018) Completeness	Not resolved. Estimate indirect N_2O emissions associated with the mineralization of the N content of SOC losses in mineral soils for forest land, wetlands, settlements and other land and report them in CRF table 4(IV), and explain the estimations in the NIR. Both direct and indirect N_2O emissions associated with the mineralization of the N content of SOC losses in mineral soils were explained as not estimated in the NIR for forest land (p.6-50) and settlements (p.6-112) and therefore not included in the reported indirect N_2O emissions in CRF table 4(IV) (the ERT notes that this is relevant to N fertilization only). During the review, the Party clarified that indirect N_2O emissions associated with the mineralization of the N content of SOC losses in mineral soils for wetlands and other land are not estimated either. The Party explained that estimating indirect N_2O from N mineralization for all land-use categories is a planned improvement that will be implemented for either the 2020 or 2021 inventory submission.	Work is underway to report these emissions for all land categories in future submissions.
L.39	4(V) Biomass burning – CO_2, CH_4 and N_2O (L.35, 2018) (L.42, 2016) (L.33, 2015) Completeness	Not resolved. Noting that CH_4 and N_2O emissions from forest fires are key categories, estimate CH_4 and N_2O emissions from biomass burning for land converted to forest land, land converted to wetlands, cropland, grassland and settlements; and populate CRF table 4(V). CH_4 and N_2O emissions from biomass burning from forest land and grassland are estimated but all burning is reported under forest land remaining forest land and grassland remaining grassland. The Party explained that it is currently unable to report separately the emissions from land converted to forest land and land converted to grassland. Biomass burning from wildfires on cropland and biomass burning on wetlands and settlements were not estimated owing to a lack of data.	As noted in our original response, we are unable to report on these emissions at the level of land use conversion, but we will continue to explore approaches for doing this.
L.38	4(IV) Indirect N_2O emissions from managed soils – N_2O (L.62, 2018) Completeness	Not resolved. Estimate indirect N_2O emissions associated with the mineralization of the N content of SOC losses in mineral soils for forest land, wetlands, settlements and other land and report them in CRF table 4(IV), and explain the estimations in the NIR. Both direct and indirect N_2O emissions associated with the mineralization of the N content of SOC losses in mineral soils were explained as not estimated in the NIR for forest land (p.6-50) and settlements (p.6-112) and therefore not included in the reported indirect N_2O emissions in CRF table 4(IV) (the ERT notes that this is relevant to N fertilization only). During the review, the Party clarified that indirect N_2O emissions associated with the mineralization of the N content of SOC losses in mineral soils for wetlands and other land are not estimated either. The Party explained that estimating indirect N_2O from N mineralization for all land-use categories is a planned improvement that will be implemented for either the 2020 or	Work is planned to report on this information in a future submission.

		2021 inventory submission.	
L.39	4(V) Biomass burning – CO_2, CH_4 and N_2O (L.35, 2018) (L.42, 2016) (L.33, 2015) Completeness	Not resolved. Noting that CH_4 and N_2O emissions from forest fires are key categories, estimate CH_4 and N_2O emissions from biomass burning for land converted to forest land, land converted to wetlands, cropland, grassland and settlements; and populate CRF table 4(V). CH_4 and N_2O emissions from biomass burning from forest land and grassland are estimated but all burning is reported under forest land remaining forest land and grassland remaining grassland. The Party explained that it is currently unable to report separately the emissions from land converted to forest land and land converted to grassland. Biomass burning from wildfires on cropland and biomass burning on wetlands and settlements were not estimated owing to a lack of data.	Work is planned over the next few years to utilize supplemental data sources to improve our ability to go back to 1971 as part of the land representation.
L.41	4. General (LULUCF) –CO_2, CH_4 and N_2O Transparency	The United States indicated for the first time in its inventory the preliminary estimates of the land areas of the United States territories (Puerto Rico, Virgin Islands, Guam, Northern Mariana Islands, and American Samoa) in the planned improvements section of the NIR (box 6-2, p.6-21), showing the efforts made so far to incorporate area data by land-use type fully for the United States territories (see ID# L.2 in table 3). The NIR states that the preliminary estimates of these land areas represent 0.1 per cent of the total land base of the United States. The ERT is of the view that the Party could also report preliminary estimates of emissions or removals and provide a preliminary analysis of the impact and significance of emissions or removals from each of these land areas compared with the total LULUCF emission estimates, in order to increase the transparency of the information in the inventory. The ERT recommends that the United States report in the NIR preliminary emission or removal estimates for the land areas of the United States territories reported as a preliminary result of the planned improvement carried out in the Party's inventory.	Work to improve the land representation and tracking of managed/unmanaged land will be initiated in 2021 with the goal of updating this chapter for the 2022 or 2023 submission.
L.42	Land Representation –CO_2, CH_4 and N_2O. Accuracy	The United States reported that, for land converted to cropland, grassland and settlements, the historical areas cumulate from 1979, so that for 1999 onward a 20-year cumulated area is reported (NIR pp.6-53, 6-68 and 6-102), and for land converted to forest land, the historical areas are cumulated from 1982, so that for 2002 onward, a 20- year cumulated area is reported (NIR p.6-44). The ERT noted that the gap in historical data from 1971 to 1978 for land converted to cropland, grassland and settlements, and from 1971 to 1981 for land converted to forest land, has an impact on the level of, and trend in, carbon stock changes and associated emissions and removals reported in all land conversion and land remaining categories. The ERT further noted that this leads to an underestimation of the areas of land conversion categories for 1990–1997 (for cropland, grassland and settlements) and 1990–2001 (for forest land) and therefore must have some impact on the time-series trend of emissions and removals in the LULUCF sector. During the review, the Party explained that it is planning to use Landsat data to fill gaps in the area data up to 1971 and that this will be included in future submissions.	We will improve the transparency of reporting for the 2021 submission.

		The ERT recommends that the United States include the land-use changes that occurred during the periods 1971– 1978 for land converted to cropland, grassland and settlements, and 1971–1981 for land converted to forest land, in order to ensure that the areas of land converted categories for all inventory years since 1990 contain the accumulated total of the land-use changes over the past 20 years.	
L.43	Land Representation –CO2, CH4 and N2O Accuracy	The United States classified its national land into managed land and unmanaged land, as reported in the NIR (table 6-6, p. 6-9). The area of unmanaged grassland has increased over the time series owing to the conversion from managed grassland to unmanaged grassland. During the review, in response to a previous recommendation (see ID# L.22), the Party clarified its approach to classifying managed and unmanaged land, which is that land is classified as unmanaged 20 years after the last direct human intervention on that land. The Party further clarified that this is consistent with the period of time for tracking the influence of land-use change on GHG emissions and removals. In the case of conversions from managed to unmanaged land, the land is no longer directly influenced by human activity, so there are no further effects on anthropogenic emissions and removals to be estimated after the 20- year period. The Party also informed the ERT that the current area of unmanaged grassland is considered to be overestimated for Alaska and will be corrected in the next submission. The ERT recommends that the United States revise the area of unmanaged grassland for Alaska and report on the changes in the NIR. The ERT also recommends that the Party increase the transparency regarding the approach to classifying managed and unmanaged land and include a specific example of the change from managed land to unmanaged land in the NIR, because this type of land-use change is not common in the inventory reporting of other Parties.	This issue was resolved with the 2020 submission, see page 6-95, Table 6-54.
L.44	4.A Forest land 4(II) Emissions and removals from drainage and rewetting and other management of organic/mineral soils – CO2, CH4 and N2O Transparency	In response to a previous recommendation (see ID# L.12), the United States explained that carbon stock changes in forest organic soils (reported in CRF table 4.A) and CO2 emissions from drained forest organic soils (reported in CRF table 4(II)) are calculated separately. The Party also explained that these emissions are not double-counted. The ERT checked the method applied by the Party and concluded that the emission estimates are consistent, but that the information should be more clearly explained in the NIR. The ERT recommends that the United States provide information regarding which emissions or removals are estimated under carbon stock change in forest organic soils (category 4.A) and drained forest organic soils (category 4(II)) and how it avoids double counting of emissions between the two sources in the NIR and in the relevant documentation boxes of CRF tables 4.A and 4(II).	Work is planned to report on this information in a future submission.
L.45	4(II) Emissions and removals from drainage and rewetting and other management of organic/mineral soils – N2O.	The United States made the assumption that 100 t peat are extracted from 1 ha peat area in a single year (NIR p.6- 86). Therefore, for the same soil types (nutrient-rich or nutrient-poor), the area of peat production (ha) should be represented as a number 10 times higher than the peat production amount (kt). However, the ERT noted that the area of nutrient-rich peat production in NIR table 6-50 (660 ha) is correlated to the amount of nutrient-poor peat production (NIR table 6-48: 66 kt) for the entire time series instead of being correlated to nutrient-rich peat production (NIR table 6-48: 374	Work is planned to improve reporting of HWP in the CRF for the 2021 submission.

	Convention reporting adherence	kt). During the review, the Party clarified that the area of nutrient-rich peat production in NIR table 6-50 was reported incorrectly but that the correct values (e.g. 3,740 ha in 2017) were used in the inventory to calculate N2O emissions. The ERT checked CRF table 4(II) and confirmed that N2O emissions were estimated using the correct area for nutrient-rich peat production. The ERT recommends that the United States correct the area of nutrient-rich peat production in NIR table 6-50.	
Waste			
W.1	5. General (waste) – CO_2, CH_4 and N_2O (W.1, 2018) (W.9, 2016) (W.9, 2015) Transparency	Not resolved. Provide background information that is consistent with the data actually used for the emission estimates, including the waste management practices. The United States did not provide background information that is consistent with the data used for emission estimates. The Party continues to report data from different data sources in table 3-27 (p.3-53, energy section), figure 7-3 (p.7-17) and table A-235 (annex 3.14, p.A-387). During the review, the Party explained that it provided information on waste management practices in accordance with national circumstances and is still looking into differences between the data provided by BioCycle and the Earth Engineering Center of Columbia University in surveys on the state of waste in the country and EPA data on MSW in the country, including for AD for waste incineration. The Party indicated that this issue will be resolved in future submissions.	Explanation of the differences between the waste quantity data sources is provided. See 2020 NIR submission starting on pp A-461. See response to W.11 below.
W.2	5.A Solid waste disposal on land – CH_4 (W.3, 2018) (W.3, 2016) (W.3, 2015) (101 and 104, 2013) Accuracy	Not resolved. Revise the estimates of emissions from solid waste disposal on land by incorporating the revised DOC values into the emission estimation. The United States continues to use a constant value for DOC across the time series which does not capture any changes in waste composition over the time series. During the review, the Party explained that the composition of MSW sent to landfill is generally not available for many of the 1,500 active MSW landfills in the United States and therefore the composition is estimated at the national level. The Party is investigating possible variations on the national waste composition on the basis of site-specific waste composition studies and will summarize this information in the 2021 submission at the earliest. See ID# W.3 below.	With regard to municipal solid waste (MSW) landfills, the United States has collected all publicly available and online MSW characterization study data since 1990. A limited number of studies are available that are not representative of the large number of landfills nationwide. In addition, the level of detail in individual waste composition studies varies significantly. While we can provide the list of studies examined, we will not be conducting additional activities to refine the DOC value for MSW landfills. The DOC value of 0.2 is applied for 1990-2004 only and is considered representative of waste disposed. 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 via the regulatory process.

W.3	5.A Solid waste disposal on land – CH_4 (W.4, 2018) (W.4, 2016) (W.4, 2015) (104, 2013) (125, 2012) Transparency	Not resolved. Report the composition of waste landfilled, with the amounts/shares and corresponding coefficients, including DOC. The United States clarified during the review that it is still investigating studies of waste characteristics which are due to be completed across the country, including any variations on the national waste composition. The Party also clarified that landfill-specific waste composition studies are only available for a small number of landfills and for specific years and that, owing to national circumstances, it is unlikely that efforts to obtain such information will be supported in the near future, as it would jeopardize resources for estimating other key categories. It therefore requested that the ERT consider this issue to be resolved on the basis of national circumstances. However, the ERT noted that, as per the original recommendation, this issue relates to ID# W.2 above. Therefore, as soon as the Party provides the summary of the results of the investigation (as mentioned in ID# W.2 above) the ERT will be able to evaluate this issue further.	See response to W.2 from ARR for 2019.
W.4	5.A.1 Managed waste disposal sites – CH_4 (W.15, 2018) Transparency	Not resolved. Include detailed information on the methods and parameters used by the facilities to estimate net CH_4 emissions and how the estimates are chosen for the national inventory when alternative estimates of net CH_4 emissions (e.g. from facilities that recover CH4) are also produced. The United State clarified during the review that this recommendation will be addressed in the 2020 submission.	This was addressed in the 2020 submission. Significant detail was added to Annex 3.14 to address the methods used to estimate net CH4 emissions including those for facilities that recover CH4 across the time series. See 2020 NIR submission starting on pp. A-460.
W.5	5.A.1 Managed waste disposal sites – CH_4 (W.15, 2018) Transparency	Not resolved. The Party used the top-down tier 2 first-order decay method from the 2006 IPCC Guidelines (volume 5, chapter 3, section 3.2.1) for estimating CH_4 emissions for 1990–2004. To estimate CH_4 emissions for 2005 onward, the Party used a country-specific bottom-up method using directly reported net CH_4 emissions (i.e. the difference between the CH4 generated and the CH4 recovered) from GHGRP in combination with a scale-up factor to account for facilities that do not need to report to GHGRP. The ERT notes that (1) the methodologies that the facilities are using to produce estimates of net CH4 emissions reported in GHGRP are not described in detail in the NIR, which makes it difficult to assess the accuracy of those estimates; (2) the rationale for choosing 2005 as the start of the bottom-up estimation method is not provided in the NIR; and (3) the assumption of a 9 per cent scale-up factor for estimating emissions from non-reporting facilities for 2005 onward is not described in the NIR. As a result, the ERT finds it impossible to assess both the accuracy of the bottom-up method and the consistency of the time series 1990–2016. During the review (e.g. 2018 submission), the Party provided information on the methods and parameters that the facilities use to produce the estimates of net CH4 emissions. The Party also explained that facilities that recover CH4 also produce alternative estimates of net CH4 emissions using a back-calculation method, and clarified how it selects which of the two estimates provided by the facilities to use in the national inventory. The Party also provided information on the analysis that was done in order to select a suitable year to start using the new bottom-up method. In that regard, it provided and discussed a relevant technical report (RTI International, 2017). Another technical report (RTI International, 2018) was provided by the Party and discussed, which covers the methodologies used and analysis conducted in order to produce a scale-up factor	This was addressed in the 2020 submission. See 2020 NIR submission starting on pp. A-460

		for non-reporting facilities. Include in the NIR a summary of the process to select the year to start using the new bottom-up method. See ID# W.4 above.	
W.6	5.A.1 Managed waste disposal sites – CH_4 (W.15, 2018) Transparency	Not resolved. Include in the NIR a summary of the methodologies used and analysis conducted in order to produce a scale-up factor for non- reporting facilities. The United States provided a link during the review to the same technical report (RTI, 2018) that was provided to the previous ERT. The report covers the methodologies used and analysis conducted in order to produce a scale-up factor for non-reporting facilities. However, the Party did not include a summary of the methodologies or provide a text with a reference to the link for the technical report (RTI, 2018) to clarify the methodologies used or analysis conducted. During the review, the Party clarified that it will address this recommendation in the 2020 submission.	This was addressed in the 2020 submission. See 2020 NIR submission pp. A-469
W.7	5.A.1.a Anaerobic – CH_4 (W.16, 2018) Comparability	Addressing. Estimate and report the amounts of CH_4 flared and CH_4 for energy recovery for anaerobic waste disposal sites, but, until that is possible, report them as "NE" instead of "IE" in CRF table 5.A. The Party reported both the amount of CH_4 flared and the amount of CH_4 for energy recovery using "NE" in CRF table 5.A instead of estimating the amount of CH_4 flared and the amount of CH_4 for energy recovery. During the review, the Party explained the use of directly reported GHGRP net emissions and the rule that does not require facilities to report separately the total amounts of CH_4 recovered for energy versus CH_4 flared. The 2006 IPCC Guidelines (vol. 5, chap. 3, p. 3.18) state that emissions from flaring are however not significant, as the CO_2 emissions are of biogenic origin and the CH_4 and N_2O emissions are very small. However, in the case of the amount of CH_4 for energy recovery, the Party identified the quantity of recovered CH_4 using equation HH-4 of the GHGRP (NIR p. A-391) and explained that CH_4 recovery was based on data from the LandFill Gas-to-Energy project (NIR p. A-390). The ERT notes that the 2006 IPCC Guidelines (vol. 5, chap. 3, p. 3.18) state that if the recovered gas is used for energy, then the resulting GHG emissions should be reported under the energy sector. They also state (p. 3.19) that reporting based on metering of all gas recovered for energy and flaring, or reporting gas recovery based on the monitoring of produced amount of electricity from the gas, is consistent with good practice. The ERT is of the view that CH_4 recovery for energy could be calculated using the estimation from electricity monitoring (in accordance with the 2006 IPCC Guidelines). The Party could report the amount of CH_4 for energy recovery in CRF table 5.A and include an explanation in the NIR, taking into account the good practice outlined in the 2006 IPCC Guidelines.	This was addressed in the 2020 submission. See CRF Tables 5.A and Table 9 of the 2020 submission and NIR Annex 5. The CH4 has been reported as NE.

W.8	5.A.1.a Anaerobic – CH_4 (W.7, 2018) (W.12, 2016) (W.11, 2015) Accuracy	Addressing. Obtain up-to-date data on the type and fractions of organic waste placed in industrial waste landfills; and revise the CH_4 estimates for all major industrial waste landfills. The NIR (p.7-11) referred to a technical memorandum mentioned during the previous review (RTI, 2018). The Party explained during the review that this technical memorandum provides information on an EPA analysis to validate the assumption that most of the organic waste which would result in CH_4 emissions is disposed of at pulp, paper and food processing facilities (54 per cent) and food manufacturing facilities (7 per cent). According to the analysis, the total waste disposed of by facilities under each primary North American Industrial Classification System reported in 2016 was calculated in order to determine that 93 per cent of the total organic waste quantity originates from either the pulp and paper, or food and beverages sector (NIR p.7-11). The Party also made reference to the uncertainty section (NIR p.7-13), which explains the uncertainty values applied to the waste disposal and CH_4 generation information on industrial waste landfills. The ERT notes that there are approximately 1,200 industrial waste landfills in the country but only 172 meet the reporting threshold of the GHGRP (for which data are available).	This is ongoing work, progress and/or results of which will be addressed in the 2021 submission.
W.9	5.B.2 Anaerobic digestion at biogas facilities – CH_4 (W.8, 2018) (W.14, 2016) (W.13, 2015) Transparency	Not resolved. Estimate and report CH_4 emissions from unintentional leakages using the default value of 5 per cent provided in the 2006 IPCC Guidelines. The United States did not estimate CH_4 emissions as required. The Party explained during the review that it is investigating the data sources and practices of anaerobic digestion and will assess the addition of a 5 per cent factor to account for unintentional leakages for the 2021 submission.	Addressing. Party intends to include emissions from stand alone anaerobic digestion facilities starting in the 2021 submission.
W.10	5.B.2 Anaerobic digestion at biogas facilities – CH_4 and N_2O (W.17, 2018) Transparency	Not resolved. The Party did not add the required information for "NE" used for CH_4 and N_2O under category 2.B.2.b (other) in CRF table 9. During the review the Party explained that basic research has been initiated which indicates that some activity for this category occurs in the United States, but EPA needs to conduct further research on available AD for estimating emissions.	This was addressed in the 2020 submission. See CRF table 9.
W.11	5.C.1 Waste incineration – CO_2, CH_4 and N_2O (W.10, 2018) (W.15, 2016) (W.14, 2015) Transparency	Not resolved. Provide in the NIR consistent information on the data that are used for the estimation of emissions from waste incineration (e.g. on the percentage of waste incinerated in 2013 reported in figure 7-2 and tables 3-26 and A- 272 of the 2016 NIR). There are still inconsistencies in the information on MSW incineration in the NIR, such as between figure 7-2 (p.7-16) (12.8 per cent) and table 3-27 (p.3-53) (7.6 per cent). The ERT also notes that table A-133 (p.A-214) presents the amount of plastic incinerated (7 per cent). The table A-272 mentioned by the previous ERT corresponds to table A-235 (p. A- 387) in the 2019 submission, but the ERT could not find any reference to the amount of waste incinerated in this table. The main difference between table A-235 and figure 7-2 relates to the amount of waste	The United States reiterates that different methods and data are used for determining emissions from Waste Incineration and emissions from Landfilling. The methods (i.e. tiers) applied to estimate emissions differ so therefore data listed will not necessarily be consistent, however this is not inconsistent with the 2006 IPCC Guidelines. See for example Annex 3.7 of the NIR where the Party describes the differences between the main

		landfilled (52.5 per cent in figure 7-2 and 64 per cent in table A-235) (see ID# W.1 above). During the review, the United States explained that the percentage of waste incineration shown in figure 7.2 comes from a different source from that used in table 3-27 and does not represent the data used in the analysis for estimating emissions from waste incineration. However, the ERT is of the view that data in the NIR should be consistent across the waste and energy sectors and cross-references should be provided in the NIR for the descriptions of the methodology and AD used and any inconsistencies should be clearly explained.	data sources used to determine waste incineration emissions. Data from the Biocycle's State of Garbage in America report is assumed to be the best data to determine overall percent of waste incinerated however it does not have data on waste characterization. The U.S. EPA Facts and Figures report has data on waste characterization which is combined with the overall amount of waste incinerated to determine emissions. Emissions from landfilling is based on different data sources including direct data from the GHRP. The differences in the two waste reports are what leads to the inconsistencies shown in the different tables and figures in the report across the waste incineration and landfilling sections in terms of percent of waste incinerated and landfilled. However, since that data is not used directly in the calculations (as indicated in the report) there are no inconsistencies in the methodology and AD used.
W.12	5.C.1 Waste incineration – CO_2, CH_4 and N_2O (W.18, 2018) Transparency	Not resolved. Ensure that the 2019 NIR indicates that the emissions from the incineration of non-hazardous industrial waste referred to in the 2018 NIR are in fact emissions from the incineration of hazardous industrial waste and already included in the inventory by (a) correcting the entry in annex 5 to the NIR, p.A-427, section on category 1.A.5.a (CO_2 emissions from non-hazardous industrial waste incineration and medical waste incineration); (b) correcting the entry in annex 5 to the NIR, table A-266, row on category 1.A.5.a; and (c) changing the notation key reported for CO_2, CH_4 and N_2O emissions for category 5.C.1 (non-biogenic (other)) from "NA" to "IE" in CRF table 5.C and explaining in CRF table 9 where the emissions are included. There are no changes to the NIR or CRF table 5.C in the 2019 submission. The Party indicated during the review that this recommendation will be addressed in the 2020 submission.	This issue was addressed in the latest submission. Annex 5 of the NIR was updated as well as the CRF category 5.C.1 (non-biogenic (other)) now reads "IE" and information is included in Table 9 that incineration emissions are included under energy.

W.13	5.D.2 Industrial wastewater – CH_4 (W.14, 2018) (W.5, 2016) (W.5, 2015) (105, 2013) Completeness	Not resolved. Include information on the non-estimation of CH_4 emissions from sludge under industrial wastewater. The Party did not include information on emissions from sludge in the NIR. During the review, the Party explained that sludge removed from industrial wastewater is not estimated owing to insufficient data and that an explanation will be added in annex 5 to the next submission in line with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	This will be included in Annex 5 in the 2021 submission.
W.14	5.A Solid waste disposal on land – CH4 Transparency	The United States reported in the NIR (annex 3.14, p. A-391) the use of a default value (0.75) for collection efficiency at landfills. The 2006 IPCC Guidelines (vol. 5, chap. 3, box 3.1) note that the use of a collection efficiency will need to be researched and justified in order to be used with confidence. During the review, the United States informed the ERT that the collection efficiency value was developed by EPA and is referenced in EPA AP-42 section 2.4 (see https://www3.epa.gov/ttn/chief/ap42/ch02/index.html). The justification for the use of a collection efficiency of 0.75 includes a consideration of the availability of data such as surface monitoring under the EPA new source performance standards for MSW landfills. During the review, the Party explained that the categories of collection efficiency used in landfill gas estimation vary according to the gas collection activity and types and thickness of final soil cover included in the formula of weighted average collection efficiency of the landfill. The Party also indicated that the collection efficiency range of United States landfills with gas collection is between 60 and 85 per cent, with the average value of 75 per cent considered as the default value. The ERT considers that the information on collection efficiency used in the NIR is based on well-documented research and is justified but, for improved transparency, more information should be included in the NIR. The ERT recommends that the United States include in the NIR the explanation provided to the ERT above on how the collection efficiency default value of 0.75 was derived to justify its confidence in the collection efficiency value used.	This was addressed in the 2020 submission. See 2020 NIR submission pp. A-472
W.15	5.A.1 Managed waste disposal sites – CH4 Transparency	The ERT noted that the United States reported in the NIR (pp.7-7, 7-11 and A-394) that the oxidation factor is directly reported to the GHGRP. The GHGRP allows facilities to use varying oxidation factors depending on their facility-specific calculated CH4 flux rate (i.e. 0, 10, 25 or 35 per cent) and an average value of 20 per cent was used in the inventory. The 2006 IPCC Guidelines state that the oxidation factor is very uncertain because it is difficult to measure, varies considerably with the thickness and nature of the cover material, atmospheric conditions and climate, the flux of methane, and the escape of methane through cracks/fissures in the cover material (vol. 5, chap. 3, p.3.26) and that the use of an oxidation value higher than 0.1 should be clearly documented, referenced and supported by data relevant to national circumstances (vol. 5, chap. 3, p.3.15). During the review, the Party explained that the methodology and oxidation factors used in the GHGRP were developed on the basis of published, peer- reviewed literature and through external	This was addressed in the 2020 submission. See 2020 NIR submission starting at bottom of pp. A-473

		stakeholder engagement. Justification for the use of an oxidation factor higher than 0.1 considers cover types of material including the thickness of the soil (RTI, 2012). This document contains default values for oxidation with seven categories of oxidation factor used. Thickness of soil cover greater than 12 inches is the main condition for considering an oxidation factor above 0.1. The 2006 IPCC Guidelines (vol. 5, chap. 3, table 3.5) indicate the uncertainty analysis of the oxidation factor for a non-zero value. The ERT considers that, according to the 2006 IPCC Guidelines, the use of an oxidation factor higher than 0.1 should be documented clearly with references and supported by data relevant to national circumstances, including an uncertainty analysis. The ERT recommends that the United States include information to justify the oxidation factor used, including references and supporting data relevant to national circumstances as well as an uncertainty analysis for the oxidation factor applied in the estimation.	