ANNEX 8 QA/QC Procedures – TO BE UPDATED FOR FINAL INVENTORY REPORT

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.

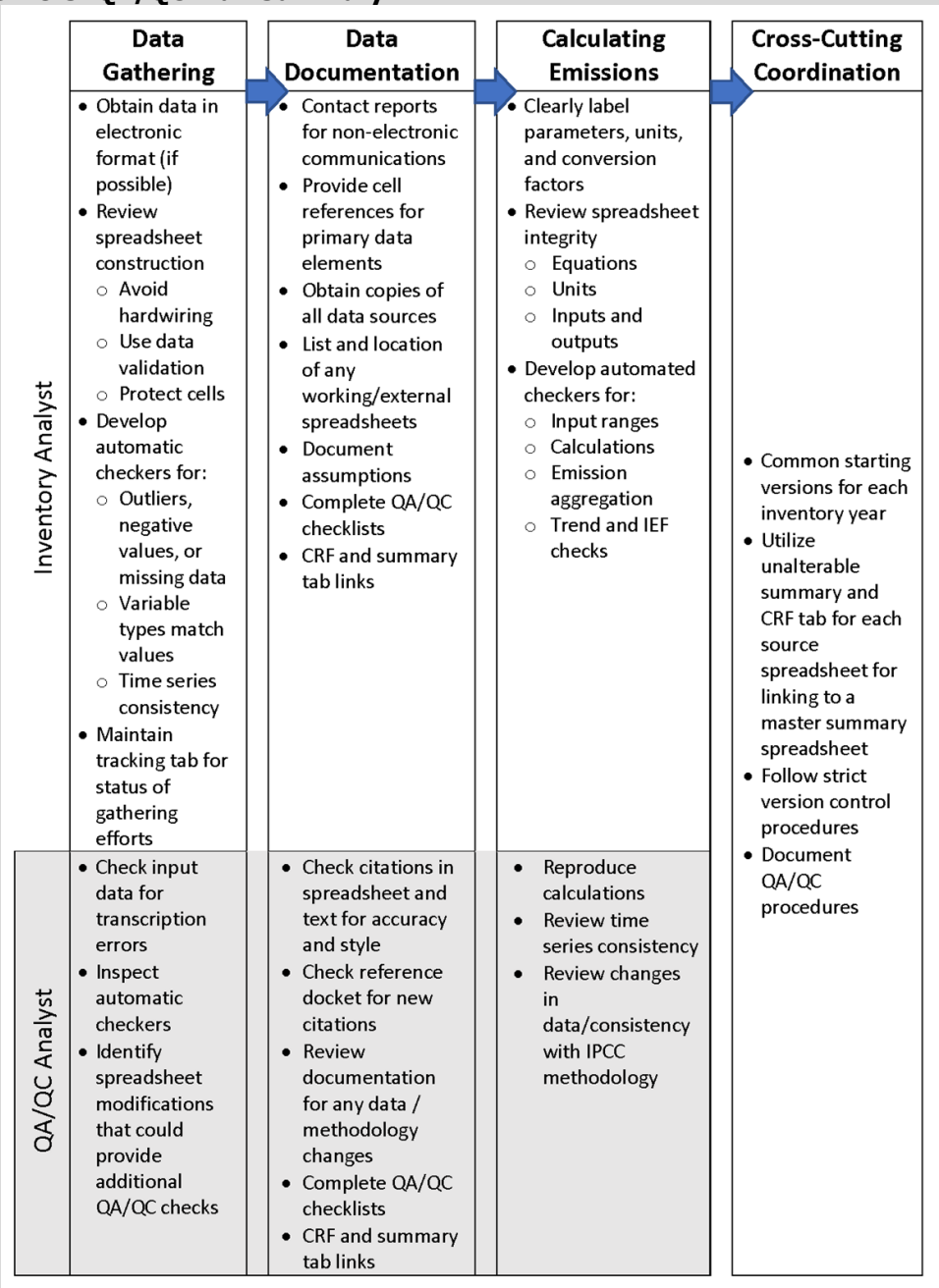
Key attributes of the QA/QC Management Plan are summarized in Figure A-19. These attributes include:

- *Procedures and Forms:* detailed and specific systems that serve to standardize the process of documenting and archiving information, as well as to guide the implementation of QA/QC and the analysis of uncertainty.
- *Implementation of Procedures:* application of QA/QC procedures throughout the whole Inventory development process from initial data collection, through preparation of the emission estimates, to publication of the Inventory.
- *Quality Assurance:* expert and public reviews for both the Inventory estimates and the report (which is the primary vehicle for disseminating the results of the Inventory development process). The expert technical review conducted by the UNFCCC supplements these QA processes, consistent with the QA good practice recommended in 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. Further information on verification will be included in future submissions.

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, but tailor 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 or sink category go beyond the general level, and include category-specific checks, further explanation is provided within the respective category text. Similarly, responses or updates based on comments from the expert, public and the international technical expert reviews (e.g., UNFCCC) are also addressed within the respective source or sink category text. For transparency, responses to public and expert review comments are also posted on the EPA website with the final report.

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



8.3. Assessment Factors

The *Inventory of U.S. Greenhouse Gas Emissions and Sinks* development process follows guidance outlined in EPA's *Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency*[158] and *A Summary of General Assessment Factors for Evaluating the Quality of Scientific*

[158] 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.

and Technical Information.[159] 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-244 defines each factor and explains how it was considered during the process of creating the current Inventory.

Table A-244: Assessment Factors and Definitions

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 25 years. When possible, Tier 2 and Tier 3 methodologies from the *2006 IPCC Guidelines* are applied to calculate U.S. emissions more accurately.
Applicability and Utility (AF2)	The extent to which the information is relevant for the Agency's intended use.	The Inventory's underlying data, methodology, and models are relevant for their intended application because they generate the sector-specific greenhouse gas emissions trends necessary for assessing and understanding all sources and sinks of greenhouse gases in the United States for the Inventory year. They are relevant for communicating U.S. emissions information to domestic audiences, and they are consistent with the *2006 IPCC Guidelines* developed specifically for UNFCCC reporting purposes of international greenhouse gas inventories.
Clarity and Completeness (AF3)	The degree of clarity and completeness with which the data, assumptions, methods, quality assurance, sponsoring organizations and analyzes employed to generate the information are documented.	The methodological and calculation approaches applied to generate the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* are extensively documented in the *2006 IPCC Guidelines*. The Inventory report describes its adherence to the *2006 IPCC Guidelines*, and the U.S. Government agencies provide data to implement the *2006 IPCC Guidelines* approaches. Any changes made to calculations, due to updated data and methods, are explained and documented in the report consistent with UNFCCC reporting guidelines.
Uncertainty and Variability (AF4)	The extent to which the variability and uncertainty (quantitative and qualitative) in the information or in the procedures, measures, methods or models are evaluated and characterized.	The evaluation of uncertainties for underlying data is documented in the Annex 7 Uncertainty 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 input data was evaluated by running a Monte Carlo uncertainty analysis on most source and/or category emissions data to produce a 95 percent confidence interval for the annual greenhouse gas emissions for that source and/or sink. The error propagation approach is used to

[159] 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.

		quantify uncertainties for some categories that are not significant contributors to emissions across the time series. To develop overall uncertainty estimates, the Monte Carlo simulation output data for each emission source and/or sink 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* and the *2019 Refinement*. 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 supplemental stakeholder outreach efforts. 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.[160]

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:

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

- UNFCCC Reporting Guidelines for annual national greenhouse gas inventories[161]
- UNFCCC Review Process and Guidelines for annual national greenhouse gas inventories[162]
- Inventory Review reports of annual submissions (latest reviews).[163]

Table A-245 includes responses to findings from the latest UNFCCC expert review to facilitate future reviews. The most recent review was conducted the week of November 2-7, 2020 and focused on the annual Inventory submitted in April 2020.

[161] Available online at: https://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2.
[162] Available online at: https://unfccc.int/resource/docs/2014/cop20/eng/10a03.pdf#page=3.
[163] 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-2019.

Table A-245: Response to UN Review of the 2020 Inventory Submission

ID#	*Issue Classification*	*Recommendation Made in Previous Review Report Including ERT Assessment and Rationale*	*Response on Status of Issue*
General			
G.1	Annual submission (G.1, 2019) G.1, 2018) (G.1, 2016) (G.1, 2015) (9, 2013) (8, 2012) Completeness	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).	The United States is still addressing this issue and notes 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 National Inventory Report (NIR). EPA has approximated significance of additional categories for some categories, per ongoing research into available data and also included some categories previously not estimated (e.g., Flooded Lands Remaining Flooded Lands and Lands Converted to Flooded Lands). Remaining 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 (G.2, 2019) 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	The United States is still addressing this issue and notes 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 current (i.e., 2022) submission does include updates to both quantitative and qualitative assessments of significance for some categories.

		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 of national total GHG emissions.	
Energy			
E.1	1. General (energy sector) – gaseous fuels– CO_2 and CH_4 (E.2, 2019) (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 uncertainty analysis is provided in the NIR (pp.3-35–3-37) for CO_2 from fossil fuel combustion, with supporting information given in annexes 2.2 and 7. The Party explains in the NIR that the uncertainty estimates are not affected by the updates to the carbon content of natural gas in the 2019 submission, and that the general findings regarding the carbon content of fuels given in NIR annex 2.2 (pp.A-103–A-106) still apply for natural gas without updating. The uncertainty range reported in the 2020 submission for CO_2 emissions from natural gas combustion was in the 2019 inventory submission with the exception of United States territories, where the lower bound differs by 1 percentage point (from –13 per cent in the 2019 submission to –12 per cent in the 2020 submission). During the review, the Party clarified that this was attributable to statistical variations in the approach used (Monte Carlo analysis). The ERT considers that this issue has not been fully addressed because no specific information has been documented to demonstrate that the impact of updates to the carbon content of natural gas on the uncertainty analysis is negligible.	This issue was addressed in the previous (i.e., 2021) submission. The 2021 NIR and current submission include specific information to demonstrate that the impact of updates to the carbon content of natural gas on the uncertainty analysis is negligible. See the 2021 NIR Section 3.1 pp. 3-36: "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. Recent updates to carbon factors for natural gas and coal utilized the same approach as previous Inventories with updated recent data, therefore, the uncertainty estimates around carbon contents of the different fuels as outlined in Annex 2.2 were not impacted and the historic uncertainty ranges still apply."
E.2	1. General (energy sector) – gaseous fuels– CO_2 and CH_4 (E.2, 2020) (E.3, 2019) (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 previous (i.e., 2021) submission. The 2021 NIR documents research on why a separate CO_2 emission factor (EF) for fuel gas used by upstream oil and gas producers is not needed. See the 2021 NIR Annex Section 2.2 pp. A-96: "Furthermore, research was done on CO_2 emission factors for fuel gas used by upstream oil and gas producers in order to determine whether a different CO_2 emission factor for fuel gas used in offshore oil and gas production than the emission factor for the processed gas that enters the transmission, storage and distribution networks used in power and industrial plants and by other users is warranted. It was determined that a different factor was not warranted as natural gas carbon content is based on the heating value of the gas and EIA reports that the heat content of dry natural gas produced (which is used in upstream oil and gas production) is the same value as natural gas consumed in downstream operations (EIA 2020a). Therefore, the same carbon factor is used for all natural gas consumption including upstream operations. This language was retained

			in the 2022 NIR submission."
E.3	Fuel combustion – reference approach – all fuels – CO_2 (E.3, 2020) (E.3, 2019) (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. For the reference approach, the values reported in CRF table 1.A(c) for apparent energy consumption and apparent energy consumption excluding NEU were the same for the entire time series. The Party explained in the NIR (p.3-38) that emissions from carbon that was not stored during NEU of fuels are subtracted under the sectoral approach and reported separately but are not subtracted under the reference approach. Thus, emission estimates under the reference approach are comparable to those under the sectoral approach, except that the emissions from NEU of fuels are included in the reference approach. The ERT noted that a similar explanation was included in annex 4 to the NIR (p.A-482). During the review, the Party confirmed that (1) the emission scope of the reference and the sectoral approaches is the same since carbon emissions from NEU (i.e. carbon not excluded) are included in both approaches, except for other fossil fuels (see ID# E.25 in table 5); (2) the energy consumption covered by the sectoral approach includes both fuel consumption and NEU, which is reported under category 1.A.5 other, hence the scope of energy consumption under the sectoral approach is comparable with that under the reference approach without excluding NEU; and (3) where it is indicated that NEU emissions are subtracted under the sectoral approach, it means that they are reported separately, not that they are not covered by the sectoral approach. The ERT considers that it would be useful to include this explanation in the NIR of future inventory submissions.	This issue was addressed in the previous (i.e., 2021) submission. The United States refers the ERT to the 2021 NIR (annex 4, starting on pp. A-470) describing the different treatments of NEU under the reference and sectoral approaches. Further clarification is in the 2021 NIR Chapter 3 (pp. 3-39) and additional language is included in the 2021 submission to address this issue; see Annex 4 pp. A-471 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." Also, footnote 139 (pp. A-471): "The emission scope of the reference and the sectoral approaches is the same since C emissions from NEU (i.e., C not excluded) are included in both approaches, the energy consumption covered by the sectoral approach includes both fuel consumption and NEU, which is reported under category 1.A.5 other, hence the scope of energy consumption under the sectoral approach is comparable with that under the reference approach without excluding NEU. To the extent it is indicated that NEU emissions are subtracted under the sectoral approach, it means that they are reported separately, not that they are not covered by the sectoral approach."
E.4	Feedstocks, reductants and other NEU of fuels – all fuels – CO_2 (E.5, 2019) (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). Emissions from NEU of lubricants and waxes and other (e.g., asphalt and road oil), which should be reported under CRF category 2.D, were still reported under fuel combustion under category 1.A.5 and combined with emissions from NEU of other fuels (see ID# E.3 above), and as "IE" under the IPPU sector. Like in the 2019 submission, the Party indicated in the NIR (p.3-54, box 3-5) that these emissions cannot be reallocated to IPPU owing to national circumstances, in particular where a carbon balance calculation was performed on the basis of the aggregated amount of fossil fuels used for NEU, and that artificial adjustments to reallocate emissions could lead to transparency issues. The ERT noted that a similar	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 2021 NIR. The United States continues to evaluate ways to update this approach, including reallocation of lubricant non-combustion emissions and will provide more clarification as applicable in the future NIRs (i.e., 2023 submission).

		explanation was provided in the IPPU section of the NIR (p.4-6), where it is stated that artificial adjustments would result in the carbon emissions for lubricants, waxes, asphalt and road oil being reported under the IPPU sector, while carbon storage for those subcategories would be reported under the energy sector. The ERT noted that the carbon balance approaches for most petrochemical products were provided in NIR annex 2.3 (pp.A-141–A-157). Taking lubricants as an example, the ERT remarked that, according to the information provided in the NIR (pp.A-152–A-154), 92 per cent of lubricants are categorized as lubricant oils and the remaining 8 per cent as lubricant greases. Annex 2.3 to the NIR also provides information on the commercial and environmental fate of oil lubricant (table A-85) and grease lubricant (table A-86), with information on the percentage combusted during use and not combusted during use. The ERT is of the view that emissions relevant to lubricant use could be allocated consistently with the 2006 IPCC Guidelines by using the existing statistical information and assumptions mentioned above without raising transparency concerns. While reallocating the small portion of emissions associated with non-combustion use to the IPPU sector may not improve the overall accuracy of the inventory, it would improve its comparability with the inventories of other Annex I Parties (see ID# I.18 below).	
E.5	Feedstocks, reductants and other NEU of fuels – CO_2 (E.6, 2019) (E.19, 2018) Accuracy	Addressing. 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 reported in its NIR (p.4-58) that some degree of double counting may occur between CO_2 emissions from NEU of fuels in the energy sector and CO_2 process emissions from petrochemical production in the IPPU sector, but that data integration is not feasible as feedstock data from EIA used to estimate NEU of fuels were aggregated by fuel type, rather than disaggregated by both fuel type and individual IPPU industries. The Party noted in the NIR (footnote 65 on p.3-48) and further clarified during the review that this is not considered to be a significant issue since NEU industrial release data (e.g., the Toxics Release Inventory) include different categories of sources to those included under the IPPU sector, and the NEU estimates account for roughly 20 per cent of the emissions captured in the IPPU sector. During the review, the Party further clarified that, for 2018, carbon emissions from industrial releases from NEU of	This issue was addressed in the current (i.e., 2022) submission. See, for example, the 2022 NIR Section 3.2 for the following discussion: "It is important to ensure no double counting of emissions between fuel combustion, non-energy use of fuels and industrial process emissions. For petrochemical feedstock production, our review of the categories suggests this is not a significant issue since the non-energy use industrial release data includes different categories of sources and sectors than those included in the Industrial Processes and Product Use (IPPU) emissions category for petrochemicals. Further data integration is not available at his time because 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. Also, GHGRP-reported data on quantities of fuel consumed as feedstocks by petrochemical producers is unable to be used due to the data failing GHGRP CBI aggregation criteria. "

		fuels, reported as 6,500 kt CO_2 in table A-67 of annex 2.3 to the NIR (p.A-136), represent 21.8 per cent of the emissions from petrochemical production (29,700 kt CO_2 eq) reported under the IPPU sector, as shown in NIR table 4-46 (p.4-59) and CRF table 2(I).A-H (sheet 1) for category 2.B.8. However, the ERT considers that the Party has not yet fully addressed the recommendation, in particular the potential issue related to possible double counting, which the Party considers not to be significant, by describing how the country-specific approach is better able to reflect the Party's national situation and how these methodologies are compatible with the 2006 IPCC Guidelines (see ID#s E.4 above and I.12 below).	
E.6	International aviation – liquid fuels – CO_2, CH_4 and N_2O (E.6, 2019) (E.5, 2018) (E.6, 2016) (E.6, 2015) (35, 2013) Transparency	Addressing. 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 as international bunker fuel between CRF tables 1.A(b) and 1.D (e.g., 198.85 Mbbl (approx. 1,207,361.48 TJ) and 1,209,889.16 TJ for 2018, respectively). An explanation was provided in footnote 6 to table A-244 of NIR annex 4 (p.4-487), indicating that jet kerosene used in international aviation has a different NCV based on data specific to that source. The Party clarified during the review that physical values of jet kerosene consumption are converted on the basis of a combined calorific value across all sources of jet fuel (export, import and stock change, as shown in CRF table 1.A(b)), which may result in inconsistency with jet fuel data for international aviation (as shown in CRF table 1.D). The Party further clarified that the value in CRF table 1.D is based on bunkers only (198.85 Mbbl and heating content of 6,084.42 TJ/Mbbl) while the values in table 1.A(b) are based on apparent consumption, including imports, exports and so on, and average heating value (–227.08 Mbbl and 6071.71 TJ/Mbbl). The ERT is of the view that the amount of jet fuel used as international bunker fuel should be reported as a single value that is consistent across the approaches used in the inventory reporting. In this regard, the ERT considers that the footnote and the additional information provided do not fully explain the inconsistencies between CRF tables 1.A(b) and 1.D. The ERT believes it is necessary to provide in the NIR the reason why different heating values are applied to jet kerosene in CRF tables 1.A(b) and 1.D to resolve this issue.	This issue was addressed in the current (i.e., 2022) submission. See the 2022 NIR Annex 4, Footnote 6 to Table A-229 for the following discussion: "Jet fuel used in bunkers has a different heating value based on data specific to that source." Values in CRF Table 1.A(b) and 1.D match for residual and distillate fuels for international bunker consumption. For jet fuel, there is a small discrepancy because of the difference in granularity of data. In the Sectoral Approach, jet fuels are broken out by different types with varying densities used to calculate consumption. In the Reference Approach, only one heat content is used to calculate consumption for all jet fuel from bunker fuels.

E.7	1.A Fuel combustion – sectoral approach – biomass – CH_4 and N_2O (E.9, 2019) (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 NIR did not contain information on any such research. In addition, in the 2020 inventory submission, the amount of CH4 recovered for energy use for subcategory 5.A.1.a anaerobic (managed waste disposal sites) was reported in CRF table 5.A as numerical values for 1990–2004 and as "NE" for 2005–2018, and in the 2018 inventory submission as "IE" for 2005–2016. During the review, the Party clarified that it is conducting research on the sources of data on biogas use and biogas combustion for energy purposes to confirm whether or not these emissions are reported elsewhere, and that updates to CH_4 and N_2O emissions from the combustion of landfill gas, sewage gas and other biogas will be made, as needed, and described in future inventory submissions (see ID# W.9 below).	The United States is still 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.8	1.A.2.g Other (manufacturing industries and construction) – liquid fuels – CO_2, CH_4 and N_2O (E.12, 2019) (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 MOVES2014b model has been incorporated in inventory development since the 2019 inventory submission, in which the impact of the recalculation on CH4 and N_2O emissions was explained without any reference to CO_2 emissions. According to the information provided in the 2020 NIR (p.3-36), no particular recalculation was performed for non-road mobile machinery. In addition, no documentation on the validity of the outputs of the model was included in the NIR. During the review, the Party emphasized that (1) the use of the MOVES2014b model was limited primarily to the estimation of CH4 and N_2O emissions from non-transportation mobile sources; (2) the model was also used to generate vehicle age distributions that were used to estimate CH4 and N_2O emissions from transportation sources; (3) it plans to incrementally improve the discussion of the validity of the MOVES2014b model in future inventory submissions; and (4) the model was not used to derive CO_2 emissions from non-road mobile machinery, which were calculated using fuel consumption data from EIA and were included under the industrial and commercial categories of the inventory, so any recalculations performed using the MOVES2014b model will not impact the estimated CO_2 emissions from non-transportation mobile sources. The ERT considers that this issue has not yet been fully resolved as the NIR does not indicate that the recalculation using the MOVES2014b model had no impact on CO_2 emissions from non-road	See explanation included in the current (i.e., 2022) submission in Section 3.1 (CH_4 and N_2O from Mobile Combustion) of Chapter 3 and Annex 3.2. The use of the MOVES model in the development of the Inventory is limited primarily to the estimation of CH_4 and N_2O emissions from non-transportation mobile sources. The model is also used to generate vehicle age distributions and mileage accumulations that are used to estimate CH_4 and N_2O emissions from Transportation sources. The United States plans to incrementally improve the discussion of the validity of the MOVES model in future submissions.

		mobile machinery, and the NIR could provide more information on specific assumptions that were made and modifications to the MOVES2014b model (see ID# E.14 below).	
E.9	1.A.2.g Other (manufacturing industries and construction) – liquid fuels – CO_2, CH_4 and N_2O (E.12,2019) (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 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).	The United States is 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). The United States has researched data on allocating emissions and fuel use for fishing vessels to category 1.A.4.c.iii (fishing) and determined that the information is not available. The activity data (AD) on marine fuel use is not specified in terms of type of vessel and includes recreational vehicles as well as cargo and passenger carrying, military (i.e., U.S. Navy), fishing, and miscellaneous support ships (e.g., tugboats). More information stating the data is not available is found in the latest submission. See Annex 3.2 of the 2022 NIR.
E.10	1.A.2.g Other (manufacturing industries and construction) – liquid fuels – CO_2, CH_4 and N_2O (E.14, 2019) (E.24, 2018) Accuracy	Addressing. 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. According to the NIR (p.3-40), EPA tested an alternative approach for disaggregating gasoline between road and non-road use. It used on-road fuel consumption output from the MOVES2014b model to determine the percentage of the Federal Highway Administration consumption data totals that are attributable to highway transportation sources, and then applied this to the EIA total data to determine gasoline consumption from highway transportation sources, such that the remainder could be defined as industrial and commercial consumption and allocated to non-road mobile machinery. However, as the results of the test revealed differences between fuel consumption data from the MOVES2014b model and those from the Federal Highway Administration, no changes were made to the methodology for estimating motor gasoline consumption for non-road mobile sources. The ERT considers that this issue has not been fully addressed as the optimum AD were not determined for each subsource under non-road	The United States notes that information on AD used to calculate non-road mobile source emissions is discussed in the NIR Section 3.1 and Annex 3.2. The language from the 2020 NIR specified in the issue rationale in terms of testing an alternative approach was in reference to a specific backcasting methodology used to address a time series inconsistency. As noted, that test determined that no changes were needed to the current approach and the AD being used were appropriate. The United Stated is therefore unsure of the basis of this issue in the UNFCCC reporting guidelines and *2006 IPCC Guidelines* and requests clarification on how optimum AD has not been determined.

		mobile machinery.	
E.11	1.A.3 Transport – liquid fuels – CO_2, CH_4 and N_2O (E.15, 2019) (E.25, 2018) Accuracy	Addressing. Advance the research in order to implement as soon as practicable the following improvements indicated during the review: Updating on-road diesel CH_4 and N_2O EFs; Developing improved methodology and data sources to estimate emissions from class II and III (short-line and regional) rail locomotives; Applying a consistent methodology over time to estimate vehicle miles 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. (a) Resolved. For the 2020 inventory submission, the Party updated the CH_4 and N_2O EFs for diesel oil for subcategory 1.A.3.b road transportation for years after 2006. For example, the CH_4 EF for diesel oil for 2017 was updated from 0.24 kg/TJ in the 2019 inventory submission to 0.53 kg/TJ in the 2020 inventory submission. The Party explained in the NIR (p.3-46) that CH_4 and N_2O EFs for on-road gasoline and diesel oil vehicles were developed on the basis of annual certification data compiled by EPA instead of regression analyses (for N_2O) or the ratio of non-methane organic gas emission standards (for CH_4). It remarked during the review that certification data containing CH_4 and N_2O emission information for the period preceding 2006 were not available; (b) Resolved. It also explained in the NIR (p.3-46) that the methodology for estimating fuel consumption and emissions from class II and III rail locomotives was updated to use surrogate carload data reported by the company Railinc for 2014 onward, as 2014 is the last year for which the Party was able to receive class II and III fuel consumption data from the American Short Line and Regional Railroad Association; (c) Not resolved. During the review, the Party confirmed that it will apply a more consistent methodology over time to estimate vehicle miles travelled for on-road vehicles by vehicle type; (d) Not resolved. The ERT noted that the emissions from urea use for non-agricultural purposes presented on page 4-32 of the NIR did not contain any specific information on trucks. It also noted that, according to annex 5 to the NIR (p.A-493), N_2O emissions from biomass fuel use in	Items (a) and (b) were addressed in the 2020 submission as noted by the ERT. For item (d), the United States notes that urea use in trucks is captured under Urea Consumption for Non-Agricultural Purposes. For example, see pg. 4-32 of the 2020 NIR that indicates "In addition, urea is used for abating nitrogen oxide (NO_x) emissions from coal-fired power plants and diesel transportation motors." Emissions from urea use in trucks is specifically captured under this source. Furthermore, in the current (i.e., 2022) NIR the United States has updated the estimate for non-CO_2 emissions from bio-jet fuel and found them to be insignificant. See Annex 5 of the 2022 NIR. Additional research (i.e., on issue c) and improvements will be undertaken in stages over future submissions, pending data availability.

		domestic aviation were not estimated as they are considered insignificant. During the review, the Party confirmed that it will include research results and document minor emissions sources not currently included in the inventory in stages over the 2021 and 2022 inventory submissions, pending data availability.	
E.12	1.A.3.b Road transportation – liquid fuels – CO_2 (E.16, 2019) (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 ERT noted that the Party did not revise the CO_2 EFs for diesel oil and gasoline for subcategory 1.A.3.b road transportation in the 2020 inventory submission and continued to use constant values for the EFs for gasoline (67.62 t CO_2/TJ) for 2008–2017 (the EFs vary between 70.68 and 71.55 t CO_2/TJ for other years) and for diesel (70.10 t CO_2/TJ) for the entire time series, without justifying the accuracy of the EFs. During the review, the Party clarified that it is in the process of updating the time series of diesel oil and gasoline CO_2 EFs, and that additional considerations identified by expert input during the 2020 inventory compilation cycle had the update. The Party expected to address this issue in the 2021 inventory submission.	This issue was addressed in the current submission (i.e., 2022 submission). The update of the time series of diesel and gasoline was implemented in the previous (i.e., April 2021) NIR submission. See the Recalculations discussion in the Energy Chapter on page 3-40 in the submission available online on UNFCCC website https://unfccc.int/documents/272415 or on EPA's website at https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2019.
E.13	1.A.3.b Road transportation – liquid fuels – CO_2 (E.17, 2019) (E.27, 2018) Completeness	Addressing. 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 inventory was not updated to account for possible emissions from the fossil carbon component of biofuels. The Party explained in footnote 97 to page 3-114 of the NIR that CO_2 emissions from biodiesel do not include emissions associated with the carbon contained in methanol used in the process of combustion, as emissions from methanol use in combustion are assumed to be accounted for under NEU. It also explained in a footnote to page A-134 of NIR annex 2.3 that natural gas used as a petrochemical feedstock includes use in production of methanol and that, as a result, the carbon storage factor developed for natural gas as petrochemical feedstocks (65 per cent stored and 35 per cent emitted for 2018) takes into consideration the emissions from the use of the resulting products, including methanol. However, the ERT noted that table A-67 of NIR annex 2.3 (p.A-136) shows the carbon stored and emitted by products obtained from petrochemical feedstock for 2018 but provides no specific information on methanol, which is one of the products obtained from	In addition to the existing documentation described in the NIR (footnote 91 and footnote 85 in Annex 2.3), the United States will continue to examine ways to incorporate information into Table A-67 of NIR Annex 2.3 to further clarify uses of methanol as part of petrochemical feedstocks.

		natural gas. During the review, the Party clarified that it will examine ways to incorporate more information into table A-67 of NIR annex 2.3 to further clarify uses of petrochemical feedstocks. The ERT considers that the issue of possible underestimation has not been fully addressed, since emissions from methanol combustion, which is assumed to be included under NEU (CRF category 1.A.5 other), are not transparently estimated and reported.	
E.14	1.A.3.b Road transportation –liquid fuels – CH_4 and N_2O (E.18, 2019) (E.28, 2018) Convention reporting adherence	Addressing. 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 reported in the NIR (p.3-44) that CH_4 and N_2O EFs for alternatively fuelled vehicles were developed on the basis of the 2018 GREET model and provided a related reference in annex 3.2 (p.A-219) (Argonne National Laboratory, 2018). It also provided a reference for the MOVES model in annex 3.2 (p.A-220). During the review, the Party reiterated its plans to incrementally improve discussion of the validity of the MOVES and GREET models in future inventory submissions. In relation to the list of provisional main findings, the Party provided an additional document (EPA, 2020) showing that the CH4 and N_2O EFs for on-highway gasoline and diesel vehicles generated by MOVES2014b were reviewed by experts in October 2019. The ERT considers that this issue has not been fully addressed as no reference to the expert review of EFs was included in NIR.	The United States plans to incrementally improve the discussion of the validity of the MOVES model in future submissions.
E.15	1.A.5.b Mobile – solid and gaseous fuels, and biomass use – CO_2, CH_4 and N_2O (E.21, 2019) (E.31, 2018) Transparency	Addressing. 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". The Party reported in CRF table 1.A(a) (sheet 4) "NO" for consumption of solid and gaseous fuels and biomass for CO_2, CH_4 and N_2O emissions for subcategory 1.A.5.b other – mobile (military) for the whole time series, but "NA" for other fossil fuels.	This issue was addressed in the current submission, see CRF Table1.A(a)s4 in the 2022 Inventory Submission, the CO_2, CH_4 and N_2O emissions from solid, gaseous, biomass and other fossil fuels use in 1.A.5.b (other mobile (military)) are all reported as NO.
E.17	1.B.2.c Venting and flaring – CO_2 and CH_4 (E.23, 2019) (E.16, 2018) (E.20, 2016) (E.20, 2015)	Addressing. Enhance transparency in reporting CH4 emissions from petroleum systems from venting and flaring, in accordance with the UNFCCC Annex I inventory reporting guidelines. The Party still reported "IE" for CO_2 and CH4 emissions from venting and flaring in CRF table 1.B.2 and did not provide any specific information on venting and flaring in the NIR. During the review, the Party reiterated the clarification and response provided during previous reviews, namely that providing an	The United States reiterates its previous clarification and response provided during previous reviews. Language was added to the NIR, noting "The United States reports data to the UNFCCC using this Inventory report along with Common Reporting Format (CRF) tables. This note is provided for those reviewing the CRF tables: The notation key "IE" is used for CO_2 and CH_4 emissions from venting and flaring in CRF table 1.B.2. Disaggregating flaring and venting estimates across the

	Transparency	estimate of disaggregated flaring and venting emissions would involve the application of many assumptions, which would result in inconsistent reporting and, potentially, decreased transparency. The Party also clarified during the review that there were inconsistencies in data availability across segments (such as gathering) within oil and gas activities systems and noted that EF data available for activities that cover flaring (such as heavy fuel oil well completions with flaring) include emissions from multiple sources (flaring, venting and leaks).	Inventory would involve the application of assumptions and could result in inconsistent reporting and, potentially, decreased transparency. Data availability varies across segments within oil and gas activities systems, and emission factor data available for activities that include flaring can include emissions from multiple sources (flaring, venting and leaks)." This language can be found on page 3-76 and 3-94 and 3-95 of the 2021 NIR and the same language is also included in in Chapter 3, Sections 3.6 and 3.7 of the current submission (2022 NIR).
E.18	1.C CO_2 transport and storage – CO_2 (E.25, 2019) Transparency	Not Resolved. 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 CO_2 geological storage formations is assessed for both EOR and CCS projects. No progress was reported in the NIR, and CO_2 emissions for subcategories 1.C.2.a injection and 1.C.2.b storage were reported as "IE" for all years of the time series in the 2019 and 2020 inventory submissions. During the review, the Party clarified that it will continue to review new data available from the GHGRP and other sources of information for consideration in updating emission estimates and allocations from category 1.C.1 transport of CO_2 and subcategories 1.C.2.a injection and 1.C.2.b storage. The Party indicated that it will provide an update, as appropriate, in future inventory submissions on recalculations and planned improvements, where feasible.	The United States continues to review new data from its GHGRP and other sources for consideration in updating emissions estimates from transport of CO_2 (category 1.C.1), injection (category 1.C.2.a), and 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.19	1.C CO_2 transport and storage – CO_2 (E.26, 2019) Comparability	Not resolved. 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 CO_2 geological storage formations is assessed for both EOR and CCS projects. The total amount of CO_2 captured for storage was reported as "NA" for all years of the time series in the 2019 and 2020 inventory submissions. During the review, the Party clarified that it will review and correct notation key use as appropriate in a future inventory submission.	This issue has been addressed in the latest submission. The United States reviewed and corrected the notation keys reported under 1.C.2 as appropriate.
E.20	1.C CO_2 transport and storage – CO_2 Comparability (E.26, 2019)	Not resolved. Report the total amounts of CO_2 injected at storage sites and the total leakage from transport, injection and storage as "IE". CO_2 emissions for the total amounts of CO_2 injected at storage sites and total leakage from transport, injection and storage were reported as "NA" for all years of the time series in the 2019 and 2020 inventory submissions. During the review, the Party clarified that it will review and correct notation key use as appropriate in a future inventory submission.	This issue has been addressed in the current (i.e., 2022) submission. The United States reported the total amounts of CO_2 injected at storage sites and the total leakage from transport, injection and storage as "IE".

E.21	Fuel combustion – reference approach – gaseous and liquid fuels – CO_2 Convention Reporting Adherence	The Party provided an explanation in annex 4 to the NIR of the comparison between the reference approach and the sectoral approach. The energy data presented in NIR table A-249 (pp.A-490–A-491) for fuel consumption under the reference approach match the data presented in CRF table 1.A(c); however, the energy data reported under the sectoral approach do not match those presented in CRF table 1.A(c) for natural gas, petroleum and total values (excluding other fossil fuels). For example, NIR table A-249 shows natural gas consumption of 30,788 TBtu for 2018 under the sectoral approach, equal to 34,483.2 PJ, whereas a value of 32,630.1 PJ is given in CRF table 1.A(c). During the review, the Party clarified that the natural gas data presented in NIR table A-249 include natural gas for combustion and NEU, and that the gaseous fuels data in CRF table 1.A(c) are derived from CRF table 1.A(a) and include natural gas for combustion and NEU as well as still gas for NEU, which is included as a gaseous fuel as opposed to a liquid fuel. The ERT recommends that the Party consistently treat still gas as liquid fuel under the sectoral and reference approaches to improve consistency between CRF tables 1.A(a), 1.A(b), 1.A(c) and the NIR table that compares fuel consumption under the two approaches (see also ID# E.22 below).	The United States reports Still Gas under petroleum in the NIR because it is a petroleum product. However, still gas is physically a gas, consisting primary of methane and ethane, and some hydrogen and other trace gases. Therefore, the United States will continue to report still gas as a gaseous fuel in CRF. The most recent submission also lists still gas as a gaseous fuel in the NIR. See Tables A-228 through A-231 in the current 2022 NIR.
E.22	Fuel combustion – reference approach – all fuels – CO_2 Comparability	The Party reported the quantity of carbon stored (carbon excluded) in CRF table 1.A(b) and the quantity of carbon excluded from the reference approach in CRF table 1.A(d). The ERT notes that the total carbon stored in liquid, solid and gaseous fuels for 2018 (60,469.88 kt C) is exactly the same in both tables, but that the disaggregated values are drastically different. For example, carbon stored in liquid, solid and gaseous fuels are reported as 57,034.45, 562.68 and 2,872.72 kt C, respectively, in CRF table 1.A(b) but as 38,903.00, 16,784.93 and 4,781.96 kt C, respectively, in CRF table 1.A(d). During the review, the Party clarified that the data in CRF table 1.A(d) were taken from the reference approach but recharacterized to reflect the Party's fuel categories, as explained in NIR annex 4 (p.A-483). It also clarified that asphalt and road oil are treated as a solid fuel, and still gas is treated as a gaseous fuel (see ID# E.21 above, under both the reference and the sectoral approach. The ERT is of the view that treating asphalt and road oil as a solid fuel is not in accordance with the 2006 IPCC Guidelines (vol. 2, table 1.1). To improve consistency between CRF tables 1.A(b) and 1.A(d) and compliance with the 2006 IPCC Guidelines, the ERT recommends that the Party consistently categorize asphalt and road oil as liquid fuels under both the reference and sectoral approaches.	The United States has updated the CRF in the current (i.e., 2022) submission so that Asphalt and Road Oil are reported as a liquid fuel in Tables 1.A9(b) and 1.A(d) for consistency with how it is reported in the NIR.

E.23	Feedstocks, reductants and other NEU of fuels – all fuels – CO_2 Convention Reporting Adherence	The ERT noted that the Party reported CO_2 emissions from NEU of fuels under category 1.A.5.a in CRF table 1.A(a)s4 and only reported them for certain years (1990, 2005 and 2014–2018) in NIR table 3-20 (p.3-48). The data from the two sources are different; for example, the NIR and CRF table 1.A(a)s4 report 129.5 and 136.4 Mt CO_2, respectively, for 2018. During the review, the Party clarified that, in CRF table 1.A(a)s4, category 1.A.5.a covers incineration of waste, United States territories and NEU. Emissions from NEU listed in CRF table 1.A(a)s4 do not include NEU of lubricants and other petroleum in United States territories (i.e. American Samoa, Guam, Puerto Rico, the United States Virgin Islands, Wake Island and other United States Pacific islands); these emissions are allocated to territories together with other emissions in United States territories. For example, for 2018, the total emissions from NEU of lubricants and other petroleum in United States territories stood at 136.4 Mt CO_2 (i.e., 5.1 Mt CO_2 (NIR table 3-22, p.3-20) plus 129.5 Mt CO_2 (CRF table 1.A(a)s4)), as reported in NIR table 3-20. The ERT concluded that the NIR and CRF tables do not transparently explain what is included under category 1.A.5.a. The ERT recommends that the Party reconcile the emission data on NEU of fuel reported in the NIR and CRF table 1.A(a)s4 by either reallocating NEU of lubricants and other petroleum in United States territories to NEU in CRF table 1.A(a)s4 or adding a footnote to NIR table 3-20 to explain how the data reported in that table differ from those presented in CRF table1.A(a)s4.	This issue has been addressed in the current (i.e., 2022) submission. A footnote was added to Table 3-20 in the NIR explaining the differences.
E.24	Feedstocks, reductants and other NEU of fuels – solid fuels – CO_2 Transparency	Whereas the Party reports in the NIR (p.3-50; annex 2.3, pp.A-133 and A-156) that storage factors, including those for industrial coking coal and distillate fuel oil (0.1 and 0.5, respectively), were taken from the 2006 IPCC Guidelines, which in turn draw on data from Marland and Rotty (1984), the ERT understands that the 2006 IPCC Guidelines do not provide storage factors for NEU of fuels. During the review, the Party clarified that the storage factors for industrial coking coal and distillate fuel oil were taken from the Revised 1996 IPCC Guidelines but primarily from Marland and Rotty (1984). The ERT recommends that in future submissions the Party include the correct reference, that is to the Revised 1996 IPCC Guidelines rather than the 2006 IPCC Guidelines, for storage factors for industrial coking coal and distillate fuel oil, together with a justification of their applicability	This issue has been addressed in the current 2022 NIR submission. The reference has been changed to the original source of the data Marland and Rotty (1984). Annex 2.3 provides the justification for use of these factors.

E.25	Fuel combustion – reference approach – other fossil fuels – CO_2, CH_4 and N_2O Consistency	Data on the non-biomass portion of waste, reported to IEA for all years, are missing from CRF table 1.A(b). In the 2020 submission, the ERT notes that the AD and emissions for other fossil fuels are reported under CRF categories 1.A.1.a (public electricity and heat production) and 1.A.5.a (incineration of waste) under the sectoral approach, but as "NA" in CRF tables 1A(b) and 1A(c) under the reference approach, for the whole time series. During the review, the Party clarified that comparisons of energy use and CO_2 values between the sectoral and reference approaches concern only fossil fuel sources (coal, natural gas and petroleum) and exclude waste fuels for reasons of consistency, as shown in table A-250 (NIR annex 4, p.A-491). The ERT recommends that the Party either take into account other fossil fuels under the reference approach when completing CRF table 1.A(b) or document that waste fuels are not used in the comparison between the sectoral and reference approaches in order to improve consistency between the reference and sectoral approaches in terms of estimation coverage, and amend the reference approach column in CRF table 1.A(c) as needed.	This issue has been addressed in the current 2022 NIR submission. Language was added to Annex 4 of the NIR to indicate that waste fuels are not used in the comparison between the sectoral and reference approaches in order to improve consistency between the reference and sectoral approaches in terms of estimation coverage.
E.26	Fuel combustion – reference approach – LPG – CO_2 Comparability	The ERT noted that data on LPG production, trade and stock changes reported under NGL in CRF table 1.A(b) seem to be different to those reported to IEA. For example, apparent consumption of NGL for 2017 is reported in the CRF table as 3,634,913 TJ (gross calorific value), equivalent to 3,453,168 TJ (NCV), but to IEA as 4,669,988 TJ (NCV), while LPG is reported as "NA" in the CRF table and as –1,238,360 TJ (NCV) to IEA. All headings for LPG are reported as "NA" except for "C stored" for the whole time series in CRF table 1.A(b). During the review, the Party clarified that LPG is a fuel category under the sectoral approach while NGL is not. LPG statistics reported under the sectoral approach consist of both NGL and LPG (as explained briefly in NIR annex 4, p.A-483), while under the reference approach, LPG falls under NGL and liquefied refinery gases, whose carbon content is based on the EF for LPG reported under the sectoral approach. The Party believes that this is the most accurate approach for calculating emissions under both the sectoral and reference approaches. The ERT recommends that the Party either estimate NGL and LPG consistently between the reference and sectoral approaches or explain in the NIR why covering different fuels under the reference approach applying a different list of fuels than that used for the sectoral approach is the most accurate way to estimate emissions under both approaches, and change the notation key reported for LPG in CRF table 1.A(b) from "NA" to "IE".	The discussion in Annex 4 of the NIR has been updated to further clarify differences in the fuel definitions in the reference and sectoral approach. LPG as a category is no longer used; it was replaced with Hydrocarbon Gas Liquids (HGL). The following language was included "Additionally, the accounting of pentanes plus as a part of HGL is different between the approaches. The United States reports consumption of all HGL components (i.e., ethane, propane, isobutane, normal butane, ethylene, propylene, isobutylene, butylene, and pentanes plus) for both approaches, but in the Sectoral Approach, pentanes plus is accounted for separately from other HGL components whereas it is included in HGL in the Reference Approach." Furthermore, the notation key reported for LPG in CRF table 1.A(b) has been changed from "NA" to "IE".

E.27	1.A.2.g Other (manufacturing industries and construction) – all fuels – CO_2, CH_4 and N_2O Transparency	The ERT noted that, in the recalculation performed for subcategory 1.A.2.g (other) in the 2020 submission, the values reported for fuel consumption and CO_2 emissions were reduced by more than 20 per cent for the whole time series, whereas those reported for CH_4 and N_2O emissions were reduced by only 5–6 and 2–3 per cent, respectively. It also noted that fuel distribution among categories changed significantly in the 2020 submission compared with the 2019 submission. For example, for 2017, fuel consumption increased by 2,838,783.55 TJ under category 1.A.1 and decreased by 2,930,213.62 TJ under category 1.A.2 and by 293,474,205 TJ under subcategory 1.A.2.g. According to the explanation provided in the NIR (pp.3-38–3-39), EIA updated the data for LPG consumption in economic sectors and revised sector allocations for propane and total LPG for 2010–2017, and for natural gas, distillate fuel oil and kerosene for 2017, without providing any explanation for the significant changes noted by the ERT. The discussion in the NIR (pp.3-38–3-39) of the impact of the recalculation on overall emissions similarly fails to broach these changes. During the review, the Party noted that, in addition to the reallocation of liquid fuels, as reported in the NIR (box 3-4, p.3-34), the values reported in the CRF tables for petroleum refining (subcategory 1.A.1.b) and manufacture of solid fuels (subcategory 1.A.1.c) were corrected to include part of the total fuel consumption when calculating energy use under subcategory 1.A.2.g. That correction accounted for most of the revisions in energy use between categories 1.A.1 and 1.A.2 for 2017. The Party explained that biomass energy use under category 1.A.2 and related non-CO_2 emissions are not disaggregated to subcategories (i.e., 1.A.2.a–f) and are reported only under subcategory 1.A.2.g, whereas biomass consumption remains unchanged in the 2020 submission. It noted that since the majority of non- CO_2 emissions are driven by biomass combustion, the adjustment made to fossil energy use and CO_2 emissions did not have as significant an impact on non-CO_2 emissions. The ERT recommends that the Party provide information in the NIR on the recalculation of emission estimates and clearly indicate the reason for any changes and corrections compared with previous submissions.	The United States has provided information in the NIR on the recalculation of emission estimates and clearly indicated the reason for any changes and corrections compared with previous submissions. See, for example, the recalculation discussions in Section 3.1 of the Energy chapter of the NIR.
E.29	1.A.3 Transport– all fuels – CO_2, CH_4 and N_2O Transparency	In CRF summary table 3, the United States reported on its use of a combination of default and higher-tier methods and a mix of default and country-specific EFs for estimating GHG emissions for subcategory 1.A.3, which was identified as a key category in NIR annex 1 (p.A-3). However, the NIR did not contain an explanation for every instance of the default method and parameters being used to estimate emissions for key	This issue was addressed in the previous (i.e., 2021) submission. See Section 3.1, pp. 3-46 of the 2021 NIR which states that "The non-road mobile category for CH_4 and N_2O includes ships and boats, aircraft, locomotives and off-road sources (e.g., construction or agricultural equipment). For non-road sources, fuel-based emission factors are applied to data on fuel consumption, following the IPCC Tier 1 approach,

		categories. The ERT noted that this is not in accordance with paragraphs 11 and 50(c) of the UNFCCC Annex I inventory reporting guidelines, which state that the Party should make every effort to use a method recommended in the 2006 IPCC Guidelines or otherwise shall explain in its annual GHG inventory submission why it was unable to implement a recommended method in accordance with the decision trees in the 2006 IPCC Guidelines. During the review, the Party clarified that the use of default methods for gases for subcategories within the key categories (1.A.3) estimating CH4 and N_2O emissions from off-road transport (category 1.A.3) could be enhanced. The ERT noted that the reasons for the Party's inability to implement higher-tier methods for this category were not transparently described in the NIR. In response, the Party explained why it had been unable to implement higher-tier methods for estimating CH_4 and N_2O emissions from off-road transport (category 1.A.3). The ERT recommends that the United States include the explanation shared with the ERT during the review in its NIR describing why it was unable to implement a recommended method in accordance with the decision trees in the 2006 IPCC Guidelines, as outlined in paragraphs 11 and 50(c) of the UNFCCC Annex I inventory reporting guidelines, where default methods and emission parameters were used for estimating GHG emissions and removals for categories identified as key, particularly for category 1.A.3 (CH_4 and N_2O for off-road sources), which includes ships and boats, aircraft, locomotives and off-road sources (i.e. construction or agricultural equipment).	for locomotives, aircraft, ships and boats. The Tier 2 approach would require separate fuel-based emissions factors by technology for which data are not available. For some of the non-road categories, 2-stroke and 4-stroke technologies are broken out and have separate emission factors; those cases could be considered a Tier 2 approach."
E.30	1.A.5.a Stationary – other fossil fuels – CO_2, CH_4 and N_2O Accuracy	According to the NIR (p.3-56; table 3-27, p.3-57), the amount of waste incinerated for 2012–2018 is assumed to be equal to the amount for 2011, and waste discarded for 2014–2018 is constant. This results in a constant ratio of incinerated waste to total waste for 2014–2018 (7.6 per cent). The ERT notes that according to historical data on MSW generation in the United States for 2000–2018 published on the OECD website (https://data.oecd.org/waste/municipal-waste.htm), 265.2 Mt waste was generated in 2018, whereas according to the NIR (table 3-27) this figure is 273.1 Mt. It also notes that the OECD data are comparable to those used for estimating emissions from waste incineration, as reported in the NIR, and do not show how much of the waste is incinerated. During the review, the Party acknowledged that the reporting of constant values for waste incineration for years after 2011 is an issue and stated that it has drawn up an improvement plan to investigate additional sources of MSW data (NIR p.3-58), including data on how much waste is incinerated, and will include the results in a future submission. The ERT recommends that the	This issue has been addressed in the current (i.e., 2022) submission. The methodology for waste incineration was updated for the 2022 submission. See the NIR Energy chapter Section 3.3 for a discussion of the updated methodology.

		Party use updated data to estimate GHG emissions from waste incineration, including by updating the amount of waste generated and the ratio of incineration for the latest year of the time series, and examine the applicability of data from the OECD website and other sources.	
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I.3	2.A.4 Other process uses of carbonates – CO_2 (1.3, 2019) (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 reported CO_2 emissions from other limestone and dolomite use under category 2.A.4.d (other) in NIR section 4.4 and CRF table2(I).A-Hs1, but "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 reported its progress and the status of this issue in the NIR (p.4-27). During the review, the Party clarified that there is no reportable progress in identifying data for the estimation of emissions based on further outreach and that efforts continue under the current cycle (see NIR annex 5, p.A-495).	See Annex 5 of the current (i.e., 2022) NIR. Using recently identified surrogate data in place of activity data as identified in the *2006 IPCC Guidelines*, the United States assessed that national emissions from ceramics production will exceed the category-level threshold for significance of 500 kt. EPA is still assessing if emissions are already reflected in other process uses of carbonates. The United States has made no reportable progress in identifying data to estimate emissions for non-metallurgical magnesium production based on further outreach. Efforts will continue with next Inventory cycle.
I.4	2.B.1 Ammonia production – CO_2 (I.4, 2019) (I.7, 2018) (I.19, 2016) (I.19, 2015) Comparability	Not resolved. 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 reported CO_2 emissions from fossil fuel use as fuel for energy use for ammonia production under the energy sector (NIR p.4-27). During the review, the Party clarified that its planned improvements (NIR p.4-31) include assessing anticipated new data for updating EFs to include both fuel and feedstock CO_2 emissions and to improve consistency with the 2006 IPCC Guidelines (vol. 3, chap. 3.2). The Party indicated that this is a long-term improvement to be included in the 2024 or 2025 submission at the earliest. Until these additional data are available and have been assessed as indicated in the NIR, consistently with the UNFCCC Annex I inventory reporting guidelines, the United States has provided an explanation on the use of a country-specific or national method as noted in the NIR (p.4-29).	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. See the NIR IPPU chapter Section 4.5 for the discussion of the country-specific methodology. 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 Guidelines*. 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.2 Nitric Acid production – N_2O (I.25, 2019) Transparency	Not resolved. Include in the NIR an explanation of the trends observed for N_2O emissions and AD for nitric acid production. The observed trends in N_2O emissions and AD for nitric acid production for 2014–2016 were not explained in the NIR. During the review, the Party clarified that work is ongoing to update trend explanations in the 2021 submission.	This issue has been addressed in the current April 2022 submission. See the NIR IPPU chapter Section 4.7 for an expanded discussion on observed trends in emissions and nitric acid production.
I.8	2.B.4 Caprolactam, glyoxal and glyoxylic acid production – N_2O (I.7, 2019) (I.31, 2018) Completeness	Not resolved. Gather the necessary data and report N_2O emissions from glyoxal and glyoxylic acid production. The Party reported AD and N_2O emissions from glyoxal and glyoxylic acid production as "NE" in CRF table 2(I).A-Hs1. During the review, the Party clarified that potential data sources for glyoxal and glyoxylic acid were being investigated on the basis of ongoing research. It stated that progress on AD gathering and N_2O estimates will be included in the 2022 or 2023 submission. If production of glyoxal and/or glyoxylic acid is found to not occur in the United States, then the notation key will be revised from "NE" to "NO".	See Annex 5 of the current (2022) NIR. EPA has identified potential data sources for glyoxal, and glyoxylic acid based on ongoing research efforts. Using limited data on the range of domestic production and import of glyoxal, EPA estimates that emissions from glyoxal production do not exceed the category-level threshold for significance of 500 kt in recent years. Research suggests that glyoxylic acid may not be produced in the United States at levels that would exceed the category-level threshold for significance of 500 kt. EPA hopes to report more progress in the next (i.e., April 2023) submission, but anticipates the earliest reflection of this data, if useful, would be the April 2024 submission as additional historical data to develop the time series has not been identified.
I.9	2.B.5 Carbide production – CO_2 (I.8, 2019) (I.32, 2018) Comparability	Addressing. 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 reported CO_2 emissions from coke use for calcium carbide production under the energy sector, with an appropriate explanation in the NIR and the correct notation key ("IE") in CRF table (I).A-H. During the review, the Party clarified that there are no AD for calculating CO_2 emissions from calcium carbide production under the IPPU sector. The ERT noted that, according to annex 5 to the NIR (pp.A-495–A-496), EPA has initiated research to obtain data from the limited production facilities in the United States (fewer than five). During the expert review of the inventory compilation, EPA sought input on production data for CO_2 emissions from calcium carbide production but was unable to identify data sources for applying tier 1 methods.	The United States reiterates that a country-specific approach was taken for CO_2 emissions from production of calcium carbide. Footnote 15 in the 2022 NIR (pp. 4-19) 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 indicates that CO_2 (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 percent for petroleum coke used in non-energy uses. This indicates effectively that 70 percent 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 (as is done for silicon carbide) since production data are not available for calcium carbide to estimate emissions directly.

I.11	2.B.8 Petrochemical and carbon black production –CH_4 and N_2O (I.9, 2019) (I.10, 2018) (I.22, 2016) (I.22, 2015) Completeness	Not resolved. 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 Party stated in the NIR (p.4-63) that CH_4 emissions from ethylene production reported under the GHGRP have not been included as this would result in double counting of carbon (i.e. all carbon in the CH_4 emissions would also be included in the CO_2 emissions from ethylene processing units, which are subset of facilities reporting under the GHGRP use alternative methods to the carbon balance approach). During the review, the Party clarified that EPA continues to assess the GHGRP data to determine how best to disaggregate and incorporate them into the inventory.	The United States also points to Section 4.13 of the 2022 NIR in the QA/QC and Verification discussion, 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 carbon at least is already included in CO_2 emission estimates. The United States continues to assess its 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.12	2.B.8 Petrochemical and carbon black production –CO_2 and CH_4 (I.10 2019) (I.12, 2018) (I.25, 2016) (I.25, 2015) Comparability	Addressing. 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 ERT considers that the recommendation has not been addressed because the CO_2 emissions for category 2.B.8 were not fully allocated to the IPPU sector. As with ID# E.5 above, the Party will resolve this issue by describing how the country-specific approach is better able to reflect its national situation and providing a description of how these methodologies are compatible with the 2006 IPCC 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*. Per question E.5, the issue of potential double counting is discussed in the current 2022 submission. See Section 4.13 of the 2022 NIR for the following discussion: "It is important to ensure no double counting of emissions between fuel combustion, non-energy use of fuels and industrial process emissions. For petrochemical feedstock production, our review of the categories suggests this is not a significant issue since the non-energy use industrial release data includes different categories of sources and sectors than those included in the IPPU emissions category for petrochemicals. As noted previously in the methodology section, data integration is not available at his time because 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. Also, GHGRP-reported data on quantities of fuel consumed as feedstocks by petrochemical producers is unable to be used due to the data failing GHGRP CBI aggregation criteria."

I.16	2.C.1 Iron and steel production – CO_2 (I.14, 2019) (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 Party explained in NIR section 4.16 and annex 2 the allocation of the CO_2 emissions from iron and steel production across both the IPPU and energy sectors. In its clarifications on the list of provisional main findings, the Party indicated that factors are reported transparently in the NIR (p.4-80), including the material carbon contents for metallurgical coke production (NIR table 4-66) and the production and consumption data for the calculation of CO_2 emissions from metallurgical coke production (NIR tables 4-67 and 4-68). However, the ERT noted that the United States did not confirm its allocation of CO_2 emissions from coke production through a fully transparent tracking of carbon flows as per the previous recommendation. The ERT considers that the recommendation has not yet been fully addressed because the Party did not confirm the allocation of CO_2 emissions from coke production by providing a fully transparent tracking of carbon flows.	The United States reiterates that the Party has transparently reported in its NIR. See the 2022 NIR Annex 2.1 for 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. 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.17	2.C.4 Magnesium production – SF_6 (I.15, 2019) (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 Party did not report in the NIR the outcomes of any such investigation or the reasons for the increase in the SF_6 IEF between 2009 and 2011. During the review, the Party clarified that the increase in SF_6 emissions between 2010 and 2011 was attributable partially to one facility anomalously reporting high emissions for 2011 and partially to increased production. It also stated that the 2021 NIR will include a discussion on the trends in the SF_6 IEF. The ERT noted that the SF_6 emissions for 2009–2011 were revised in the previous submission and approved by the ERT, and that there have been no new recalculations since the previous submission. The ERT considers that the recommendation has not yet been fully addressed because the Party did not include in the NIR an explanation of the outstanding trends on the IEF for magnesium production.	Adjustments to the activity data are discussed in the recalculation sections of Section 4.20 in the 2019 and 2020 NIRs. The 2021 NIR included a discussion on the trends in the SF_6 IEF. The revised activity data more accurately reflects the change in production that occurred during the recession. The large increase in SF_6 emissions from 2010 to 2011 is due in part to 1 facility reporting anomalously high emissions in 2011 and also partially due to increased production.

I.18	2.D Non-energy products from fuels and solvent use – CO_2 (I.16, 2019) (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 Party reported CO_2 emissions from paraffin wax as "IE" under category 2.D (non-energy products from fuels and solvent use). The ERT noted that AD on the use of waxes are available for the Party, for example, in NIR table 3-22 (pp.3-49 and 3-50). The ERT is of the view that emissions from wax use could be determined on the basis of the statistical information and assumptions provided in the NIR and reported under category 2.D.	As per ID # above E.4, 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 2021 NIR. The United States continues to evaluate ways to update this approach, including reallocation of lubricant non-combustion emissions and will provides more clarification as applicable in future Inventory NIRs (i.e., 2023 submission).
I.23	2.G.2 SF_6 and PFCs from other product use – SF_6 (I.22, 2019) (I.37, 2018) Completeness	Addressing. Investigate possible SF_6 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 SF_6 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 Party reported SF_6 emissions for category 2.G.2 as "NE" and PFC emissions as "NA" in CRF table 2(II). It clarified in NIR annex 5 (p.A-496) that emissions from some particle accelerators and from military applications are reported by the Government to the Federal Energy Management Program. The updated analysis of the underlying data for 2018 identified fugitive SF_6 emissions of pproximately 600 kt CO_2 eq. The Party noted that the sources of the identified emissions are probably particle accelerators and compounds commonly used as fluorinated heat transfer fluid (NIR p.A-496). According to NIR annex 5 (p. A-496), EPA plans to contact reporting agencies to better understand the sources of the emissions and the estimation methods used by reporters. The ERT considers that the recommendation has not yet been resolved because the identified emissions of SF_6 and PFCs for category 2.G.2 were not reported in the CRF tables.	See Annex 5 of the NIR. EPA's analysis of reported data is ongoing, and EPA is continuing to review the available reported data and the methods used to estimate emissions.
I.26	2.A.1 Cement production – CO_2 Accuracy	The United States reported in the NIR (p.4-10) that it used the tier 2 method from the 2006 IPCC Guidelines for estimating CO_2 emissions for the key category 2.A.1 cement production. The ERT noted that non-carbonate sources of CaO in clinker production were not taken into consideration, as stated in the NIR (p.4-11), whereas it is good practice under the chosen tier 2 method to identify non-carbonate sources, for example slag, fly ash and so on, and exclude them from CaO content in clinker (2006 IPCC Guidelines, vol. 3, chap. 2, pp.2.12 and 2.14). During the review, the Party confirmed that non-carbonate sources of CaO were not included in the estimates and informed the ERT about a planned	The United States continues to review data from GHGRP and other sources on CaO content of clinker and inputs of non-carbonate CaO for consideration in order to estimate a country-specific CO_2 emission factor for clinker. An update will be provided, as appropriate, in future submissions.

		improvement involving the identification of non-carbonate raw materials used in clinker production. The ERT noted that the estimates of CO_2 emissions for category 2.A.1 cement production may be not accurate because non-carbonate sources of CaO were not included in the estimates, which is not in compliance with the Party's chosen tier 2 method from the 2006 IPCC Guidelines. The ERT recommends that the Party identify the amount of non-carbonate sources of CaO used in cement production (category 2.A.1) by fully implementing the planned improvement related to the use of non-carbonate raw materials in clinker production, and revise estimates of CO_2 emissions in accordance with the tier 2 method from the 2006 IPCC Guidelines by correcting the amount of CaO from non-carbonate sources if data of noncarbonate CaO sources are available.	
I.27	2.A.3 Glass production – CO_2 Transparency	The Party used the tier 3 method from the 2006 IPCC Guidelines (vol. 2, chap. 2.4, p.2.28) for estimating CO_2 emissions from glass production on the basis of carbonates used, including limestone, dolomite and soda ash (NIR p.4-20). According to the NIR (section 4.3), AD on carbonate use can be obtained directly from national statistics and are not consistent across the time series. For example, dolomite consumption is reported as 541 kt for 2005 but as 0 kt for 2014–2018 (NIR table 4-12, pp.4-20–4-21). During the review, the Party clarified that updating the AD for glass production is a priority among its planned improvements. In its clarifications to the ERT, the Party reiterated information in the NIR that may impact data consistency, such as withheld data. The ERT recommends that the Party explain transparently in the NIR the reasons for the dramatic reduction in reported dolomite use for glass production, from 541 kt for 2005 to 0 kt for 2014–2018, and ensure that all major carbonates (limestone, dolomite and soda ash) are estimated for the whole inventory period.	This issue has been addressed in the latest submission. New AD on dolomite is consistent across the time series. See the current 2022 NIR IPPU chapter Section 4.3 for a discussion on new AD from GHGRP used for 2010-2020 and a revised methodology for 1990-2009 to address time-series consistency.
I.28	2.B.7 Soda ash production – CO_2 Transparency	The Party reported in NIR table 4-44 (p.4-56) the soda ash production AD used for estimating CO_2 emissions. However, the ERT noted that according to the NIR (p.4-55), the EF for CO_2 emissions was applied for trona consumption (0.0974 t CO_2/t trona) but not for soda ash production. During the review, the Party clarified that the data provided in NIR table 4-44 correspond not to soda ash production but to trona consumption. The ERT also noted that the AD description provided in CRF table 2(I).A-Hs1 was also not clearly related to trona consumption and still described AD as "soda ash production". The ERT recommends that the Party correct the table heading for the AD from "soda ash production" to "trona consumption" in the NIR and clarify the AD description in CRF table 2(I).A-Hs1.	This issue was addressed in the April 2021 submission. See the previous 2021 NIR IPPU chapter Section 4.12 p. 4-58, table 4-44 for the revised title: Trona Ore Use (kt) and the footnote clarifying that trona ore use is assumed to be equal to trona ore production.

I.29	2.B.10 Other (chemical industry) – N_2O Comparability	The Party reported CO_2 emissions from SiC consumption under category 2.B.10 in CRF table 2(I).A-Hs1 (e.g. some 97.41 kt CO_2 in 2018). During the review, the Party clarified that these emissions stem from the use of SiC in non-abrasive applications, which include steel smelting and other end-uses, where SiC is heated to a sufficiently high temperature that carbon is oxidized and released as CO_2. The ERT agreed with the provided explanation but noted that emissive sources of SiC are not transparently described in the NIR. It also noted that emissions from SiC use were reported in the NIR (section 4.10) as a sum total that also included emissions from SiC production. The ERT recommends that the Party clarify the emissive non-abrasive applications of SiC, document why these emissions are not reported elsewhere (e.g. category 2.C.1) and separately report in the NIR CO_2 emissions from SiC production and SiC use.	See the 2022 NIR IPPU chapter Section 4.10 for clarification on why emissive non-abrasive applications of SiC are reported here and not elsewhere. See also Tables 4-36 and 4-37 which show emissions by SiC production and consumption.
I.30	2.C.1 Iron and steel production – CO_2 Accuracy	The Party included coke breeze production in the estimates of CO_2 emissions from coke production (NIR pp.4-79–4-80). The amount of coke breeze produced was approximated using a production factor of 0.075 t coke breeze/t coking coal consumed (NIR p.4-79) because actual data were not available. However, the ERT noted that actual data on coke breeze production in the United States can be obtained from EIA quarterly coal reports. The ERT compared the estimated data on coke breeze production used in the GHG inventory (1,248 kt coke breeze for 2018) with the EIA statistics (636 kt coke breeze for 2018) and concluded that coke breeze production was potentially overestimated in the inventory. The overestimation of coke breeze production could lead to an underestimation of emissions because the emissions are estimated using the carbon balance method, where the carbon content of products (coke and coke breeze) is subtracted from the carbon inputs (coking coal). During the review, the Party acknowledged the difference between the EIA statistics and the data used for estimating CO_2emissions. In its clarifications on the list of provisional main findings, the Party indicated that: (a) Industry data more accurately represent coke output data in relation to the other industry data used (data on coke production output are linked to other sources of iron and steel production emissions, including sinter production, where coke breeze is often used, and non-energy use of energy where coal tar is utilized); (b) Use of industry data allows for a consistent approach across the different emission categories; (c) Overall, there is no underestimation or overestimation of CO_2 emissions because all carbon associated with the coal used to make the coke is eventually accounted for, either in the coke production process or where the coke is eventually used, and a consistent approach is used to	The United States notes that the methodology used to calculate coke production emissions is described in Section 4.17 of the 2022 NIR. See for example Tables 4-67 and 4-68 on pp. 4-88. The Party continues to assess EIA data on coke breeze production and the impact of this change on emission estimates. The Party will provide an update as appropriate in future submissions.

		track the carbon throughout (see ID# I.31 below). The ERT recommends that the Party revise estimates of CO_2 emissions from coke production taking into account national statistics on coke breeze production, for example from EIA quarterly coal reports, or demonstrate in the NIR that CO_2 emissions from coke production were not underestimated by using industry data on coke breeze production instead of EIA statistics, and explain how there is a consistent approach used to track carbon throughout the calculations.	
I.31	2.C.1 Iron and steel production – CO_2 Accuracy	The Party reported coke consumption for pig iron production in NIR table 4-72 (p.4-83) (e.g. 7,618 kt for 2018) and carbon content in the coke used in estimates in NIR table 4-69 (p.4-81) (0.83 t C/t coke). During the review, the Party clarified that data on coke consumption are reported in t dry coke according to the data source (American Iron and Steel Institute annual statistical report). The ERT noted that the chosen carbon content of coke does not correspond to the coke consumption units because the expected value of carbon content for dry coke is significantly higher (e.g. according to the CO_2 Emissions Data Collection User Guide (version 7) of the World Steel Association, the carbon content of dry coke is approximately 0.89 t C/t dry coke or 3.257 t CO_2/t dry coke). The ERT concluded that CO_2 emissions for category 2.C.1 iron production were probably underestimated because the carbon content of coke chosen for estimates was incorrect. In the estimation of the ERT, the missing emissions might account for 1,675.96 kt CO_2 for 2018 for iron production, but emissions would be overestimated by the same amount for coke production. During the review, the Party explained that underestimated emissions from coke consumption were included in other parts of the inventory. However, the ERT was unable to confirm this because the Party did not provide the initial sources of data used in estimates. The ERT recommends that the Party specify in the NIR the units of coke consumption and coke production (t coke or t dry coke) and provide supporting data sources, and revise estimates of CO_2 emissions as needed from pig iron production and coke production by applying a carbon content value for coke that corresponds to the AD for coke production or consumption.	The United States uses the carbon content for coke as provided in the *2006 IPCC Guidelines*, Volume 3, Table 4.3 on p. 4-27 for a Tier 2 methodology. EPA asked the data provider of coke consumption for pig iron production for information on carbon content for this AD and will continue to assess available resources. As noted in the NIR, the United States utilizes a country-specific approach based on Tier 2 methodologies. See the 2022 NIR submission, IPPU chapter Section 4.17 for additional clarification that the units for coke consumed for pig iron production are consistent with the units for the carbon content of coke.
I.32	2.C.1 Iron and steel production – CO_2 Accuracy	The Party estimated that the carbon content of pellets, sinter and natural ore used in pig iron production is equal to the carbon content of direct reduced iron (2 per cent) (NIR p.4-84). During the review, the Party did not provide any relevant sources to justify the chosen carbon content value for pellets, sinter and natural ore. In its clarifications on the list of provisional main findings, the Party indicated that, given the lack of default carbon content values for pellets, sinter and natural ore, it	The United States reiterates the previous clarification and response provided during the previous review. In the absence of a default carbon content value from the *2006 IPCC Guidelines* and the *2019 Refinement* for pellet, sinter, or natural ore consumed for pig iron production, the United States uses a country-specific approach based on Tier 2 methodologies. EPA assumes that pellets, sinter, and natural ore used as an input for pig iron production have the same carbon content as

		adopted a country-specific approach to determine these values, as documented in the NIR (table 4-69, p.4-81). It added that, although iron and steel is a key category, any updates to estimates for subcategories resulting from updates to the carbon content of pellets, sinter and natural ore are unlikely to lead to a significant recalculation of total emissions for iron and steel. Noting that the carbon content of pellets, sinter and natural ore is likely to be significantly lower than 2 per cent, the ERT concluded that the related CO_2 emissions might not be accurate. Moreover, the failure of the Party to provide any justification for its chosen carbon content value for pellets, sinter and natural ore is not in compliance with paragraph 50(a) of the UNFCCC Annex I inventory reporting guidelines. The ERT recommends that the Party justify its chosen carbon content value of 2 per cent for pellets, sinter and natural ore by indicating that it used a country-specific approach of assuming the same carbon content as direct reduced iron (2 per cent), with confirmation by the references to the relevant data sources in the NIR, or otherwise revise the emission estimates for iron and steel production (category 2.C.1) by updating the carbon content value for pellets, sinter and natural ore used in pig iron production on the basis of relevant data sources.	direct reduced iron (2 percent). See the 2022 NIR submission, IPPU chapter Section 4.17 for this clarification on this country-specific approach. Current QC and outreach do not indicate that this approach needs to be changed.
I.33	2.C.1 Iron and steel production – CO_2 Accuracy	The Party included in its estimates of CO_2 emissions from iron and steel production (category 2.C.1) flux consumption for electric arc furnace steel and basic oxygen furnace steel production (NIR table 4-72, p.483). According to the NIR (p.4-81), the amount of flux used in pig iron production was deducted from other process uses of carbonates (CRF source category 2.A.4) to avoid double counting. During the review, the Party explained that data for flux consumption in both basic oxygen furnace and electric arc furnace steel production were obtained from American Iron and Steel Institute annual statistical reports. In its clarifications on the list of provisional main findings, the Party indicated that the flux consumption data provided by the American Iron and Steel Institute include all flux types, including limestone, lime and fluorspar, and that it only accounts for the use of fluxes containing carbon (limestone and dolomite) in iron and steel sector emissions, since the emissions associated with other fluxes are reported for their individual sectors (e.g. lime production). The ERT recommends that the Party transparently describe in the NIR the type of fluxes used in iron and steel production and ensure that only CO_2 emissions from the emissive source of fluxes are reported under category 2.C.1 and consumption of carbonates under category 2.A.4 is adjusted to subtract emissive sources accounted for elsewhere but not by subtracting non-carbonate fluxes.	The United States reiterates the previous clarification and response provided during the previous review. The current 2022 NIR submission clarifies in the IPPU chapter Section 4.17 that the United States includes only carbon-containing fluxes (I.e., limestone and dolomite) in emissions calculations from electric arc furnace and basic oxygen furnace steel production.

Agriculture			
A.1	3. General (agriculture) – CH_4 and N_2O (A.25, 2019) Completeness	Not resolved. 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. The Party reported in its NIR (pp.5-44 and 5-54) that the current inventory includes N_2O emissions from mineral fertilizer and Nex on pasture, range and paddock in Alaska and Hawaii and drained organic soils in Hawaii, but excludes CH_4 and N_2O emissions from field burning of agricultural residues in those States. During the review, the Party clarified that work is under way to assemble these data for Alaska and Hawaii for inclusion in either the 2021 or 2022 NIR.	Work is ongoing to assemble this data for Alaska and Hawaii for inclusion in the NIR. This will be provided at the earliest in the 2024 submission.
A.2	3. General (agriculture) – CH_4 and N_2O (A.26, 2019) Consistency	Not resolved. 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), and if alternative data sets are not available, the ERT recommends that the Party use proxy data or extrapolation methods to derive AD. The Party reported in its NIR that surrogate data, trend analysis and statistical approaches were used to estimate CH_4 emissions from rice cultivation for 2016–2018 (p.5-24), N_2O emissions from managed soils for 2016–2018 (p.5-36) and CO_2 emissions from field biomass burning for 2015–2018 (p.5-36). However, the ERT noted that the AD reported in CRF tables 3.C for 2015–2018 and 3.F for 2014–2018 are simply the same figures. During the review, the Party clarified that it will continue to seek out alternative data sources to derive the inventory estimates for the portion of the time series not covered by the National Resources Inventory. It noted that this is a medium- to long-term update.	The United States 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.
A.3	3.A Enteric fermentation – CH_4 (A.2, 2019) (A.16, 2018) Convention reporting adherence	Not resolved. Undertake a quantitative uncertainty assessment in conjunction with future planned methodological updates. The Party reported the same uncertainty range in its NIR (p.5-8) as in previous submissions (i.e. a range of 11 per cent below to 18 per cent above the 2018 emission estimates). The ERT noted that the last quantitative uncertainty analysis for CH_4 emissions from enteric fermentation was undertaken for the 2003 GHG inventory submission. During the review, the Party reiterated its previous response, namely that updates will be accounted for in methodological refinements planned for future submissions.	The United States reiterates its 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.6, 2019) (A.20, 2018) Accuracy	Not resolved. 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. The Party reported regional digestible energy intake, which is expressed in percentage of GE, and average CH_4 conversion rate data in NIR tables A-172 and A-173 and GE by animal type and state in table A-174 of NIR annex 3.10. These data are the same as those reported in the previous submission. In the footnotes to these tables it is indicated that they will be updated for the entire time series in the next inventory submission. During the review, the Party informed the ERT that work is under way to address this issue by the 2022 submission at the earliest and that, since the 2021 NIR will focus on the improvement, rather than the running, of the Cattle Enteric Fermentation Model, updated values will not be available until the 2022 NIR, when the model is next run.	Work is underway to address this in future submissions; the earliest will be the next (i.e., 2023) submission.
A.7	3.A.1 Cattle –CH_4 (A.4, 2019) (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 reported in its NIR (p.5-9) that, according to information obtained through recent improvements, the 4 per cent value is still representative of milk fat for 2018. During the review, the Party informed the ERT that it had obtained a source for milk fat percentages and expected to include these new values in the 2022 submission. The ERT commends the efforts made by the Party but considers that the issue remains unresolved as the milk fat value has not been updated as recommended.	The United States considers this issue resolved. Updated milk fat percentages are included in the current submission. These values ranged from 3.7 percent to 4.1 percent across the time series and are more representative of U.S. livestock industry.
A.8	3.A.1 Cattle –CH_4 (A.5, 2019) (A.19, 2018) Accuracy	Addressing. 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 reported in NIR annex 3.10 (p.A-301) that the number of births is assumed to be distributed equally throughout the year for calf births from dairy cows but noted in the planned improvements section (p.5-9) that it is seeking data for births by month. During the review, the Party informed the ERT that work is under way to identify sources of data. It noted that this is a long-term improvement and will be included in the 2023 submission at the earliest.	To date, 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 2024 submission.
A.9	3.A.2 Sheep – CH_4 (A.7, 2019) (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 Party reported in NIR annex 3.11 (p.A-326) that population distribution data for lamb and sheep on feed are not available for after 1993. During the review, the Party informed the ERT	It should be noted that the animal population distribution data used to calculate Enteric Fermentation emissions (A.21, 2018 ERT issue) for sheep were taken from the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) agricultural statistics database (USDA 2021a) or the Census of Agriculture (USDA 2019) and

		that it expects to include updated sheep EFs and populations in the 2021 and 2022 submissions, respectively.	updated on an annual basis. For sheep and goats, default national emission factors were updated in the 2021 submission to reflect revisions made in the *2019 IPCC Refinement to the 2006 IPCC Guidelines* and improve the accuracy of emissions. EPA understands from exchange with ERT that the issue is manure management waste management distribution systems for sheep. The last year of available waste management distribution data for sheep is 2001. As described in the Annex 3.11, due to lack of additional data, data for years 2002 and beyond are assumed to be the same as 2001. Based on expert opinion cited, it was assumed that all sheep manure not deposited in feedlots was deposited on pasture, range, or paddock lands.
A.10	3.B Manure management – CH_4 (A.11, 2019) (A.25, 2018) Convention reporting adherence	Not resolved. Update the quantitative uncertainty assessment. The Party reported in its NIR (p.5-16) that the quantitative uncertainty analysis for CH_4 and N_2O emissions from manure management was performed in 2002 using approach 2 from the 2006 IPCC Guidelines, and that the uncertainty estimates were applied directly to the values for 2018. During the review, the Party reiterated its previous response, namely that the updates will be accounted for in the methodological refinements planned for future submissions.	The United States reiterates its previous response that updates will be considered with methodological refinements planned and underway in future submissions.
A.11	3.B Manure management – CH_4 and N_2O (A.12, 2019) (A.5, 2018) (A.14, 2016) (A.14, 2015) Accuracy	Addressing. 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 NIR annex 3.11 updated MMS data for dairy cows (p.A-330), swine (p.A-331) and poultry (p.A-332); however, data for other livestock types, such as sheep, have not been updated since 2001. During the review, the Party informed the ERT that it will report on further progress in the 2021 submission.	The United States considers this issue to be resolved as the 2020 and 2021 NIR submissions have reported on progress to update MMS data. Efforts are underway with support from the USDA to update waste management system data in the Inventory.
A.12	3.B Manure management – N_2O (A.14, 2019) (A.26, 2018) Accuracy	Addressing. Investigate other potential data sources of animal MMS data, such as extension services (i.e. agricultural advisory services). The Party reported in its NIR (p.5-18) that waste management system distribution data for dairy cows were updated using data from the 2016 Agricultural Resource Management Survey of dairy producers, and anaerobic digestion data were updated for swine, dairy cows and poultry using data from the EPA AgSTAR Program. The Party also reported that it is continuing to investigate new sources of MMS data. During the review, the Party informed the ERT that further progress on animal MMS data will be reported in the 2021 submission. The ERT commends the Party's progress but considers that the recommendation has not yet been fully addressed; for example, the MMS distribution data for sheep have not	Please see response to A.11; work is ongoing to obtain and incorporate updated data.

		been updated since 2001 (NIR annex 3.11, p.A-332) (see ID# A.11 above).	
A.13	3.B.1 Cattle – CH_4 (A.16, 2019) (A.7, 2018) (A.15, 2016) (A.15, 2015) Transparency	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 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 Party applied option C and disaggregated data on cattle characterization reported in CRF table 3.B(a)s1, such as livestock population, typical animal mass, volatile solid daily excretion and CH_4 producing potential. Data on population size in CRF table 3.B(a)s1 and MMS in CRF table 3.B(a)s2 are still reported according to dairy and non-dairy cattle, rather than according to disaggregated information on population allocations to climate regions and usage of MMS. During the review, the Party reiterated its previous response, namely that updates will be accounted for in methodological refinements planned for future submissions. The Party is still investigating the possibility of reporting disaggregated climate parameters in the CRF tables.	The United States reiterates its previous response that updates will be considered with methodological refinements planned and underway in future submissions. The United States is still investigating the possibility of reporting disaggregated climate parameters in the CRF Reporter.
A.15	3.B.1 Cattle – N_2O (A.29, 2019) Transparency	Not resolved. 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. Discrepancies persist in the reported total N excreted and the results calculated by multiplying population by Nex rate for dairy cows, beef calves and dairy calves in CRF table 3.B(b). During the review, the Party indicated that it is currently investigating the possibility of providing disaggregated Nex rates for these cattle types in its 2022 submission.	CRF reported Nex rates are <u>average</u> N excretion rates for all U.S. states. For cattle, the United States calculates the N excreted for each state using a state-specific N excretion rate factor and then combines all states to calculate and report the total national N excreted value shown in the CRF table. The total reported N excreted by MMS type and total N excreted reported in the CRF tables reflect the actual totals calculated. Reporting a different value for Nex rates other than the weighted values currently reported would not accurately reflect the information used in calculating emissions. Therefore, the United States does not believe it is appropriate to report a different, average value just to ensure values N excretion values align.
A.16	3.B.1 Cattle – N_2O (A.30, 2019) Transparency	Not resolved. 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. The Party continued to report "IE" for the Nex rate for heifer stockers and beef replacements in CRF table 3.B(b) in its 2020 submission. During the review, the Party indicated that it is currently investigating the possibility of updating disaggregated Nex rates for these cattle types in its 2022 submission. The ERT considers that the recommendation has not yet	The United States is currently investigating the possibility of providing the Nex values for these disaggregated cattle types in a future Inventory. The earliest we could disaggregate Nex rates by cattle type is the 2024 submission.

		been addressed.	
A.17	3.B.1 Sheep–CH_4 and N_2O (A.31, 2019) Transparency	Not resolved. Include information on MMS distribution for sheep in NIR table A-189. The Party did not report MMS distribution for sheep in NIR table A-189 (annex 3.11, pp.A-346–A-347). During the review, the Party informed the ERT that it is currently working on including these values in the 2022 submission.	This issue has been resolved in the current (i.e., 2022) submission).
A.18	3.D Direct and indirect N_2O emissions from agricultural soils – N_2O (A.19, 2019) (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 reported that N_2O emissions from the States of Alaska and Hawaii are not included in the current inventory for agricultural soil management, with the exception of N_2O emissions from drained organic soils in cropland and grassland for Hawaii and synthetic fertilizer and pasture, range and paddock N amendments for grassland in Alaska and Hawaii. This issue is identified in the Party's planned improvements in its NIR (p.5-45). During the review, the Party informed the ERT that work is under way to assemble these data for inclusion in the agricultural soil N_2O estimates by either the 2021 or 2022 submission.	Work is underway to assemble this data for inclusion in the Agricultural Soils N_2O estimates. This will be provided in the 2024 submission at earliest.
A.19	3.D Direct and indirect N_2O emissions from agricultural soils – N_2O (A.20, 2019) (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. The Party did not report additional information on the N content of commercial organic amendments included in the NIR (section 5.4). During the review, the Party informed the ERT that it will include this information in a future inventory if the unique N content of each of the non-commercial organic amendments can be found.	This has been resolved with the previous 2021 submission; see page 5-40.
A.20	3.D Direct and indirect N_2O emissions from agricultural soils – N_2O (A.32, 2019) Convention reporting adherence	Not resolved. Correct the text in its NIR to reflect the actual method applied, namely that N_2O emissions from tobacco crops are estimated using the DAYCENT model (tier 3 method). The Party reported in its NIR (p.5-36) both that DAYCENT is used and that it is not used to estimate N_2O emissions from tobacco. During the review, the Party indicated that this issue will be addressed in the 2021 submission.	This has been resolved with the previous 2021 submission.

A.23	3.D.a.3 Urine and dung deposited by grazing animals – N_2O (A.41, 2019) Transparency	Not resolved. 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 N_2O emissions. The Party did not include in its NIR information on 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 N_2O emissions. During the review, the Party informed the ERT that it planned to include an additional explanation on the approach used to allocate N deposited in the 2021 submission.	This has been resolved with the previous 2021 submission; see page A-366.
A.24	3.D.b Indirect N_2O emissions from managed soils – N_2O (A.24, 2019) (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 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 in its NIR. During the review, the Party informed the ERT that additional information will be added to the NIR for either the 2021 or 2022 submission.	Information has been updated in the recent submission and is transparently reported in Chapter 5 and Annex 3.12 of the NIR, which provides detailed information on how DayCent is used to generate the amount of N volatilized and how this is used in combination with IPCC defaults to estimate emissions of indirect N_2O. This information is consistent with the *2006 IPCC Guidelines*. In addition, following peer-reviewed publications are provided in the NIR on the use of DayCent for estimating soil N_2O emissions that speak to scientific basis of the model. These papers are referenced in Chapter 10 and Annex 3.12. Del Grosso, S.J., A.R. Mosier, W.J. Parton, and D.S. Ojima (2005) "DAYCENT Model Analysis of Past and Contemporary Soil N_2O and Net Greenhouse Gas Flux for Major Crops in the USA." *Soil Tillage and Research*, 83: 9-24. doi: 10.1016/j.still.2005.02.007. Del Grosso, S.J., S.M. Ogle, W.J. Parton, and F.J. Breidt (2010) "Estimating Uncertainty in N_2O Emissions from U.S. Cropland Soils." *Global Biogeochemical Cycles*, 24, GB1009, doi:10.1029/2009GB003544. Del Grosso, S.J., W.J. Parton, C.A. Keough, and M. Reyes-Fox. (2011) Special features of the DAYCENT modeling package and additional procedures for parameterization, calibration, validation, and applications, in Methods of Introducing System Models into Agricultural Research, L.R. Ahuja and Liwang Ma, editors, p. 155-176, American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Madison, WI. USA. Del Grosso, S.J., W.J. Parton, A.R. Mosier, M.D. Hartman, J. Brenner, D.S. Ojima, and D.S. Schimel (2001) "Simulated Interaction of Carbon Dynamics and Nitrogen Trace Gas Fluxes Using the DAYCENT Model." In Schaffer, M., L. Ma, S. Hansen, (eds.). Modeling Carbon and Nitrogen Dynamics for Soil Management. CRC Press. Boca Raton, Florida. 303-332. Del Grosso, S.J., T. Wirth, S.M. Ogle, W.J. Parton (2008) Estimating

			agricultural nitrous oxide emissions. EOS 89, 529-530. Delgado, J.A., S.J. Del Grosso, and S.M. Ogle (2009) "15N isotopic crop residue cycling studies and modeling suggest that IPCC methodologies to assess residue contributions to N_2O-N emissions should be reevaluated." *Nutrient Cycling in Agroecosystems*, DOI 10.1007/s10705-009-9300-9. Scheer, C., S.J. Del Grosso, W.J. Parton, D.W. Rowlings, P.R. Grace (2013) Modeling Nitrous Oxide Emissions from Irrigated Agriculture: Testing DAYCENT with High Frequency Measurements, Ecological Applications, in press. Available online at: http://dx.doi.org/10.1890/13-0570.1.
A.25	3. General (agriculture) – CH_4 and N_2O Transparency	The GE values reported in NIR table A-174 (pp.A-313–A-314) for each subcategory differ significantly among States. For example, the annual GE for dairy cows is reported as 29 MJ/1,000 head in Alaska and 262,323 MJ/1,000 head in California. During the review, the Party clarified that the values reported in NIR table A-174 represent total GE for each animal type in each State rather than on a per-head basis. The ERT recommends that the Party correct the unit in the title of NIR table A-174 from "MJ/1,000 head" to "MJ/head".	This has been resolved with the previous 2021 submission.
A.26	3. General (agriculture) – N_2O Convention Reporting Adherence	The ERT noted that Nex on pasture, range and paddock for 2018 was reported in CRF table 3.D as 3,569,237,661.43 kg N/year, while total Nex on pasture, range and paddock for cattle, sheep, swine and other livestock for 2018 was reported in CRF table 3.B(b) as 4,036,707,495.09 kg N/year. It also noted that N data reported by the Party for pasture, range and paddock manure used in agricultural soil management and manure management are inconsistent between these CRF tables for 1997–2018. The ERT acknowledges that the Party noted this discrepancy in the NIR (annex 3.11, p.A-326, footnote 93). The ERT recommends that the Party report the same values for Nex on pasture, range and paddock in CRF tables 3.B(b) and 3.D.	The United States does not consider this to be an issue. This was clearly described in footnote 93 (page A-326) in Annex 3.11 of the 2020 submission and resolved with the 2021 submission.
A.27	3.D.a.2 Organic N fertilizers – N_2O Convention Reporting Adherence	The ERT considers that the average N content of biosolids of 69 per cent reported by the Party in the NIR (annex 3.12, p.A-377) is too high according to common scientific knowledge on the N content ratio of organic material. During the review, the Party clarified that the reported percentage was a typographical error and that the N content of biosolids used in estimating the total applied N from biosolids is assumed to be 3.9 per cent. The error has no impact on the estimated emissions. The ERT recommends that the Party correct the reported percentage for the average N content	This issue has been addressed in the current (i.e., 2022) submission.

		of biosolids.	
A.29	3.F Field burning of agricultural residues – CH_4 and N_2O Transparency	The ERT noted that the equation in the NIR (p.5-53) applied to calculate carbon or N released from biomass burning is incorrect. During the review, the Party stated that this typographical error in the equation would be corrected in the next inventory report and noted that carbon or N released from biomass burning was calculated using a country-specific approach based on the equation from the Revised 1996 IPCC Guidelines (vol. 3, p.4.82), as the Party clearly described in box 5-6 of the NIR. The Party noted that the calculation was performed according to the correct equation so will not require any recalculations. The ERT recommends that the Party correctly report the equation used to calculate carbon or N released from biomass burning.	The United States considers this issue as resolved. The equation for biomass burning was updated in the previous 2021 submission.
A.30	3.H Urea application – CO_2 Accuracy	The Party reported in its NIR (chap. 4.6, pp.4-32–4-35) that CO_2 emissions from the application of urea to agricultural soils were estimated using the Monte Carlo analysis, with an EF uncertainty range of 50 to 100 per cent of emissions and a triangular distribution. During the review, the Party explained that it applied a probabilistic Monte Carlo analysis based on the methods described in the 2006 IPCC Guidelines (vol. 1, chap. 3). It added that the result was based on the posterior distribution of the analysis, with the mode as the estimated highest probability value, and the confidence interval provided by distribution percentiles of 2.5 and 97.5. The ERT noted that the 2006 IPCC Guidelines (vol. 1, chap. 3) provide guidance on how to use the Monte Carlo analysis for combining uncertainties, not for reporting emission estimates. Moreover, the country-specific EFs were not justified in the light of specific national circumstances or well documented in the NIR. The ERT recommends that the Party demonstrate that the country specific EFs are appropriate for its specific national circumstances and are more accurate than the default data provided in the 2006 IPCC Guidelines, or otherwise apply the IPCC default value (0.2 t CO_2-C/t urea) for this category.	The United States considers this issue as resolved. Please see the updated description for Urea Fertilization included in the previous 2021 submission (see page 5-50, QA/QC and Verification, and Recalculations Discussion).
LULUCF			
L.1	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.1, 2019) (L.2, 2018) (L.2, 2016) (L.2, 2015)	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) and	The United 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

	(81, 2013) Completeness	4.E.2.1 (forest land converted to settlements) and in the living biomass pool only for category 4.D.2.3.1 (forest land converted to other wetlands) for the first time for 2018. 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" or "NA" in its CRF table 4.F. During the review, the Party clarified that it does not currently include estimates for the categories forest land converted to other land or flooded land, or land converted to flooded 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 land to these lands mentioned above. With respect to flooded lands, the United States plans to include the flooded land categories when it applies the updated guidance on flooded lands from the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The ERT considers that the recommendation has not yet been fully addressed because the Party did not include carbon stock change estimates for living biomass and DOM for all managed lands in the inventory.	categories of Flooded Land/Land Converted to Flooded Land or Other Land/Land Converted to Other Land. With respect to flooded lands, the United States is planning to include these when it applies the updated guidance on flooded lands from the *2019 Refinement to the 2006 IPCC Guidelines*. However, it will take several years to disaggregate the carbon stock changes from lands converted to flooded lands by the individual land use categories. Overall, this should be a very minor category as most flooded lands in the United States were created well before 1990.
L.2	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.2, 2019) (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 and 6-7, pp.6-10–6-11) include all areas of managed and unmanaged land in the United States except for United States territories. During previous reviews, the Party clarified that it plans to include these territories in future submissions, including preliminary land-use information for the United States territories in NIR table 6-9. 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, the different coverage of the reported area is highlighted in a documentation box for some of the CRF background tables. During the review, the Party explained that it has included further information in the NIR to explain the deviations. NIR tables 6-33 and 6-37 demonstrate that the area of managed land left out for categories 4.B.1 and 4.B.2 is greater than 1 kha, while NIR tables 6-41 and 6-49 show the deviations for categories 4.C.1 and 4.C.2, respectively, resulting from not including managed grassland in Alaska. Similarly, deviations between the areas given in CRF tables 4.1 and 4.A are documented in NIR annex 3.13 tables A-231 and A-233. The ERT considers that the recommendation has not yet been fully addressed because the Party did not include all managed lands in the inventory.	See the following tables included in 2022 NIR: Table 6-31: Area of Managed Land in Cropland Remaining Cropland that is not included in the current Inventory (Thousand Hectares) Table 6-35: Area of Managed Land in Land Converted to Cropland that is not included in the current Inventory (Thousand Hectares) Table 6-39: Area of Managed Land in Grassland Remaining Grassland in Alaska that is not included in the current Inventory (Thousand Hectares) Table 6-47: Area of Managed Land in Land Converted to Grassland in Alaska that is not included in the current Inventory (Thousand Hectares) Annex Table A-213: 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-217: Land Converted to Forest Land area estimates and differences between estimates in the Representation of the U.S. Land Base (CRF Category 4.1) and Land Converted to Forest Land (CRF Category 4A1) (kha)

L.3	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.3, 2019) (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. In CRF table 4.1 the United States reported for the first time areas for forest land (unmanaged), grassland (unmanaged) and wetlands (unmanaged) for the whole time series. 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). During the review, the Party clarified that it is considering reporting insignificant emissions as "NE" and justifying their exclusion in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. In its clarifications on the list of provisional main findings, the Party indicated that it reports areas for managed lands that are not included in the estimates of: (a) CRF table 4.A in NIR annex 3.13, page 442, table A-231; and NIR table A-233, page 447; (b) CRF table 4.B in NIR chapter 6.4, page 65, table 6-33; and NIR chapter 6.5, page 71, table 6-37; (c) CRF table 4.C in NIR chapter 6.6, page 79, table 6-41; and NIR chapter 6.7, page 90, table 6-49; (d) CRF table 4.D – work is under way to include information on additional wetlands such as flooded lands. The coastal wetlands estimates are assumed to include all managed coastal wetlands, but the area data are not linked to the land representation (see pp.6-98–6-99 of the NIR for more information); (e) CRF table 4.E for drained organic soils in NIR chapter 6.10, page 118, table 6-78; and NIR chapter 6.11, page 142, table 6-93. Explanations were also included in the documentation boxes of the CRF tables. The ERT considers that the recommendation has not yet been fully addressed because the Party did not report managed lands that have not been estimated as a subdivision in CRF tables 4.A, 4.B, 4.C, 4.D and 4.E.	The United States will consider this suggestion for the 2023 or 2024 NIR and CRF submission (i.e., use of notation key NE).
L.4	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.41, 2019) Transparency	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. The Party reported preliminary land-use data for United States territories but did not report any preliminary emission or removal estimates for these land areas. During the review, the Party clarified that work to improve the land representation and tracking of managed and unmanaged land will be initiated in 2021 with a view to updating NIR chapter 6 for the 2022 or 2023 submission. The improvement is expected to have been fully implemented by the 2024 submission.	Work is still underway to develop the activity data needed to estimate emissions and removals from U.S. Territories.

L.5	Land representation – CO_2, CH_4 and N_2O (L.4, 2019) (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 for category 4.1.1 forest land remaining forest land (unmanaged) for 2017 is 281,651.72 kha, while the total initial area reported for 2018 is 281,563.37 kha. During previous reviews, the Party explained that the land-use areas in CRF table 4.1 were entered in accordance with the IPCC definitions of remaining land (land that remains subject to the same use for 20 years) and converted land (cumulative area of conversion over the past 20 years) and also stated that the heading of CRF table 4.1 can be understood to allow it to be compiled in accordance with the IPCC definition (namely, using the 20-year conversion). The ERT considers that the Party should bear in mind that the CRF tables are designed to be presented as an inventory of emissions for individual years, with a separate set of tables for each year. The land transition matrix in CRF table 4.1, once published, is designed to show the changes that have occurred that year between land uses, not between land conversion categories. This approach helps to ensure transparency, as it prevents the duplication of information on land areas within an accounting category provided in CRF tables 4.A–4.F. For example, where a Party converts 100 kha from grassland to settlements each year under a default IPCC method, CRF table 4.1 would show for any given year the movement of 100 kha from grassland under initial use and to settlements under final use. By contrast, CRF table 4.E would show 2,000 kha under land converted to settlements to represent 20 years of cumulative conversions for which emissions are calculated in relation to land-use changes over time. CRF tables 4.1 and 4.E would be deemed consistent where the total area of settlements is the same. This is in accordance with the 2006 IPCC Guidelines (vol. 4), which state that Parties should retain land in a conversion category for the conversion period (CRF tables 4.A–F) while transparently reporting on the new transitions for each year (CRF table 4.1). Further information on the compilation of land transition matrices can be found in the 2006 IPCC Guidelines (vol. 4, chap. 3.3), along with examples of final matrices (vol. 4, chap. 3.3, tables 3.5 and 3.6).	See explanation included in NIR Chapter 6 Section 6.1 and documentation box in CRF Table 4.A.
L.6	Land representation – CO_2, CH_4 and N_2O (L.42, 2019)	Not resolved. 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	Work is still underway with the goal of reporting in the 2023 or 2024 submission.

	Accuracy	years since 1990 contain the accumulated total of the land-use changes over the past 20 years. The Party did not report the complete time series for the land-use transition categories mentioned in the recommendation. During the review, the Party explained that it will improve the transparency of the reporting in the 2021 submission and that it plans to report in the 2023 and 2024 submissions improvements to land representation that will allow for tracking additional land-use conversions.	
L.7	Land representation – CO_2, CH_4 and N_2O (L.43, 2019) Accuracy	Addressing. Revise the area of unmanaged grassland for Alaska and report on the changes in the NIR. During the previous review, the United States informed the ERT that the area of unmanaged grassland in Alaska had been overestimated and would be revised. The current ERT noted that no land-use transitions were reported between managed and unmanaged grassland (CRF table 4.1). During the review, the Party clarified that areas of managed and unmanaged grassland were recalculated on the basis of updated underlying data sources and that the recalculation resulted in decreased areas of unmanaged grassland. However, the Party reported in NIR table 6-41 that 50,040 kha of managed grassland in Alaska is not yet included in the inventory. As a result, the ERT considers that the recommendation has not yet been fully addressed.	Work is still underway to reconcile the area of managed grassland in Alaska and the area estimated in the Inventory. This will be updated for the 2023 or 2024 submission.
L.8	Land representation – CO_2, CH_4 and N_2O (L.43, 2019) Transparency	Not resolved. 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. The NIR does not include an explanation of the Party's approach to classifying managed and unmanaged land or include an example of the change from managed to unmanaged land.	The Land Representation chapter of the NIR provides detailed information on the definition of managed and unmanaged land, the sources of land-use data, the criteria used to designate managed lands (with lands not designated as managed being unmanaged lands) and the approach for combining the land-use data sets. We are unaware of a reporting specific example of the change from managed to unmanaged land and appreciate clarity on the basis for this reporting. A multi-year effort to improve on the land representation, including the use of additional datasets, is underway and will improve on the transparency of the methods. While this effort will be ongoing for years to come, the initial updates should be completed by the 2023 or 2024 submissions.
L.9	Land representation – CO_2, CH_4 and N_2O (L.6, 2019) (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, Forestry Inventory and Analysis and NLCD (see also ID# L.10 below). The Party explains in the NIR (pp.6-20–6-24) how different land data sources are used and harmonized to classify national land data into IPCC land-use	See section "Approach for Combining Data Sources" in Chapter 6 of the current (2022) 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 throughout this process.

		categories. During the review, it also explained that it will modify its approach to developing land representation over the next few years and will update its NIR accordingly. The ERT considers that the recommendation has not yet been fully addressed because explicit information on how the three data sources are consistently integrated was not provided.	
L.11	4.A Forest land – CO_2 (L.10, 2019) (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. No information is provided in the NIR on verification of forest soil estimation by model, despite a background research paper on the soil estimation approach being cited in annex 3 to the NIR (p.A-361). During the review, the Party explained that it expects to report this information in the 2022 or 2023 submission.	Additional detail will be included in Annex 3.13 in a future submission—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 next (2023) submission at the earliest.
L.13	4.A Forest land – CO_2 and N_2O (L.13, 2019) (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. During the previous review, the Party provided additional information on the methodology in response to a question raised by the ERT about double counting of carbon. The previous ERT considered that the methodology for calculating carbon stock change on forest land was appropriately applied taking into account the information provided by the Party. However, it noted that the information provided in the NIR did not demonstrate that the stock-difference method for forest land was applied at each land-use category level. During the most recent review, the Party explained that it will provide the requisite information in the NIR of its next submission. The ERT considers that the recommendation has not yet been fully addressed because the Party did not update the NIR information demonstrating that the stock-difference method for forest land was applied at each land-use category level.	The United States provided this supplemental information in the Annex 3.13 to the 2021 NIR.
L.14	4.A.1 Forest land remaining forest land – CO_2 (L.14, 2019) (L.13, 2018) (L.26, 2016)	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 average carbon fluxes disaggregated by region, state or forest type. During the review, the Party explained that this	We are still unsure on the reporting requirement and basis in methodological guidance that requires providing detailed tables on average carbon fluxes by region.

	Transparency	information will be included in the 2021 or 2022 submission.	
L.15	4.B Cropland – CO_2 (L.16, 2019) (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 biomass stock changes in perennial cropland (for either cropland remaining cropland or land converted to cropland). The ERT considers that, if no information is available other than the time series of areas covered by perennial crops reported in the national statistics on agriculture, the Party should consider using this information and the tier 1 methodology from the 2006 IPCC Guidelines (vol. 4, chap. 5) to prepare a time series of estimates of biomass changes in perennial crops. The carbon stock dynamic of the perennial cropland area in 1989 can be assumed to be at equilibrium and can be modelled for 1990 onward on the basis of the ageing of trees and changes in the area planted. The issue applies to both cropland remaining cropland and land converted to cropland. During the review, the Party explained that this information will be included in the 2022 submission.	This work is underway and will be included in the next (2023) submission at the earliest.
L.17	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.	This work is underway and will be included in the next (2023) submission at the earliest.
L.18	4.B Cropland 4.C Grassland – CO_2 and N_2O (L.19, 2019) (L.47, 2018) Convention reporting adherence	Not resolved. Verify the model's output for the entire time series from 1990 onward and for all applicable land categories (e.g. by verifying the model's output for each land-use category, or for the total of the land-use categories, or for any subaggregation, as long as the total estimate of all land-use categories modelled is verified) and report on the verification and the results in the NIR. The Party reported the same verification in the NIR as in the previous submission; that is, comparing SOC changes with lower tiers (figure A-13). Therefore, the concern of previous ERTs regarding coverage of land categories (i.e. that the output of the DAYCENT model was verified for carbon stock change in cropland remaining cropland, but not for other land-use categories and gases) has not been addressed. During the review, the Party explained that it still plans to improve the documentation on the model and refine the calibration used for the model, and to implement an additional verification, alongside ongoing methodological refinements for	As noted to the prior ERT, efforts 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 N_2O and soil CH_4. This will be addressed in the next (2023) submission at the earliest.

		estimating soil carbon, soil N_2O and soil CH_4. It noted that this issue will be addressed in the 2021 and 2022 submissions. In its clarifications on the list of provisional main findings, the Party indicated that it has provided documentation on the model's prediction capability for SOC on grassland and cropland (see NIR annex 3.12, p.A-405, figure A-12); the output of the model is also shown for N_2O and CH_4 (figures A-14–A-15); and these comparisons lend credibility to the ability of DAYCENT to predict emissions and removals for these gases. The Party indicated that it has allocated available resources to other improvements instead of conducting a tier 1 analysis, which would effectively entail compiling the inventory twice, and that it will work towards making this addition to the 1990–2020 inventory for reporting in 2022. The ERT considers that the recommendation has not yet been addressed because the Party has not verified the model's output for the entire time series from 1990 onward.	
L.20	4.C Grassland – CO_2 (L.21, 2019) (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 on woody grassland. Further, the Party has removed from the NIR (box 6-6, p.6-71, of the 2019 NIR) an explanation on grassland woody biomass analysis and a reference to its plans to include the woody grassland subcategory in its reporting. The Party explained during the review that while it intends to include this subcategory in the 2021 submission, owing to administrative delays it may have to include it in the 2022 submission instead. In its clarifications on the list of provisional main findings, the Party indicated that it reports all carbon stock pools for woodland that occur on grassland (i.e. land that does not meet the definition of forest land). It acknowledges that there may be some woody grassland which is not included and is reviewing the data with a view to making the relevant refinements in the future. The ERT considers that the recommendation has not yet been addressed because the Party did not report emissions and uptake under the woody grassland subcategory in CRF table 4.C.	The United States reports carbon stock changes for all pools for a subcomponent of grasslands referred to as woodlands. Woodlands are former forest lands that no longer meet the definition of forest lands and are now classified in the grassland category. Because these woodlands were formerly part of the forest land category, data are collected on woody/perennial biomass and these data are used to report on the carbon stock changes. For other grasslands not part of the woodlands, we do not have woody/perennial biomass data and are not able to report at this time. The United States is assessing how to assemble perennial biomass data for these other grasslands for future reporting. The earliest this would occur is the next (2023) submission.
L.22	4.C.2.2 Cropland converted to grassland–CO_2 (L.24, 2019) (L.51, 2018)	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 reported "NE" for carbon stock changes in biomass on cropland converted to grassland. The Party explained during the review that while it intends to include carbon stock changes in biomass on cropland converted to grassland in the 2021 submission,	This work is underway and will be included in the next (2023) submission at the earliest.

	Completeness	owing to administrative delays it may have to include it in the 2022 submission instead.	
L.23	4.D.1 Wetlands remaining wetlands – CO_2, CH_4, and N_2O (L.25, 2019) (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 Party explained in the NIR (p.6-91) that it used the total peat extraction area as AD for on-site CH_4 emissions and the nutrient-rich peat production area as AD for on-site N_2O emissions. However, these AD were not included in CRF table 4(II). In a documentation box to CRF table 4(II), the Party explains that, since different areas are used to estimate CH_4 and N_2O emissions, it is not possible to provide the AD and IEF for both gases on the same row. The ERT suggests that the Party report the area for CH_4 emissions and the values for CH_4 and N_2O emissions and explain the resulting N_2O IEF value.	Documentation on our approach was provided in the documentation box in CRF Table 4(II) of the previous (2021) and current (2022) submission.
L.24	4.D.2.2 Land converted to flooded land – CO_2 (L.26, 2019) (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 Carbon stock changes in all carbon pools for land converted to flooded land are reported as "NE" for the whole time series. During the review, the Party explained that improvements in this regard are planned for the 2022 submission. (See also ID# L.1 above for the case of forest land converted to flooded land.)	This is addressed in the current submission for 2022.
L.25	4.D.2.3 Land converted to wetlands – CO_2 (L.27, 2019) (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. The Party has reported carbon stock changes in living biomass for land converted to other wetlands (category 4.D.2.3) as numerical values since the 2019 submission, as opposed to "NE" in the 2018 submission. However, it reported carbon stock changes in DOM for category 4.D.2.3 as "NE" in the 2018, 2019 and 2020 submissions. During the review, the Party explained that it plans to make improvements in this regard for future inventory submissions.	Work is planned to report on this information in a future submission.

L.27	4.E Settlements – CO_2 (L.29, 2019) (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 Party updated the tree cover area in settlements (urban forest area) in the 2020 submission and indicated in the NIR that it plans to address the overlap between the forest and urban forest inventories (under planned improvements in settlements, p.6-126). The Party explained in the NIR that there may be a minor overlap between the forest and urban forest inventories and that this will be addressed when new NLCD data become available. It added during the review that it plans to take steps over the next few years to develop spatially explicit and spatially continuous representations of land to eliminate such overlaps and to enable the production of better settlement area estimates.	This overlap is still being investigated with new NLCD data. EPA anticipates reporting an updated status of this consideration in the next (i.e., 2023) submission.
L.28	4.E.1 Settlements remaining settlements– CO_2 (L.30, 2019) (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 category 4.H (other). During the review, the Party indicated that this reallocation will be addressed in the 2022 submission. The Party could see the issue will be resolved by reporting emissions from landfilled yard trimmings and food scraps under category 4.H (other), applying a country-specific method or under category 4.G (HWP) as an additional “other” HWP pool in solid waste disposal sites while continuing to ensure that the methods used are consistent with the waste sector reporting as per the 2006 IPCC Guidelines (vol. 4, chap. 12.2.1, and vol. 5, chap. 3.4).	Carbon stock estimates are reported as negative "Emissions" under 4.H. The estimates for landfilled yard trimmings and food scraps are estimates of changes in carbon stock, rather than emissions. Carbon stock change is not included as a measure for 4.H Other category. Carbon storage estimates within the Inventory are associated with particular land uses. For example, harvested wood products are reported under Forest Land Remaining Forest Land because these wood products originated from the forest ecosystem. Similarly, C stock changes in yard trimmings and food scraps are reported under Settlements Remaining Settlements because the bulk of the C, which comes from yard trimmings, originates from settlement areas. While the majority of food scraps originate from cropland and grassland, in this Inventory they are reported with the yard trimmings in the Settlements Remaining Settlements section. Additionally, landfills are considered part of the managed land base under settlements (see Section 6.1 Representation of the U.S. Land Base), and reporting these C stock changes that occur entirely within landfills fits most appropriately within the Settlements Remaining Settlements section given these U.S.-specific circumstances and country approach, and therefore reported under 4.E.1.
L.29	4.E.1 Settlements remaining settlements – CO_2 (L.31, 2019) (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 in the memo item in CRF table 5 on the long-term storage of carbon in waste disposal sites or on the annual change in total long-term carbon storage. During the review, the Party indicated that this will be addressed in the 2021 or 2022 submission. The ERT considers that the recommendation has not yet been addressed because the Party did not report on the long-term storage of carbon in waste disposal sites in the memo item in CRF table 5.	This has been updated in the current CRF submission; see Table 5 of the 2022 CRF submission.

L.30	Cropland converted to settlements Grassland converted to settlements– CO_2 (L.32, 2019) (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. The Party did not estimate carbon stock changes in biomass for cropland converted to settlements and grassland converted to settlements. During the review, the Party explained that it plans to report this information in the 2022 submission.	Work is planned to report on this information in a future submission.
L.31	4.F.2 Land converted to other land – CO_2 (L.33, 2019) (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 under category 4.F.2 as "NA" (previously "NE"). During the review, the Party explained that it was unable to report the required information under this category but plans to do so in a future submission. It also explained that the notation key was mistakenly changed to "NA" and will be changed back to "NE" in the next submission. (See also 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.32	4.G HWP – CO_2 (L.34, 2019) (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 reported only the values of paper and paperboard for 1990–2018. It reported "IE" for sawnwood and wood panels. During the review, the Party explained that it is working towards improving the reporting of HWP in its 2021 submission.	Work is planned to improve reporting of HWP in the CRF Reporter for the 2023 or 2024 submission.
L.34	4.H Other (LULUCF) – CH_4 (L.36, 2019) (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. While the decay rates are properly explained (see ID# L.33 above), there is still a transparency issue between the LULUCF and waste sectors. 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.6-135), it is not possible to check the relationship or consistency between carbon storage and the CH_4 emissions from yard	This issue was resolved with 2020 submission. Discussion of decay rates begins at the end of page 6-131 in the NIR (2020 submission).

		trimmings and food scraps. In the NIR, the Party explains that there are no plans to disaggregate these waste components in the data in the waste sector, which will hamper the separate reporting of CH_4 emission from yard trimmings and food scraps. During the review, the Party stated that it considers this issue to have been resolved. However, the ERT is of the opinion that, while it may be difficult to provide evidence of consistency between sectoral methods, the Party should at least demonstrate that the methods used are not inconsistent. This could be done by showing that carbon losses resulting from the decay of yard trimmings and food scraps as calculated under LULUCF are in keeping with the waste sector estimates of CH_4 emitted from landfills. Alternatively, the Party could perform a model calculation of CH_4 emissions from the yard trimming and food scraps carbon pool in landfills (see also ID# L.29 above) and compare the results with the waste sector CH_4 estimates. The ERT considers that the recommendation has not yet been fully addressed because the Party did not explain in the NIR how the decay of yard trimmings and food scraps reported in CRF table 4.E (recommended to be moved to category 4.H, see ID# L.28 above) is consistent with the emissions of CH_4 from landfills reported in the waste sector.	
L.35	4.A Forest land 4(II) Emissions and removals from drainage and rewetting and other management of organic/mineral soils – CO_2, CH_4 and N_2O (L.44, 2019) Transparency	Not resolved. 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). No information is provided either in the NIR or in the documentation boxes of CRF tables 4.A or 4(II) on the avoidance of double counting. During the review, the Party clarified that it plans to report this information in a future submission.	Carbon stock change from drained organic soils are reported under the Forest Ecosystem stock changes. See footnote "a" in Table 6-11: "These estimates include carbon stock changes from drained organic soils from both Forest Land Remaining Forest Land and Land Converted to Forest Land. See the section below on CO_2, CH_4, and N_2O Emissions from Drained Organic Soils for the methodology used to estimate the C flux from drained organic soils. Also, see Table 6-22 and Table 6-23 for greenhouse gas emissions from non-CO_2 gas changes from drainage of organic soils from Forest Land Remaining Forest Land and Land Converted to Forest Land."
L.37	4(III) Direct N_2O emissions from N mineralization/ immobilization – N_2O (L.37, 2019) (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 are not estimated. During the review, the Party informed the ERT that work is under way to enable all land categories to be reported in future submissions. The ERT considers that the recommendation has not yet been addressed because the Party	Work is underway to report these emissions for all land categories in future submissions.

		did not provide data on N_2O emissions associated with mineralization of N as a result of SOC losses in mineral soils.	
L.38	4(IV) Indirect N_2O emissions from managed soils – N_2O (L.38, 2019) (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. No indirect N_2O emissions associated with organic matter are reported. During the review, the Party clarified that work is under way to report these emissions for all land categories in future submissions.	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.39, 2019) (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). While CH_4 and N_2O emissions from biomass burning for forest land and grassland are estimated, all burning is reported under forest land remaining forest land and grassland remaining grassland. The Party explained that it is currently unable to separately report the emissions from land converted to forest land and land converted to grassland but will continue to explore ways of doing so. 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 will continue to explore approaches for doing this in future Inventories.
L.40	4.F Other land – CO_2, CH_4 and N_2O Comparability	The Party reported "NA" for all entries in CRF table 4.F (other land) owing to a lack of data. It explained in the NIR (chaps. 6.12–6.13, pp.6-142–6-143) that, while it is conducting research to track carbon pools for other land, it is unable to estimate CO_2, CH_4 and N_2O emissions for other land or land converted to other land. The ERT notes that, according to the UNFCCC Annex I inventory reporting guidelines, categories that are not estimated should be reported as "NE" where emissions or uptake can be expected. During the review, the Party stated that it will report the correct notation key in its next submission. It added that, while it is not currently developing estimates for other lands, it will aim to complete CRF table 4.F with the information available. The ERT recommends that the Party report numerical values in CRF table 4.F for managed areas of other land and "NE" for carbon pools for which numerical values cannot be reported, or otherwise develop an assumption for carbon pools being in equilibrium.	The notation keys for Table 4.F have been changed to NE for the current submission. Area estimates will be provided in future submissions.
L.41	4.G HWP – CO_2 Transparency	According to the NIR (p.6-35), the Party reports HWP using the production approach. Data for HWP are reported in CRF table 4.G (a separate issue regarding this reporting is detailed under ID# L.32 in table	The United States is unsure of the basis of this recommendation in the UNFCCC reporting guidelines and *2006 IPCC Guidelines* as they do not specify where HWP should be presented in the report; therefore, HWP is

		3). The ERT noted that the value for carbon stock change in forest land remaining forest land presented in NIR tables 6-1, 6-3, 6-4 and 6-5 (–663.2 Mt CO_2 eq) differs from the value reported in CRF table 4.1 (–565.2 Mt CO_2 eq). In a footnote to NIR tables 6-1 and 6-3 (but not to NIR tables 6-4 and 6-5), the Party explains that this figure also includes the uptake of carbon in HWP. This is contrary to reporting conventions, according to which HWP should be reported under category 4.G (including HWP in solid waste disposal sites) and not under forest land remaining forest land (category 4.A.1). The ERT considers that reporting HWP as a separate concept rather than as a subcategory of forest land is important, as HWP can sometimes fall under other land uses, such as forest converted to grassland, or former perennial horticulture on cropland. The same rationale is behind the recommendation to report the carbon balance of yard trimmings and food scraps under other (category 4.H) rather than as a sub-component of settlements (category 4.E) (see ID# L.28 in table 3). The ERT recommends that the Party clearly differentiate between HWP and forest carbon stock changes in the NIR and ensure consistent reporting between the CRF and NIR tables.	included within the forest chapter of the NIR because that is the source of wood that goes into the HWP estimates, but HWP estimates and methods are presented and documented separately. See the section on Harvest Wood Carbon (pp. 6-35 of the NIR). In the CRF submission, all HWP emissions are reported under 4.G.
Waste			
W.1	5. General (waste) – CO_2, CH_4 and N_2O (W.1, 2019) (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 reported in the NIR (annex 3.14, table A-236) the total amount of MSW generated and landfilled based on research by EPA, BioCycle and the Environmental Research and Education Foundation. However, the trend in the amount of MSW landfilled differs with the decreasing trend of CH_4 emissions from landfilled MSW for 1990–2018 (NIR tables 7-3–7-4). In addition, the ratio of landfilled MSW to total MSW generated for 2017 is reported as 65 per cent in NIR table A-236 but as 52.1 per cent in NIR box 7-4 (p.7-16). In its clarifications on the list of provisional main findings, the Party indicated that an explanation for these differences is provided in the NIR (annex 3.14, page A-463). However, the ERT considers that this explanation is narrative rather than quantitative, and that the Party should provide an analysis of the discrepancies and the data used for the emission estimates, such as waste composition data, DOC in MSW and background information on MSW streams, like the waste stream analysis by waste type provided in the 2006 IPCC Guidelines (vol. 5, chap. 2, box 2.1) (see also ID# W.3 below).	Additional information and an explanation of differences has been added in recent NIRs to explain different data sources and also estimation methods over the time series. In the current (i.e., April 2022) submission, the trends in amount of MSW waste generated, waste landfilled, and resulting CH_4 emissions are explained in Section 7.1, pp. 7-6. The differences noted in the two ratios of MSW landfilled to MSW generated are due to the two data sources and methods used by these reports. As explained in Box 7-3, the SOG and EREF data are used in the MSW methodology, while data from *EPA Facts and Figures* is presented in Box 7-4 to show trends of waste management in the United States for illustrative purposes. The discussion on the quantitative differences between these two data sources was added to Annex 3.14, Box A-3 (on p. A-451) of the April 2021 NIR submission and is retained in the current submission; see Annex 3.14. It is unclear that information outlined in Chapter 2 is required for reporting, as it is an example and as noted in the example itself depends on available data and national circumstances. The example in Chapter 2 is not consistent with our available data. Noting Section 3.8 of Volume 5 of the *2006 IPCC Guidelines* does not suggest including such an analysis. We are unsure of how this issue can be resolved in light of data sources and methodological refinements in recent years to incorporate facility-level

			GHGRP data.
W.8	5.A.1 Managed waste disposal sites – CH_4 (W.15, 2019) Transparency	Addressing. 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. The United States provided information in the NIR (pp.A-473–474) to justify the use of a country-specific oxidation factor greater than the default value of 0.1. During the review, the Party explained that it is planning to include additional detail in the discussion of the uncertainty analysis. This reporting is planned for the 2021 submission.	Addressed in current NIR submission Section 7.1 Uncertainty and Annex 3.14, Figure A-19.
W.9	5.A.1.a Anaerobic – CH_4 (W.7, 2019) (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 United States reported the amount of CH_4 flared and used for energy recovery as "NE" in CRF table 5.A. During the previous review, the Party explained its use of directly reported GHGRP net emissions and noted that facilities were not required to report separately the total amounts of CH_4 recovered for energy and CH_4 flared. However, the ERT notes that the EPA Landfill Methane Outreach Program provides information on the amount of landfill gas collected and flared. It also notes that the 2006 IPCC Guidelines (vol. 5, chap. 3, p.3.18) state that if recovered gas is used for energy, then the resulting GHG emissions should be reported under the energy sector. Therefore, the Party should report the amount of CH_4 for energy recovery in CRF table 5.A and include a corresponding explanation in the NIR, taking into account the good practice outlines in the 2006 IPCC Guidelines.	This issue was addressed in the 2020 submission. See CRF Tables 5.A and Table 9 of the 2020 submission and NIR Annex 5. CH_4 has been reported as NE. Per engagement with the reporting community, future technical corrections to EPA's GHGRP may allow for reporters to indicate volumes of gas sent to flaring and to energy projects. Reporting of this information by facilities would allow EPA to report separate amounts for CH_4 flared and CH_4 for energy recovery. The timing for such updates has not been proposed and the initial data reported will only reflect information for the latest year of time series and will require some effort to develop time series information to include in the national Inventory submission.
W.10	5.A.1.a Anaerobic – CH_4 (W.8, 2019) (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 United States provided information in the NIR (p.7-10) on an EPA analysis to validate the assumption that most of the organic waste which would result in CH4 emissions is disposed of at pulp-, paper- and food-processing facilities (54 per cent) and food manufacturing facilities (7 per cent). However, the ERT believes that the Party should consider including other industries (e.g. metal foundries, petroleum refineries and chemical manufacturing facilities) as recommended in the 2016 review report (FCCC/ARR/2016/USA, ID# W.12). According to the NIR (p.7-15), EPA plans to investigate the prevalence of food-related waste deposited in industrial waste landfills and will record the findings from this exercise in	Progress was included in 2021 submission NIR Section 7.1. Work is still in progress to finalize a memorandum summarizing literature search and data availability.

		a memorandum and implement during the following inventory cycle any warranted changes to the methodology or assumptions for industrial waste landfills. The ERT welcomes the Party's provision of this information on the estimation of CH_4 emissions from industrial waste landfill.	
W.11	5.B.2 Anaerobic digestion at biogas facilities – CH_4 (W.19, 2019) (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. During the review, the Party explained that unintentional leakages of CH_4 emissions from anaerobic digestion of organic waste, as described in the 2006 IPCC Guidelines (vol. 5, chap. 4.1), will be reported in the 2021 submission, as indicated in the NIR (p.7-39).	The United State has included estimates from anaerobic digestion at biogas facilities in the April 2021 submission. See Section 7.4 of the Waste Chapter of the current NIR submission.
W.13	5.C.1 Waste incineration – CO_2, CH_4 and N_2O (W.13, 2019) (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). Inconsistencies still exist in the combustion ratio of MSW between NIR figure 7-3 (12.7 per cent) and NIR table 3-27 (7.6 per cent). During the review, the United States explained that the percentage of waste incineration shown in figure 7-3 comes from a different source than that used for table 3-27 and does not represent the data used in the analysis for estimating emissions from waste incineration. However, the ERT considers that this inconsistency should be clearly explained in the NIR or NIR figure 7-3 should be removed.	For the current April 2022 submission the United States has updated the approach to calculating emissions from waste incineration. See Sections 3.3 and Annex 3.7 of the 2022 NIR. The updated approach does not rely on the combustion ratio of MSW but rather the tons of MSW combusted and emission factors. The tons of MSW combusted comes from multiple sources including the data discusses in Section 7.1 but also other sources including EPA's GHGRP. The data used for MSW incineration emissions is not inconsistent with the data used to develop landfill emissions.
W.15	5.D.2 Industrial wastewater – CH_4 (W.13, 2019) (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.	The United States has included an explanation in Annex 5 of the previous and current submissions, including a quantified estimate of methane emissions from sludge from industrial wastewater treatment demonstrating insignificance of these emissions.

W.16	5.C.1 Waste incineration – CO_2 Accuracy	The Party reported in the CRF tables CO_2 emissions from waste incineration (category 5.C) as "IE" and stated in the NIR (pp.3-55 and 7-39) that CO_2 emissions from incineration of plastics, synthetic rubber, synthetic fibres and carbon black in scrap tyres are accounted for under category 1.A.5 (fuel combustion – other) instead of category 5.C (waste incineration). During the review, the Party explained that CO_2 emissions from waste nappies and waste fossil oil are included under the NEU emission estimates. The Party also explained that CO_2 emissions from paper and cardboard waste are not estimated because paper waste was assumed to have 0 per cent fossil carbon content. The default range of fossil carbon fraction in the 2006 IPCC Guidelines is 0–5 per cent, and the default value is 1 per cent (vol. 5, chap. 2, table 2.4, p.2.14). The Party informed the ERT that it applies a country-specific parameter of 0 per cent fossil carbon content in paper waste based on the approach from the EPA Reduction Model (WARM). The Party noted that it could refer to the Waste Reduction Model in a future submission. The ERT recommends that the United States provide an explanation for reporting 0 per cent fossil carbon content in paper waste as a country-specific parameter as well as the reference on which the parameter is based.	For the April 2022 submission the United States has updated the approach to calculating emissions from waste incineration. See Sections 3.3 and Annex 3.7 of the 2022 NIR. The updated approach uses a country-specific emission factor for CO_2 emissions from MSW combustion. The CO_2 factor is based on measured CO_2 emissions divided by the amount of MSW combusted. Therefore, the factor would take into account any C in the MSW including from waste nappies, fossil oil, paper, etc.
W.17	5.C.1 Waste incineration – CH_4 and N_2O Completeness	The ERT noted there were approximately 170 sewage sludge incineration plants in operation in the United States in the early 1990s according to the EPA website (https://www.epa.gov/sites/production/files/2020-10/documents/c02s02.pdf) and that CH_4 and N_2O emissions from incineration of sewage sludge may not be reported in the national inventory, as the emissions reported under category 5.C.1 (waste incineration – biogenic – MSW) are reported as "IE". During the review, the Party explained that CH_4 and N_2O emissions from incineration of wastewater treatment plant sludge are likely estimated as emissions from MSW even though wastewater treatment plant sludge is not officially categorized as MSW, or that emissions could be considered insignificant given the increasing regulatory pressure on sludge incineration. However, the ERT cannot be assured that CH_4 and N_2O emissions are accurately estimated in line with the *2006 IPCC Guidelines* because AD or emission estimates are not clearly shown in the NIR. It notes that the *2006 IPCC Guidelines* (vol. 5, chap. 5, table 5.6) provide a default N_2O EF for sewage sludge of 900 g N_2O/t waste (wet weight) and the default N_2O EF for MSW of 50–60 g N2O/t waste (wet weight), but could not assess whether these emissions are included in the inventory on the basis of the information provided in the NIR and during the review week. The ERT recommends that the United States estimate CH_4 and N_2O emissions from incineration of sewage sludge at wastewater treatment	The United States considered the potential emissions associated with sewage sludge incineration and concluded they are insignificant. Based on data on the amount of sewage sludge incinerated and assumed emission factors for N_2O and CH_4 from our GHGRP for biomass solids, emissions were estimated to be approximately 9 kt CO_2 Eq. per year.

		plants in the country and either include estimates or otherwise provide an explanation in the NIR demonstrating that these emissions are already included in the inventory estimation.	

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