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# Report of the individual review of the inventory submission of the United States of America submitted in 2012*

* In the symbol for this document, 2012 refers to the year in which the inventory was submitted, and not to the year of publication.

# Contents

# I. Introduction and summary

1. This report covers the in-country review of the 2012 inventory submission of the United States of America, coordinated by the UNFCCC secretariat, in accordance with decision 19/CP.8. The review took place from 1 to 6 October 2012 in Washington, D.C., United States of America, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Mr. Riccardo De Lauretis (Italy); energy – Mr. Matej Gasperič (Slovenia); industrial processes – Ms. Sina Wartmann (Germany); agriculture – Mr. Jonas Bergström (Sweden); land use, land-use change and forestry (LULUCF) – Mr. Harry Vreuls (the Netherlands); and waste – Ms. Medea Inashvili (Georgia). Mr. De Lauretis and Ms. Inashvili were the lead reviewers. The review was coordinated by Ms. Barbara Muik (UNFCCC secretariat).

2. In accordance with the "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention" a draft version of this report was communicated to the Government of the United States of America, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

3. In 2010, the main greenhouse gas (GHG) in the United States was carbon dioxide ($CO_2$), accounting for 83.8 per cent of total GHG emissions[1] expressed in carbon dioxide equivalent ($CO_2$ eq), followed by methane ($CH_4$) (9.7 per cent) and nitrous oxide ($N_2O$) (4.4 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride ($SF_6$) collectively accounted for 2.1 per cent of the overall GHG emissions in the country. The energy sector accounted for 87.2 per cent of total GHG emissions, followed by the agriculture sector (6.3 per cent), the industrial processes sector (4.5 per cent), the waste sector (1.9 per cent) and the solvent and other product use sector (0.06 per cent). Total GHG emissions amounted to 6,802,224.51 Gg $CO_2$ eq and increased by 10.4 per cent between 1990 and 2010.

4. Tables 1 and 2 show GHG emissions under the Convention, by gas and by sector, respectively. In table 1, $CO_2$, $CH_4$ and $N_2O$ emissions do not include emissions and removals from the LULUCF sector.

[1] In this report, the term "total GHG emissions" refers to the aggregated national GHG emissions expressed in terms of carbon dioxide equivalent ($CO_2$ eq) excluding LULUCF, unless otherwise specified.

Table 1
**Greenhouse gas emissions, by gas, 1990 to 2010**

| | *Gg $CO_2$ eq* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Greenhouse gas* | *1990* | *1995* | *2000* | *2005* | *2008* | *2009* | *2010* | *Change 1990–2010 (%)* |
| $CO_2$ | 5 092 381.77 | 5 413 384.04 | 5 966 192.27 | 6 098 654.29 | 5 914 629.25 | 5 492 182.40 | 5 697 337.26 | 11.9 |
| $CH_4$ | 665 741.03 | 667 578.02 | 639 009.67 | 617 611.71 | 659 089.50 | 666 405.70 | 661 699.00 | –0.6 |
| $N_2O$ | 313 135.96 | 339 731.24 | 329 651.11 | 323 383.29 | 308 078.66 | 297 579.34 | 300 522.75 | –4.0 |
| HFCs | 36 924.10 | 64 035.14 | 104 964.81 | 115 002.68 | 117 456.01 | 112 035.73 | 122 967.12 | 233.0 |
| PFCs | 20 645.87 | 15 587.02 | 13 473.80 | 6 194.63 | 6 663.82 | 5 626.04 | 5 660.73 | –72.6 |
| $SF_6$ | 32 631.77 | 27 957.32 | 19 154.98 | 17 811.60 | 14 980.48 | 13 858.14 | 14 037.64 | –57.0 |

Table 2
**Greenhouse gas emissions by sector, 1990 to 2010**

| | *Gg $CO_2$ eq* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Sector* | *1990* | *1995* | *2000* | *2005* | *2008* | *2009* | *2010* | *Change 1990–2010 (%)* |
| Energy | 5 287 661.08 | 5 609 291.98 | 6 167 447.76 | 6 282 400.33 | 6 125 406.86 | 5 752 728.88 | 5 933 493.65 | 12.2 |
| Industrial processes | 313 914.47 | 336 529.71 | 349 589.29 | 330 084.29 | 319 067.76 | 268 157.28 | 303 389.48 | –3.4 |
| Solvent and other product use | 4 404.02 | 4 587.52 | 4 879.50 | 4 387.15 | 4 387.15 | 4 387.15 | 4 387.15 | –0.4 |
| Agriculture | 387 765.26 | 416 265.56 | 415 268.42 | 424 610.78 | 433 841.16 | 426 388.85 | 428 409.32 | 10.5 |
| LULUCF | –868 091.43 | –800 969.12 | –648 316.75 | –1 060 376.15 | –1 060 032.19 | –1 041 970.67 | –1 055 087.84 | 21.5 |
| Waste | 167 715.67 | 161 598.01 | 135 261.67 | 137 175.64 | 138 194.80 | 136 025.21 | 132 544.91 | –21.0 |
| Other | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total (with LULUCF)** | **5 293 369.07** | **5 727 303.67** | **6 424 129.89** | **6 118 282.04** | **5 960 865.53** | **5 545 716.69** | **5 747 136.67** | **8.6** |
| **Total (without LULUCF)** | **6 161 460.50** | **6 528 272.79** | **7 072 446.64** | **7 178 658.19** | **7 020 897.72** | **6 587 687.36** | **6 802 224.51** | **10.4** |

*Abbreviations*: LULUCF = land use, land-use change and forestry, NA = not applicable.

# II. Technical assessment of the inventory submission

## A. Overview

### 1. Inventory submission and other sources of information

5. The 2012 annual inventory submission was submitted on 13 April 2012; it contains a complete set of common reporting format (CRF) tables for the period 1990–2010 and a national inventory report (NIR). The inventory submission was submitted in accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines).

6. Where necessary, the expert review team (ERT) also used previous years' submissions. During the review, the United States provided the ERT with additional information and documents, which are not part of the inventory submission but are in many cases referenced in the NIR. The full list of information and documents used during the review is provided in annex I to this report.

Completeness of inventory

7. The inventory generally covers all source and sink categories for the period 1990–2010 and is complete in terms of years and geographical coverage. However, the following categories have been reported as "not estimated" ("NE"):

(a) $CH_4$ and $N_2O$ emissions from other transportation;

(b) $CO_2$, $CH_4$ and $N_2O$ emissions from the use of biomass and other fuels in the United States territories (other (stationary fuel combustion));

(c) $CO_2$ emissions from calcium carbide production;

(d) The net carbon stock change in living biomass and dead organic matter for the cropland and grassland categories.

8. The ERT recommends that the United States further improve its coverage of the above categories in the inventory, particularly by providing estimates for those categories for which the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance), the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) and the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) provide methodologies and/or emission factors (EFs), in the next inventory submission.

9. Several other categories were reported as "NE" by the Party, including: $CO_2$, $CH_4$ and $N_2O$ emissions from gaseous fuels in railways and navigation; $CO_2$, $CH_4$ and $N_2O$ emissions from gaseous, biomass and other fuels in other mobile (military); $CO_2$ emissions and removals from mineral soils in forest land remaining forest land; the net carbon stock changes in land converted to settlements; $N_2O$ emissions from industrial, and domestic and commercial wastewater treatment; $N_2O$ emissions from domestic and commercial wastewater sludge; and $CH_4$ and $N_2O$ emissions from industrial wastewater sludge. However, during the review, the Party recognized that the appropriate notation keys had not been used for these categories. The ERT encourages the Party to use the appropriate notation keys for these categories in its next inventory submission.

## 2. A description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

Overview

10. The ERT concluded that the institutional arrangements continued to perform their required functions.

Inventory planning

11. The NIR and additional information provided by the Party at the sectoral level during the review described the institutional arrangements for the preparation of the inventory. The United States Environmental Protection Agency (EPA) is the lead federal government agency charged with compiling the annual GHG inventory. The Office of Atmospheric Programs (OAP) is responsible for the emission calculations provided in the inventory, as well as for the completion of the NIR and the CRF tables. The Office of Transportation and Air Quality (OTAQ) is also involved in calculating the emission estimates, in particular those for the transport sector. The EPA offices OAP and OTAQ jointly coordinate the collection of activity data (AD) and emission calculations at the individual category level and ensure consistency and quality throughout the NIR and the CRF tables. Within OAP, an inventory coordinator compiles the entire inventory into the proper reporting format and is also responsible for the cross-cutting issues in the inventory. Other agencies and organizations are also involved in the preparation of the inventory, such as the Energy Information Administration (EIA) of the Department of Energy, which provides national fuel consumption data, the Department of Agriculture, the Geological Survey (USGS), the National Agricultural Statistics Service and the Federal Aviation Administration (FAA), which supply the other relevant AD and parameters needed for the emission estimates.

12. The United States' inventory is prepared in a decentralized manner. Emission calculations for individual categories are the responsibility of individual category leads in different organizations, who also determine the most appropriate methodology, collect the best AD to use in the emission calculations, based upon their expertise in the category, and coordinate with researchers and contractors familiar with the categories. Every year, the inventory coordinator prepares and distributes a memorandum with the aim of providing guidelines for those responsible for preparing the category estimates and associated text for the new United States GHG inventory, addressing issues related to the documentation procedures, the data management practices and the structure of the NIR, as well as new procedures for providing data for the CRF tables.

13. In the NIR, planned improvements are reported in the sector chapters, but a general paragraph reporting the list of planned improvements and their prioritization is not provided. In response to a question raised by the ERT during the review, the Party explained that the inventory improvement prioritization is conducted primarily through the budget planning process. Every year, each inventory sector lead determines potential updates through the assessment of information received via expert, public and UNFCCC review of the inventory, information available from new studies and data collection, and issues identified by quality assurance/quality control (QA/QC) procedures. The sector lead then develops a prioritized list of improvements and presents this information, along with a proposed budget, to the inventory team and to management at EPA. Using this information, the inventory budget is developed and allocated between sectors, taking into consideration prioritized improvements. Higher priority improvements would be: those identified for the key categories; those in areas for which comments were received during the review processes; those to correct errors detected in the QA/QC procedures; and those to

incorporate improved data sources, EFs and assumptions. The ERT recommends that the Party report this information, according to the annotated outline of the NIR provided in the UNFCCC reporting guidelines, in the relevant recalculations chapter, and encourages the Party to include, in this paragraph, the list of major improvements planned and a time frame for their expected implementation.

14. The ERT identified potential issues of inconsistent time series in all sectors due to the lack of AD for some years or the different data sources used for the AD time series. The ERT considers that the EPA GHG Reporting Program (GHGRP) should contribute to the improvement of the inventory, and in particular to data collection, providing further information at the facility level which will be especially useful for the energy, industrial processes and waste sectors. The ERT encourages the Party to start exploring the potential of integrating the GHGRP data into the inventory and to explore more legally binding agreements and/or memorandums of understanding, especially for categories in the energy and industrial processes sectors which are not part of the GHGRP, to ensure the timely availability of data and the consistency of the time series, as well as the full coverage of emission sources.

Inventory preparation

*Key categories*

15. The United States has reported key category tier 1 and tier 2 analyses, both level and trend assessment, as part of its 2012 inventory submission. The tier 1 key category analysis performed by the Party and that performed by the secretariat[2] produced similar results. The United States has included the LULUCF sector in its key category analysis, which was performed in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

16. In its NIR, the United States explained that it uses the results of the key category analysis to prioritize the development and improvement of the inventory.

*Uncertainties*

17. The NIR states that an IPCC tier 2 uncertainty analysis has been performed and the results of this analysis are presented both at the summary level and at the individual category level. The total level uncertainty is equal to –2 per cent to +5 per cent without LULUCF and –3 per cent to +6 per cent with LULUCF. The increasing emissions trend in comparison with the base year is estimated to be within the range of +5 per cent to +16 per cent, and +2 per cent to +16 per cent, respectively, without and with LULUCF. Annex 7 to the NIR further disaggregates the underlying information in the uncertainty analysis. In response to questions raised by the ERT during the review, the Party provided additional information on uncertainties in an addendum to annex 7 of the NIR, which contains relevant data on uncertainty ranges for the EFs and AD. The ERT encourages the United States to make this information available in the NIR of its next inventory submission, for example by providing the addendum on its website and by adding, in the NIR, the relevant website address.

[2] The secretariat identified, for each Party, the categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance for LULUCF. Key categories according to the tier 1 trend assessment were also identified for Parties that provided a full set of CRF tables for the base year or period. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

*Recalculations and time-series consistency*

18. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. The rationale for these recalculations is provided in the NIR and in CRF table 8(b). The ERT noted that the recalculations reported by the Party of the time series 1990 to 2009 have been undertaken to take into account methodological improvements and an update of historical data, which include emission estimates for categories previously reported as "NE".

19. The major changes were observed for the following categories: forest land remaining forest land ($CO_2$ emissions and removals); wastewater treatment ($CH_4$ and $N_2O$); solid waste disposal on land ($CH_4$); enteric fermentation ($CH_4$); agricultural soil management ($N_2O$); road transportation ($CO_2$, only for the last year of the time series); stationary combustion ($CH_4$ and $N_2O$). The effect of the recalculations was a decrease in estimated total GHG emissions in 1990 (0.1 per cent) and a decrease in 2009 (0.3 per cent).

20. The ERT noted that the time-series consistency was difficult to assess in some cases, such as for the stationary combustion category in the energy sector (see para. 35 below), due to the aggregation of different categories. The ERT recommends that the Party improve the transparency of its inventory in its next inventory submission by ensuring that information is reported at the aggregation level provided by the UNFCCC reporting guidelines.

*Verification and quality assurance/quality control approaches*

21. The United States has a QA/QC plan entitled "Quality Assurance/Quality Control and Uncertainty Management Plan for the United States Greenhouse Gas Inventory: Procedures Manual for QA/QC and Uncertainty Analysis", which stipulates the tier 1 procedures used for the entire inventory. The key attributes of this plan are summarized in section 1.6 of the NIR. Where QA/QC activities for a particular category go beyond the minimum tier 1 level, further explanation is provided within the respective category section. Information on the QC procedures performed in individual sectors is provided in the sector chapters of the NIR. During the review, the Party supplied additional documentation containing all tier 1 and tier 2 QC checks applied to the annual inventory.

22. The ERT considers that the Party's QA/QC plan, as described in the NIR, is in accordance with the IPCC good practice guidance. Both tier 1 (general) and tier 2 (category-specific) QC activities and checks are performed in line with the IPCC good practice guidance. The inventory is also subjected to QA through a public review by the United States.

23. During the review, the ERT detected some inconsistencies regarding the information reported in the CRF tables and in the NIR, and between the CRF tables in the agriculture and LULUCF sectors as a consequence of recalculations in the agriculture sector, and in the energy sector concerning the reference approach (see paras. 39, 90, 91, 97, 98, 114, 117 and 118 below). The ERT noted that developing verification analysis in some sectors, such as the industrial processes sector, could improve the time-series consistency. The ERT recommends that the Party, in the next inventory submission, implement the appropriate further developments of the QA/QC plan to reduce these inconsistencies, as far as possible.

*Transparency*

24. The NIR generally provides much of the information on methodologies and approaches necessary to assess the inventory and follows the structure outlined in the UNFCCC reporting guidelines. Detailed information on the methodologies used, the key category analysis and the uncertainty analyses is included in annexes to the NIR. However, the ERT identified areas where more transparency is needed in all sectors (see, for example,

paras. 34, 37, 60, 87, 89, 97 and 123 below). Sector-specific recommendations on transparency are provided in the relevant sector chapters of this report.

25. In general, the transparency of the NIR could be improved by: including justifications for the decision to use default EFs from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines), where relevant; implementing and reporting a comparison of country-specific EFs with the IPCC default EFs; disaggregating emissions by category according to the UNFCCC reporting guidelines, especially where basic data are available (e.g. for stationary combustion); reporting emissions and removals in the NIR tables consistently with the CRF tables; and enhancing intersectoral comparisons and the exchange of information (e.g. for the waste and energy sectors). The ERT recommends that the Party improve the transparency of its reporting by including, in the NIR, the additional information required in the relevant sectors. Moreover, the ERT noted that the use of the 2006 IPCC Guidelines could affect the comparability of the emission estimates with those of other Parties included in Annex I to the Convention (Annex I Parties) (e.g. the reporting of $CO_2$ emissions from urea in the LULUCF sector instead of in the industrial processes sector). The ERT therefore recommends that the Party report $CO_2$ emissions from urea following the current UNFCCC reporting guidelines in the industrial processes sector, and include them in the national totals without LULUCF.

Inventory management

26. The United States has a centralized archiving system, at the offices of EPA, which includes the archiving of disaggregated EFs and AD, and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory. The archived information also includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on annual key categories, key category identification and planned inventory improvements. Some components of the archive which are not available electronically, such as scientific papers and industry correspondence, are also kept as hard copies at EPA. During the review, the ERT was provided with the requested additional archived information.

## 3. Follow-up to previous reviews

27. In response to previous review reports, the United States has implemented several improvements in its 2012 inventory submission, in particular with regard to the completeness of the submission and the use of higher-tier estimation methodologies. However, other recommendations made in previous review reports have not yet been implemented, such as improving the transparency of the inventory in the energy and LULUCF sectors, and ensuring that information is reported at the aggregation level provided by the UNFCCC reporting guidelines and by relevant decisions of the Conference of the Parties.

## 4. Areas for further improvement identified by the expert review team

28. During the review, the ERT identified cross-cutting issues for improvement. These are listed in table 3 below.

29. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report and in table 3 below.

## B. Energy

### 1. Sector overview

30. The energy sector is the main sector in the GHG inventory of the United States. In 2010, emissions from the energy sector amounted to 5,933,493.65 Gg $CO_2$ eq, or 87.2 per cent of total GHG emissions. Since 1990, emissions have increased by 12.2 per cent. The key drivers for the rise in emissions are the increases in emissions from public electricity and heat production, and road transportation. Within the sector, 38.6 per cent of the emissions were from energy industries, followed by 29.4 per cent from transport, 13.2 per cent from manufacturing industries and construction and 9.6 per cent from other sectors, including residential and commercial. Fugitive emissions from solid fuels, oil and natural gas accounted for 6.0 per cent. The remaining 3.1 per cent were from other combustion (United States territories, non-energy use and military use).

31. The Party has made numerous recalculations for the energy sector between the 2011 and 2012 submissions following changes in AD. The main reason for the recalculations, which take place for every inventory submission, is that at the end of the year only preliminary AD are available for many activities used in the emission estimates. In response to questions raised by the ERT, the Party stated that in the future the United States will fully incorporate data from the GHGRP, which is expected to lead to significant recalculations in subsequent inventory submissions. The impact of the current recalculations on the energy sector is an increase in emissions of 0.03 per cent for 2009. The main recalculations took place in the following categories:

(a) Fugitive emissions – solid fuels (–1.6 per cent);

(b) Manufacturing industries and construction (–0.5 per cent);

(c) Transport (+0.4 per cent).

32. In terms of completeness, a number of categories in the 2012 inventory submission continue to be reported as "NE" due to a lack of relevant AD, such as: $CO_2$, $N_2O$ and $CH_4$ emissions from the combustion of biomass and other fuels used in the United States territories; $CO_2$, $N_2O$ and $CH_4$ emissions from solid, gaseous, biomass and other fuels for military use; and $CO_2$, $N_2O$ and $CH_4$ emissions from gaseous and solid fuels from railways. In addition, $CH_4$ and $N_2O$ emissions from other transportation continue to be reported as "NE" due to a lack of relevant EFs. The ERT reiterates the recommendations in the previous review reports that the United States obtain the necessary AD and EFs to prepare emission estimates for the combustion of biomass and other fuels used in the United States territories, focusing resources, as appropriate, on improvements in line with the IPCC good practice guidance, and report the emissions in its next inventory submission. The ERT recommends that the Party ensure that emissions from solid fuels, gaseous fuels, biomass and other fuels used by the military are either estimated and reported or that the appropriate notation key is used in the next inventory submission.

33. Moreover, during the review, the ERT noted that fuels used for the production of intermediate products that are exported from the United States are deducted from the amount of fuel reported under the category other (stationary) (see also para. 46 below). The ERT strongly recommends that, in the next inventory submission, the Party does not deduct the amount of fuel used for the production of intermediate products that are exported from the United States, since this fuel for production is consumed in the United States.

34. As noted in previous review reports, the inventory for the energy sector is not sufficiently transparent in the following aspect: all emissions from petroleum refining, manufacture of solid fuels and other energy industries, manufacturing industries and

construction and agriculture/forestry/fisheries (other sectors) are aggregated and reported under other (manufacturing industries and construction).

35. During the review, the ERT was not able to find any technical reason for not reporting the above emissions at the appropriately disaggregated level. The Party informed the ERT that statistical information for the industrial categories is available only every four years. Additionally, EPA has established the GHGRP which, in the future, will provide the necessary facility-level data to allow for the disaggregation of the statistics for the industrial categories in the energy sector. However, the ERT noted that the United States reports disaggregated AD for manufacturing industries and construction to the International Energy Agency (IEA). Furthermore, based on information provided by the Party, the ERT noted that annual data are available for petroleum refining. The ERT considers that the Party's reporting at this aggregated level both reduces the transparency of the inventory and undermines the comparability of the emission estimates with those of other Annex I Parties, as well as the assessment of time-series consistency. The ERT therefore reiterates the recommendation in previous review reports that the Party improve the transparency in its next inventory submission by reporting emissions from these categories at the most disaggregated level, in line with the UNFCCC reporting guidelines.

36. The United States uses the 2006 IPCC Guidelines to estimate and report GHG emissions from fossil fuel combustion. The ERT notes that the UNFCCC reporting guidelines state that all Annex I Parties shall use the Revised 1996 IPCC Guidelines and the IPCC good practice guidance to estimate and report GHG emissions. The ERT reiterates the recommendation in the previous review report that the United States endeavour to follow the UNFCCC reporting guidelines, without compromising accuracy, in order to improve the comparability of its emission estimates with those of other Annex I Parties, including by providing justifications for the decision to use default EFs from the 2006 IPCC Guidelines and by disaggregating the emissions by category, in accordance with the UNFCCC reporting guidelines.

37. During the review, the ERT noted that QA/QC procedures regarding the comparison of data from the CRF tables with the IEA data are not established and that some data flows, particularly for the preparation of emission estimates in the reference approach (e.g. coal rankings and imports and exports of different coal ranks), are not sufficient. The ERT encourages the Party, in close cooperation with EIA, to make relevant arrangements and establish QA/QC procedures in order to ensure harmonized and appropriately disaggregated data and increase the transparency and comparability of its GHG emission estimates.

38. During the review, the United States presented information on the GHGRP. It is anticipated that the programme will cover 80–95 per cent of the Party's emissions. The direct use of GHGRP data will allow the replacement of the current emission estimates for categories where the GHGRP has complete coverage, and will allow a partial replacement of the emission estimates for categories that include facilities that emit more than 25,000 kt $CO_2$ eq annually. Indirectly, the use of the GHGRP data will allow the development of more accurate national EFs based on plant-specific measurements and will allow the disaggregation of the national estimates into more detailed categories and subcategories. Further, the United States also plans to use the GHGRP data to disaggregate energy consumption data based on the facility-level reporting. These efforts will be undertaken with guidance from IPCC experts and by consulting the IPCC report *Use of Models and Facility-Level Data in Greenhouse Gas Inventories*.[3] The ERT noted that there is significant potential for the Party to use the GHGRP to improve the understanding of emission trends. The ERT welcomes the intention of the United States to use new data to

[3] Available at <http://www.ipcc-nggip.iges.or.jp/meeting/pdfiles/1008_Model_and_Facility_Level_Data_Report.pdf>.

improve the accuracy of its inventory and its emission estimates and recommends that the Party, in its future inventory submissions, include information on the progress made in this regard and describe in detail the expected outcome of implementing the use of these new data.

## 2. Reference and sectoral approaches

Comparison of the reference approach with the sectoral approach and international statistics

39. In CRF table 1.A(c) the difference between the reference approach and the sectoral approach for 2010 for energy use and $CO_2$ emissions is –8.0 per cent and –4.8 per cent, respectively. The ERT noted that, due to an error in linking with relevant data, these figures are significantly different from those provided in annex IV to the NIR. During the review, the ERT assessed the reference approach and concluded that the Party's preparation of the reference approach is not fully in line with the Revised 1996 IPCC Guidelines. The fuel used for industrial processes is removed in the form of corrected stock changes from the reference approach, as reported in CRF table 1.A(b). Furthermore, the fuel used for non-energy use of products has also been removed from the reference approach, as reported in CRF table 1.A(b), including both the amount of fuel reported under other non-energy use and the amount of fuel used as feedstock for the production of intermediate products which are exported from the United States. Furthermore, that amount of fuel is not even accounted for in the sectoral approach. The ERT also noted discrepancies in the gross calorific values (GCVs) used and in the naming of solid fuels between the sectoral and reference approaches without any relevant explanation.

40. The ERT noted that the current data source used for the preparation of the reference approach, the *Annual Energy Review* report (EIA, 2012), is in many ways not sufficient to prepare the reference approach estimates. This is particularly true for solid fuels, since the data on coal types are too aggregated. Furthermore, there is no information on imports, exports and stock changes, which makes it necessary for EPA to apply approximations in order to prepare relevant data for CRF table 1.A(b).

41. The ERT recommends that the Party make no further corrections in CRF table 1.A(b), except the correction made for the inclusion of the United States territories, and address that correction in the NIR in a transparent manner. The ERT also reiterates the recommendation in the previous review report that the Party estimate and report the reference approach by strictly following the Revised 1996 IPCC Guidelines in its next inventory submission or provide appropriate justification for the use of the 2006 IPCC Guidelines. Furthermore, the ERT recommends that the Party clearly explain the differences between the reference and sectoral approaches in the NIR and include this comparison in its internal QA/QC procedures.

42. The corrections described above for the conversion of fossil fuels, exports and non-energy use of fuels are having a significant impact on the comparison between the data provided in the CRF tables and the IEA data, and the data provided in the CRF tables are consistently lower than the IEA data. The ERT noted that EIA provides data to IEA and also to EPA for the preparation of emission estimates. However, significant discrepancies do exist, in particular regarding the GCVs for solid fuels. The ERT therefore encourages the United States to ensure the harmonization of reported data from EIA to EPA and IEA, in order to avoid discrepancies between the national inventory data and the data provided to IEA.

*International bunker fuels*

43. According to the information provided in the NIR, the AD on aircraft fuel consumption for the inventory years 2000–2005 were developed using the FAA model,

System for assessing Aviation's Global Emissions (SAGE). This tool has been incorporated into the Aviation Environmental Design Tool (AEDT), which calculates noise in addition to aircraft fuel burned and emissions for all commercial flights globally in a given year. The ERT noted that, because only data for the inventory years 2006–2010 were developed using the AEDT, this could cause time-series inconsistency of the emission estimates. During the review, the ERT also noted a difference between the data provided in CRF table 1.C and the data provided to the IEA. In the CRF table, aviation bunkers in the year 2010 account for 1,059,733 TJ (taking into account GCVs), while according to the IEA data the allocated amount of fuel is 9.2 per cent lower (961,464 TJ). Following a recommendation in the previous review report, the United States excluded fuel consumption for flights between the United States and the United States territories from aviation bunker fuels for the year 2010 and informed the ERT that recalculations for the time series 1990–2009 will be conducted in the next inventory submission. The ERT commends the United States for the efforts made to appropriately address aviation bunker fuels and encourages the Party to further improve its estimates by using the same tool for the GHG emission estimates for the complete time series, in its next inventory submission. Furthermore, the ERT encourages the Party to ensure the harmonization of the reported data on fuel consumption for international aviation bunkers to both the UNFCCC and IEA, to the extent possible.

44. As stated in the NIR, the AD on distillate diesel and residual fuel oil consumption by cargo- or passenger-carrying marine vessels departing from United States ports were taken from unpublished data collected by the Foreign Trade Division of the United States Department of Commerce's Census Bureau for 1990–2001 and 2007–2010, and from the Department of Homeland Security's *Bunker Report* for 2003–2006. The fuel consumption data for 2002 were interpolated. The AD on distillate diesel consumption by military vessels departing from United States ports were provided by the Defence Energy Support Center. During the review, the Party informed the ERT that it is aware that data for maritime bunker fuels are fairly uncertain and that data from the Department of Homeland Security's *Bunker Report*, which were deemed to be more reliable, were only available for the period 2003–2006 because after 2008 the Department of Homeland Security decided not to collect relevant marine bunker data. The ERT noted that the declining GHG emission trends between 1990 and 2010 are not addressed and properly explained in the NIR and encourages the Party to provide all relevant information regarding the declining GHG emission trends in its next inventory submission.

45. In the IEA energy balance for the United States the amount of fuel allocated under international marine bunkers is 47.2 per cent higher (1,146,323 TJ) using GCVs than the amount of fuel reported in CRF table 1.C (778,832 TJ). The ERT also noted that the discrepancy in fuel oil (242,486 TJ) represents 83.4 per cent of the total final consumption of fuel oil. The ERT therefore encourages the Party to assess the differences between the national energy balance and the data provided in the CRF tables in collaboration with EIA and ensure the appropriate and harmonized allocation of international bunker fuels.

*Feedstocks and non-energy use of fuels*

46. During this and several previous reviews the Party was informed by the ERT that the correction of AD due to export of products is not in line with the UNFCCC reporting guidelines and the Revised 1996 IPCC Guidelines. The ERT notes that total final energy consumption data presented in table A-10 of annex 2.1 should not be further adjusted for net exports as presented in table 3-20 since the definition of "total consumption" already takes into account imports, production, exports and stock changes. The same applies for the correction of AD in transformation due to export of some intermediate petrochemical products, which is also not appropriate and could, as a consequence, result in an underestimation of emissions during the production of the product concerned. Therefore, the ERT recommends that the Party follow the IEA/Organisation for Economic Co-

operation and Development structure of the energy balance and benefit from this structure in order to assess all input and output from the transformation sector in a transparent manner and to avoid any additional import/export adjustments. The ERT, furthermore, notes that non-energy use of fuels can, in principle, occur in two categories: in transformation (e.g. as petrochemical feedstock) and/or in total final consumption (non-energy related uses such as asphalt, some lubricants, and the use of liquefied petroleum gas and natural gas in chemical industry). The United States separately reports emissions from the two categories of non-energy use of fuels. For fuels used as petrochemical feedstock, the Party conducts a bottom-up analysis of all major industries known to use such feedstock in order to determine total carbon stored, total carbon emitted, and ultimately an overall storage factor for feedstocks. This aggregated storage factor is then applied to non-fuel input data from EIA to estimate emissions from petrochemical feedstocks. However, since there are two different segments of application of carbon stored which should be clearly identified, the ERT recommends that the Party further improve transparency and provide relevant data in the NIR.

47. Despite recommendations in the previous review reports, the United States continues to allocate emissions from non-energy use of fuels under energy combustion (category other (energy)). The ERT again reiterates that, according to the Revised 1996 IPCC Guidelines, only emissions from fuels combusted for the use of their energy should be reported under fuel combustion. The ERT also reiterates the recommendation in the previous review reports, contained in particular in the review reports of the Party's 2007, 2008, 2009, 2010 and 2011 inventory submissions, that the United States reallocate, in its next inventory submission, the relevant emissions currently reported under the subcategories of the category other (non-energy use of fuels and part of the fuel used in the United States territories), because the Party's current practice reduces the transparency and comparability of the inventory and is not in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. During the review, the Party stated that it will continue its efforts to improve the transparency of this approach and conduct an assessment of the data received through the GHGRP to assess any improvements that could be made to this category.

48. EIA separately reports non-fuel consumption of fuels by fuel type as a portion of total fuels consumed. Consumption for each of these fuels is reported in the NIR in table 3-20. However, the ERT noted that there is a lack of clarity with regard to the allocation of non-energy consumption because categories in the input files that EPA receives from EIA do not follow the standard energy balance form (total primary energy supply followed by transformation, the energy industry's own use and the total final consumption further disaggregated into industry, transport, other (residential, commercial) and non-energy use). The ERT encourages the Party to further improve transparency and, in collaboration with EIA, to ensure the proper allocation of data to the relevant consumption categories, which will then allow the Party to ensure that the carbon stored is neither underestimated nor overestimated.

### 3. Key categories

Stationary combustion: all fuels – $CO_2$, $CH_4$ and $N_2O$[4]

49. As noted in the previous review report, the categorization for the United States has been carried out at the aggregated level under stationary combustion for each fossil fuel. In accordance with the IPCC good practice guidance, for their key category analysis Parties should disaggregate categories to the level where EFs are distinguished (e.g. electric power coal, industrial other coal and commercial/residential coal). Given that the reporting of the detailed energy balance to IEA is conducted by the same institution (EIA) that provides relevant data to EPA to prepare the NIR for the UNFCCC, the ERT believes that the Party should make relevant arrangements in order to ensure harmonized and appropriately disaggregated data and increase the transparency and comparability of the GHG emission estimates. However, during the review, the Party informed the ERT that it is not aware of the EIA data flow used for reporting to IEA. Furthermore, the Party provided comprehensive information on the upcoming implementation of the GHGRP, which will, in principle, provide further information on fossil fuel combustion, in particular in industry. The ERT welcomes the efforts made by the Party to assess the ways to improve the inventory using the GHGRP data and strongly recommends that the Party report a full GHG inventory for all categories required in the CRF tables in accordance with the UNFCCC reporting guidelines and the Revised 1996 IPCC Guidelines. Furthermore, the ERT encourages the Party to ensure the harmonization of reported data and the streamlining of data flows with EIA during implementation of the GHGRP and to explore ways to ensure the time-series consistency of the new data sets from 1990 onwards.

50. The ERT noted that the AD for liquid and solid fuels for the United States territories reported under other (energy (stationary)) for 2010 are identical to the AD reported for 2009. The ERT encourages the Party to provide updated information on emissions for the United States territories in its next inventory submission.

51. The ERT also noted with concern that none of the $CO_2$ EFs for the different fuels (with the exception of the EF for liquefied petroleum gas) have been updated since 2008. During the review, the Party provided the information that, in the future, data reported by facilities under the GHGRP will be used to update EFs. The ERT reiterates the recommendation of the previous review report that the Party update annually the carbon content of fuels used for the estimation of emissions from stationary combustion, in particular because this category, with emissions of 3,643,756.95 Gg $CO_2$ represents 61.4 per cent of emissions from the energy sector.

52. The Party uses technology-specific EFs from the 2006 IPCC Guidelines for estimating emissions of $CH_4$ and $N_2O$ in the category stationary combustion, because information on the technology used in electricity production is collected via the EPA Acid Rain Programme Dataset. However, for the $CH_4$ and $N_2O$ estimates in manufacturing industries and construction and other sectors, including commercial and residential, the Party uses tier 1 EFs from the 2006 IPCC Guidelines. In addition, the Party informed the ERT that the primary reference for the EFs provided in the 2006 IPCC Guidelines are publications by EPA (2006 IPCC Guidelines, Volume 2, Chapter 2, "Source: US EPA,

[4] Not all emissions related to all gases, fuels and subcategories under this category are key categories, particularly $CO_2$ emissions from solid fuels (residential and other – United States territories); $CH_4$ emissions from public electricity and heat production, manufacturing industries and construction and other sectors, including commercial and residential; and $N_2O$ emissions from other sectors, including commercial and residential. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases and fuels are not assessed in separate sections.

2005b[5]"). The ERT therefore recommends that the Party provide justification in the NIR for using the tier 1 EFs from the 2006 IPCC Guidelines in the next inventory submission.

Civil aviation: liquid fuels – $CO_2$, $CH_4$ and $N_2O$[6]

53. According to the information provided in the NIR, fuel consumption of aviation jet fuel in civil aviation between 1990 and 2010 decreased by 11.8 per cent from 2,103,195 TJ in 1990 to 1,853,611 TJ in 2010. The Party provided the information that decreased fuel consumption is in part due to improved operational efficiency that results in more direct flight routing, improvements in aircraft and engine technologies to reduce fuel burn and emissions, and the accelerated retirement of older, less fuel-efficient aircraft in the face of rising fuel costs. However, according to information the ERT received from the United States Bureau of Transportation Statistics during the review, the number of passengers who travelled on domestic routes (including the United States territories) during the period 1990–2010 increased by 51.7 per cent (from 416.6 million passengers in 1990 to 632.1 million passengers in 2010), the number of passenger-miles during the same period also increased by 66.1 per cent (from 332,381 million passenger-miles in 1990 to 552,144 million passenger-miles in 2010), and domestic freight transport (including mail) increased in the same period by 227.2 per cent. During the review, the Party informed the ERT that data for the inventory years 2006–2010 were developed using the AEDT, which dynamically models aircraft performance in space and time to estimate the fuel burned, emissions and noise. The ERT strongly recommends that the Party assess the discrepancy between the decreasing fuel consumption and the drivers for domestic air transportation, provide additional relevant information in the NIR of its next inventory submission and, if appropriate, recalculate the GHG emission estimates, taking into account the above-mentioned drivers, and provide an appropriate recalculation of the complete time series from 1990 onwards.

Road transportation: liquid fuels – $CO_2$, $CH_4$ and $N_2O$[7]

54. During the review, the ERT assessed the AD for road transportation and noted that background information is available on a very detailed level, which would allow the Party to report emissions from road transportation and/or off-road emissions from agriculture/forestry/fisheries (other sectors) separately. Therefore, the ERT encourages the Party to report emissions from agriculture/forestry/fisheries under the relevant category in its next inventory submission.

55. The ERT noted that the fuel consumption and $CO_2$ emissions for the subcategory alternative-fuelled vehicles are reported as "included elsewhere" ("IE"), whereas figures are reported for $CH_4$ and $N_2O$ emissions. During the review, the United States informed the ERT that this is because $CO_2$ emissions are estimated on the basis of fuel consumption, whereas $N_2O$ and $CH_4$ emissions are estimated on the basis of vehicle-miles travelled and allocated to vehicle types. The ERT recommends that, instead of adding a technology specification (alternative-fuelled vehicles) under the "fuel type" column, the Party either add individual liquid fuel categories in the CRF tables as necessary and report $CO_2$ emissions together with $N_2O$ and $CH_4$ emissions and fuel consumption for each liquid fuel

[5] Air CHIEF, Version 12, EPA 454/C-05-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC.

[6] Not all emissions related to all gases under this category are key categories, particularly $CH_4$ and $N_2O$ emissions. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

[7] Not all emissions related to all gases under this category are key categories, particularly $CH_4$ emissions. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

type if appropriate, or aggregate specific $N_2O$ and $CH_4$ emissions under biomass, taking into account that alternative-fuelled vehicles use biomass.

Domestic navigation: liquid fuels – $CO_2$, $CH_4$ and $N_2O$[8]

56. According to the information provided in the NIR, the inventory estimates for residual and distillate fuel used by ships and boats is based in part on data on bunker fuel use from the United States Department of Commerce. Domestic fuel consumption is estimated by subtracting the fuel sold for international use from the total sold in the United States. The ERT noted that fuel consumption in navigation gas/diesel oil declined by 35.8 per cent from 284,376.3 TJ in 2007 to 182,481.5 TJ in 2010, leading to a similar decrease in GHG emissions during this period. During the review, the ERT noted that gasoline consumption for recreational boats is rather stable (a 6.0 per cent decrease between 2007 and 2010), while diesel fuel consumption for ships and other boats has dropped by 91.6 per cent. The Party has identified this issue in its planned improvements under "Non-road vehicles". The ERT encourages the Party to assess whether the approach for determining domestic fuel consumption based on the subtraction of fuel sold to international bunkers (which is associated with a great degree of uncertainty) is appropriate and to explore ways to improve the accuracy of the emission estimates by using detailed data on marine ship activities. The ERT also encourages the United States to provide all relevant information for this category in the NIR of its next inventory submission, since this category is currently not addressed in the NIR.

## C. Industrial processes and solvent and other product use

### 1. Sector overview

57. In 2010, emissions from the industrial processes sector amounted to 303,389.48 Gg $CO_2$ eq, or 4.5 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 4,387.15 Gg $CO_2$ eq, or 0.06 per cent of total GHG emissions. Since 1990, emissions have decreased by 3.4 per cent in the industrial processes sector, and decreased by 0.4 per cent in the solvent and other product use sector.

58. The key drivers for the fall in emissions in the industrial processes sector are the reductions in emissions from iron and steel production, metallurgical coke production, ammonia production, urea consumption, adipic acid production, hydrochlorofluorocarbon-22 (HCFC-22) production, aluminium production and cement production. The key driver with regard to the reported rise in emissions in this sector is the increased use of HFCs as substitutes for ozone-depleting substances. Within the industrial processes sector, 43.4 per cent of the emissions were from consumption of halocarbons and $SF_6$, followed by 21.1 per cent from metal production and 18.9 per cent from mineral products. Emissions from chemical industry accounted for 13.9 per cent and emissions from production of halocarbons and $SF_6$ for 2.7 per cent.

59. The Party has made recalculations for the industrial processes sector between the 2011 and 2012 submissions following changes in AD and the updating of the calculation model for the substitution of ozone-depleting substances. The impact of these recalculations on the industrial processes sector is a decrease in emissions of 5.2 per cent for 2009. The main recalculations took place in the following categories:

(a) Soda ash production and use (–16.7 per cent);

[8] Not all emissions related to all gases under this category are key categories, particularly $CH_4$ and $N_2O$ emissions. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

(b) Refrigeration and air-conditioning equipment (–13.0 per cent).

60. Problems related to the availability of AD and EFs affect the transparency, accuracy, completeness and time-series consistency of the industrial processes sector. This includes the use of data from different sources over the time series (e.g. adipic acid production); the use of a default EF instead of a country-specific EF for a key category (e.g. cement production); the use of capacity data instead of production data for a key category (e.g. adipic acid production); and not estimating emissions from a category (e.g. calcium carbide production). The ERT recommends that the Party continue its efforts to collect more detailed data to allow for the more accurate estimation of emissions from the key categories (e.g. cement production) and provide a time series based on a common data source that is available for all inventory years.

61. The sector is reported transparently for most categories. The Party applies approaches or EFs from the 2006 IPCC Guidelines despite the existence of approaches or EFs in the Revised 1996 IPCC Guidelines and/or the IPCC good practice guidance (e.g. for iron and steel production). The Party explained that the participation of experts from the United States in the compilation of the 2006 IPCC Guidelines ensured that the methodologies contained therein are highly applicable to the national circumstances and suggested including this explanation in the next inventory submission. The ERT welcomes this suggestion. In order to further enhance transparency, the ERT recommends that, from the 2014 inventory submission onwards, the Party provide a justification where the approaches or EFs from the 2006 IPCC Guidelines are used.

62. The sector is generally complete, although a number of smaller categories are not included due to a lack of data. The ERT recommends that the Party more vigorously pursue its ongoing efforts to include estimations for the categories currently not included (e.g. calcium carbide production) or only partly included (e.g. production of fluorinated gases (F-gases)).

63. The Party reported on the progress made with regard to the implementation of the GHGRP. In 2010, the industrial plants started to collect data, which will help to improve the accuracy of the emission estimates for categories in the industrial processes sector. For reasons of confidentiality, the Party has delayed the reporting of the background AD and/or parameters necessary for the calculation of the emission estimates until 2013 for certain sources (e.g. public utilities), partly to 2013 and partly to 2015 for some (e.g. production of F-gases) and to 2015 for others (e.g. iron and steel production and nitric acid production), meaning that the full set of information collected under the GHGRP is likely to be available only for the 2016 inventory submission. The ERT welcomes this future improvement and again encourages the Party to pursue its efforts to assess the data available under the GHGRP as far and as early as possible to allow for a smooth integration of the data into future inventory submissions, including achieving time-series consistency. The ERT also encourages the Party to revise its QA/QC procedures to cover plant-specific data following the IPCC good practice guidance.

## 2. Key categories

Cement production – $CO_2$

64. The emission estimates for this category are based on the IPCC tier 2 method, including default values for the cement kiln dust (CKD) correction factor and clinker EF. The Party expects to receive plant-specific data for the estimation of emissions from this key category in its future inventory submissions due to the GHGRP, thereby increasing the accuracy of its emission estimates.

65. As cement production is a key category, the ERT reiterates the recommendation in the previous review report that the United States use a tier 2 approach with a country-specific EF and CKD correction factor based on the GHGRP data available from 2015 onwards.

Adipic acid production – $N_2O$

66. The United States estimates $N_2O$ emissions from adipic acid production using plant-specific measurement data, where available. For the remaining plants, the $N_2O$ emissions are estimated using an approach in accordance with the IPCC good practice guidance, a default EF in line with the Revised 1996 IPCC Guidelines and a correction factor that accounts for emission control technologies. The correction factors used are in line with the IPCC good practice guidance. The production data necessary for the calculation of emissions from those plants, where no emissions measurement takes place, were estimated using the total production and plant production capacities. The ERT commends the Party for its use of a tier 3 method where data are available and recommends that the Party use plant-specific data on production and abatement technologies where emissions measurement does not yet take place, in order to increase the accuracy and time-series consistency of its reporting.

Iron and steel production – $CO_2$

67. The Party uses a mass balance approach and default EFs from the 2006 IPCC Guidelines for the estimation of $CO_2$ emissions from iron and steel production. The ERT notes that as this is a key category, country-specific EFs should be used in line with the Revised 1996 IPCC Guidelines. The ERT therefore recommends that the Party develop country-specific EFs for the mass balance, and also take into account any data available under the GHGRP.

68. The ERT noted that $CO_2$ emissions from direct-reduced iron use in electric arc furnace processes and blast furnace processes are estimated using the total consumption of direct-reduced iron and that consumption is allocated to the processes based on historical data. The ERT encourages the Party to regularly update the assumptions used for the allocation of direct-reduced iron use in the two production processes.

69. The ERT noted that, in the carbon balance for the $CO_2$ emission estimates for coke plants, the Party has not accounted for natural gas as a carbonaceous material due to a lack of data from coke plants using natural gas as a fuel, which represent 20 per cent of total national coke production. The ERT reiterates the recommendation in the previous review report that the Party include the explanation of the method used for the estimation of emissions from natural gas, provided to the ERT during the 2011 review, in its next inventory submission and recalculate these emissions accordingly, ensuring that the double-counting of these emissions in the energy sector is avoided.

70. The reporting of the carbon flows among installations in the iron and steel production category generally renders this sector less transparent. The ERT reiterates its encouragement in the previous review report that the Party include a detailed carbon balance in the iron and steel production section of the industrial processes chapter in its next inventory submission, in order to improve the transparency of the inventory.

### 3. Non-key categories

Lime production – $CO_2$

71. $CO_2$ emissions from lime production were estimated using an IPCC tier 2 method and default values for the calcium oxide (CaO) or CaO plus magnesium oxide (MgO)

content and for the lime kiln dust correction factor. The EFs for both types of lime were calculated assuming a 95 per cent quicklime content in the product. This is not in line with the Revised 1996 IPCC Guidelines, which assumes a share of 100 per cent. With regard to the EF, the ERT recommends that the Party either use the assumption as required by the Revised 1996 IPCC Guidelines or move to a higher-tier approach by determining country-specific EFs. With regard to the lime kiln dust correction factor, the ERT encourages the Party to develop a country-specific value based on the data available under the GHGRP.

Limestone and dolomite use – $CO_2$

72. $CO_2$ emissions from limestone and dolomite use were estimated using an IPCC tier 2 method, which requires the quantity of limestone or dolomite consumed and the average carbon content, based on stoichiometry. The NIR provides an explanation in the chapter on iron and steel production clarifying that the flux consumption in the iron and steel industry category was deducted from this category and allocated under iron and steel production. The ERT noted that the amount of limestone and dolomite used as flux material as stated in the USGS statistics generally exceeds the amount of flux material used in iron and steel production as reported by the American Iron and Steel Institute. In order to further increase the transparency of the inventory, the ERT encourages the Party to assess under which subcategories in metal production these amounts are used.

Ammonia production – $CO_2$

73. The Party calculates and allocates $CO_2$ emissions from ammonia production in accordance with the 2006 IPCC Guidelines, which requires the deduction of $CO_2$ emissions used for the production of urea and the reporting of these emissions in the respective categories where urea is used. This is not in accordance with the Revised 1996 IPCC Guidelines. The ERT therefore recommends that the Party report these emissions in line with the Revised 1996 IPCC Guidelines in its next inventory submission.

Nitric acid production – $N_2O$

74. $N_2O$ emissions from this category were estimated using an IPCC tier 2 method, which involves multiplying the nitric acid production by the weighted average EF calculated from the default values contained in the 2006 IPCC Guidelines in relation to the type of plant technologies used in the country. The production data were estimated based on the available total production and information on the production capacity of the plants. The ERT found that the Party did not provide a justification for the use of the default values contained in the 2006 IPCC Guidelines and recommends that the United States revert to using the default values provided in the Revised 1996 IPCC Guidelines. Furthermore, the ERT encourages the Party to use plant-specific data on production and to use abatement data from the GHGRP to estimate emissions from nitric acid production in its future inventory submissions.

Calcium carbide production – $CO_2$

75. $CO_2$ emissions from calcium carbide production were not estimated in the 2012 inventory submission due to a lack of suitable data for reasons of confidentiality. This leads to an underestimation of emissions. The ERT recommends that the Party further pursue its efforts to obtain the necessary data using appropriate methods to ensure confidentiality and to include emissions from this category in its next inventory submission.

# D. Agriculture

## 1. Sector overview

76. In 2010, emissions from the agriculture sector amounted to 428,409.32 Gg $CO_2$ eq, or 6.3 per cent of total GHG emissions. Since 1990, emissions have increased by 10.5 per cent. The key driver for the rise in emissions is the increased use of liquid and anaerobic waste management systems in the dairy cattle and swine industry that led to an increase in emissions from manure management. Within the sector, 48.5 per cent of the emissions were from agricultural soils, followed by 33.0 per cent from enteric fermentation, 16.4 per cent from manure management and 2.0 per cent from rice cultivation. Field burning of agricultural residues accounted for 0.1 per cent.

77. The Party has made recalculations for the agriculture sector between the 2011 and 2012 submissions following changes in AD and EFs. The impact of these recalculations on the agriculture sector is an increase in emissions of 1.7 per cent for 2009. The main recalculations took place in the following categories:

(a) Enteric fermentation from non-dairy cattle (+2.4 per cent);

(b) Manure management from dairy cattle (+5.6 per cent);

(c) Agricultural soils (+1.3 per cent).

78. The main reason for the increase in emissions from enteric fermentation is that emissions relating to bulls were estimated using a tier 2 methodology instead of a tier 1 methodology. In the category agricultural soils, there have been some large fluxes between subcategories. The direct soil emissions decreased by 10,644 Gg $CO_2$ eq and emissions from pasture, range and paddock manure increased by 12,697 Gg $CO_2$ eq. The reason for this is not transparently described in the NIR. During the review, the Party informed the ERT that this could be due to an error that occurred while updating the DAYCENT model. The main reason for the difference in emissions from manure management is that the distribution of animal waste management systems (AWMS) was updated due to new data from the 2007 Census of Agriculture.

79. The United States' inventory for the agriculture sector is complete, as emissions for all years, categories and gases for the total national territory have been estimated. The NIR is generally transparent with an elaborated annex to supplement the main text. However, some issues that would increase transparency are provided below and in the category-specific paragraphs.

80. The ERT noted that the results of the sector-specific QA/QC procedures have not been presented in a transparent manner in the NIR in line with the IPCC good practice guidance. In particular, where a tier 2 method or country-specific methodology is used to estimate emissions, the inventory agency should cross-check the country-specific parameters (i.e. the methane conversion rate ($Y_m$), the volatile solids and nitrogen (N) excretion rates, the methane-producing capacity and the methane conversion factor (MCF)) and the EFs against the IPCC default values. Significant differences between the country-specific parameters and the IPCC default parameters should be explained and documented in the NIR. The ERT encourages the Party to include the results of the above-mentioned tier 2 QC procedures in the NIR of its next inventory submission.

81. The time series are not always consistent. For some animal groups the Party uses identical population data for the latest years of the time series even though the time series shows a significant trend (e.g. horses, goats, mules and asses). As suggested in the IPCC good practice guidance, it is good practice to use surrogate methods, or trend extrapolation to estimate missing data if the time series contains a significant and constant trend. The

ERT recommends that the Party consider surrogate methods or trend extrapolation to fill any data gaps.

82. The ERT noted that the QA/QC procedures could be improved so that large recalculations between inventory submissions are identified and verified in accordance with the general QC procedures as described in the IPCC good practice guidance. The ERT recommends that the Party revise its QA/QC procedures accordingly and encourages the Party to include tables with recalculated values for each category as well as explanations of the impact of the recalculations on the sectoral and national levels in the NIR of its next inventory submission.

83. The ERT found some inconsistencies between sectors where the flaring of biogas from anaerobic digestion systems could not be found to be reported in the energy sector or in other sectors. The ERT encourages the Party to report all fuel combustion activities in the relevant and appropriate sector.

84. The Party specifies planned improvements at the end of every chapter in the NIR. However, the ERT notes that the transparency would be increased if an intended timetable was included for the implementation of the different inventory improvements. Among the planned improvements are: (i) the improvement of the data on digestible energy for the most important cattle groups; (ii) the switch to a tier 2 approach to calculate the emissions from enteric fermentation for some animal categories currently calculated with a tier 1 method (i.e. sheep, swine, goats, horses); (iii) the inclusion of mules, donkeys, burros and American bison in the emissions from manure management; (iv) the development of region-specific EFs for rice cultivation; and (v) the improvement of the estimation of emissions from agricultural soils by incorporating more land-use survey data from the National Resources Inventory (NRI). The ERT commends the Party for its plans to continuously improve the inventory.

### 2. Key categories

Enteric fermentation – $CH_4$

85. $CH_4$ emissions from calves younger than seven months are not included in the inventory. The IPCC good practice guidance states that the $Y_m$ rate is assumed to be zero for milk-fed juveniles. However, during the review, the Party confirmed that calves are probably given regular feed before the age of seven months. The ERT recommends that the Party include emissions from calves during the time period when they feed on anything in excess of milk.

Manure management – $CH_4$ and $N_2O$[9]

86. The ERT commends the Party for including American bison, mules, burros and donkeys in the emission estimates under the category enteric fermentation. However, these animal categories are still not included in the manure management category. The ERT recommends that the Party include mules, burros and donkeys in the emission estimates for manure management. For American bison, where no IPCC default methodology exists, the ERT encourages the Party to also include emissions from this category in the inventory to ensure consistency between categories.

87. The exact sources of data on AWMS are not transparently described in the NIR. For example, it is not clear on what type of data the *Agricultural Waste Management Field*

[9] Not all emissions related to all gases under this category are key categories, particularly $N_2O$ emissions. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases are not assessed in separate sections.

*Handbook* (as referred to in the NIR) is based (e.g. survey data or expert opinion data). During the review, the Party described more thoroughly the underlying data and informed the ERT that these data have high uncertainty and are partly built on expert judgement. The ERT noted that these data are important for the emission estimates and recommends that the Party provide, in the NIR of its next inventory submission, a better description of the type of statistical data on which the AWMS are based. The ERT also encourages the Party to improve the quality of the AD on AWMS.

88. In the NIR (p. A-244) it is stated that the Party uses default EFs from the 2006 IPCC Guidelines to estimate $N_2O$ emissions from the different AWMS. However, these values are not consistent with the implied emission factors (IEFs) in CRF table 4.B(b) and the IEFs also fluctuate between years. The ERT recommends that the Party explain the reason for the fluctuating IEFs in the NIR of its next inventory submission.

89. The method for capturing and combustion of biogas from anaerobic digestion systems is not transparently described in the NIR, but the transparency would be improved if the Party provided AD in the NIR on the amount of $CH_4$ captured and combusted. The ERT recommends that the Party include more information in the NIR of its next inventory submission regarding the methodology used to calculate the $CH_4$ subtracted from the emissions from anaerobic digestion systems. The ERT also recommends that the Party include information in the NIR on the amount of $CH_4$ captured and combusted.

Agricultural soils – $N_2O$

90. The Party uses the DAYCENT model to estimate the majority of the $N_2O$ emissions from agricultural soils. DAYCENT is a sophisticated model taking into account several country-specific parameters at a detailed spatial level. The model also undergoes constant improvements; for example, additional calibration points are regularly added. The ERT commends the Party for its efforts to improve the accuracy of the inventory.

91. In the NIR (p. A-244) it is stated that the Party uses default EFs from the 2006 IPCC Guidelines to calculate indirect emissions from atmospheric deposition and N leaching and run-off. However, these values are not consistent with the IEFs in CRF table 4.D and the IEFs also fluctuate between years. The ERT recommends that the Party explain the reason for the fluctuating IEFs in the NIR of its next inventory submission.

92. CRF tables 4.B(b) and 4.D are not consistent regarding the total N excretion on pasture, range and paddock. The ERT recommends that the Party investigate the reason for this inconsistency and correct it in the next inventory submission. The ERT also recommends that the Party improve its QA/QC procedures to avoid such inconsistencies in future inventory submissions and provide information on these improvements in its next inventory submission.

93. The Party uses EFs from the 2006 IPCC Guidelines to estimate $N_2O$ emissions from pasture, range and paddock manure. These EFs differ from the default EFs in the IPCC good practice guidance. According to the UNFCCC reporting guidelines, default EFs can only be used if they are taken from the Revised 1996 IPCC Guidelines and/or the IPCC good practice guidance. Other EFs are considered to be country-specific and the reason for using them as country-specific should be transparently described in the NIR. In the case that the Party considers the EFs from the 2006 IPCC Guidelines to be more appropriate to its national conditions, the ERT recommends that the Party justify the use of those EFs in its next inventory submission.

94. No data on fractions are reported in CRF table 4.D. During the review, the Party explained that this is because it does not use a single value in the calculation where these fractions vary within the country. However, the Party agreed that weighted national averages could be calculated and reported in the CRF table. This would increase the

transparency of the inventory and make it easier to follow the flux of N between the different CRF tables. The ERT recommends that the Party include weighted national averages in CRF table 4.D in its next inventory submission.

## E. Land use, land-use change and forestry

### 1. Sector overview

95. In 2010, net removals from the LULUCF sector amounted to 1,055,087.84 Gg $CO_2$ eq. Since 1990, net removals have increased by 21.5 per cent. The key drivers for the rise in removals are the increase of removals from forest land and from urban trees in settlements. Within the sector, 847,066.92 Gg were removals from forest land, followed by 96,596.36 Gg of removals from settlements, 78,902.84 Gg of removals from other (harvested wood products (HWPs) and landfilled yard trimmings and food scraps) and 31,913.70 Gg of removals from grassland. Cropland accounted for 1,595.77 Gg of removals while wetlands accounted for emissions of 987.75 Gg.

96. The Party has made recalculations for the LULUCF sector between the 2011 and 2012 submissions following changes in AD and EFs and in order to rectify identified errors. The impact of these recalculations on the LULUCF sector is an increase in removals of 51,908.90 Gg $CO_2$ eq, or 5.2 per cent, for 2009. The main recalculations took place in the following categories:

(a) Forest land (+6.4 per cent net removals);

(b) Cropland (+16.2 per cent net removals);

(c) Settlements (+0.2 per cent net removals).

97. The United States reports in its NIR that all of the data sets it uses for land use and land-use change have a spatially explicit time series for land-use data and that, therefore, approach 3 is used to provide a full representation of land use in the United States' inventory. Table 7-5 in the NIR holds data on each land use and land-use change for 1990 and from 2005 onwards. However, for the reporting of emissions/removals in the CRF tables this information is not used: for example, for the area of land-use changes the notation key "NA" ("not applicable") is used to report conversions to forest land (CRF table 5.A), while in CRF tables 5.B and 5.C for the area of land-use changes the notation key "IE" is used, except for other land converted to cropland and grassland, and in tables 5.D–5.F the notation keys "NA" and "NO" ("not occurring") are used. The ERT reiterates the recommendation in the previous review report that the Party provide a complete, consistent and accurate time series of annual land use and land-use change matrices that cover the whole national territory, including Alaska, and all land use and land-use categories and subcategories (as provided in CRF table 5) and also recommends that the Party ensure that the data reported in the NIR and in the CRF tables are fully consistent. The ERT further recommends that the Party report the area for which emissions and removals have not been estimated as a subdivision of relevant categories and subcategories so that the total national area is reported throughout the time series while ensuring the comparability of the IEFs. The ERT further recommends that the Party report all the changes in the carbon pools related to the land-use changes.

98. The NIR includes an overview table 7-1: "Net $CO_2$ Flux from Carbon Stock Changes in Land Use, Land-Use Change, and Forestry". In this table these fluxes are not presented in line with those provided in the CRF tables. For example, forest land remaining forest land also includes the data for land converted to forest land and for HWPs; and the total net $CO_2$ flux is not consistent with the values reported in CRF table 10. The ERT recommends that the Party improve the transparency of its reporting and provide

information in the NIR consistent with that contained in the CRF tables in its next inventory submission.

99. The Party uses country-specific EFs as well as default EFs from the 2006 IPCC Guidelines for estimating emissions and removals. The ERT recommends that the Party check the proper use of EFs and, if applicable, provide documentation on the country-specific EFs used (where those values are equal to the default EFs in the 2006 IPCC Guidelines) or use default values from the IPCC good practice guidance for LULUCF.

100. The United States reports planned improvements for all categories. During the review, the Party provided more information and a timetable for the expected implementation of these improvements, including to: account for land use and land-use change in Alaska and refine the implementation of the managed land definition in the 2013 inventory submission; incorporate improved data on the forest floor and soil organic carbon from the national volume and biomass study in the 2013 inventory submission; and incorporate the results from improved plot-level models, the foliage model and the below-ground biomass model in the 2014 inventory submission. The ERT encourages the Party to provide this information on the timetable (i.e. the expected year of implementation) in its next inventory submission.

## 2. Key categories

Forest land remaining forest land – $CO_2$

101. The United States includes in this category not only forest land remaining forest land, but also land converted to forest land and reports the carbon stock changes in land converted to forest land as "IE" and the area as "NA" in the CRF tables. In the NIR (pp. 7-6) the Party reports that it uses approach 3 for a full representation of land use in the United States' inventory. This approach results in separate areas for land converted to forest land. During the review, the Party informed the ERT that the methods used might be appropriate for estimating land converted to forest land separately, because the data collected to track land-use change include measurements made on all forest land. The ERT recommends that the United States continue the technical work under way to implement this integrated approach for tracking land-use change including afforestation. The ERT further recommends that the Party report the area and the changes in the carbon stock pools for forest land remaining forest land separately from those for land converted to forest land as soon as practicable and report, in its next inventory submission, on the progress made.

102. In the NIR, the United States reports a change in the method used to estimate above-ground biomass. Up to the 2011 inventory submission the Party used a method based on Jenkins et al. (2003),[10] which calculates the carbon in living biomass as a function of species and diameter. In the 2012 inventory submission the method used by the Party is based on the component ratio method. In the recalculations section of the NIR, the Party reports that the relative effect on net annual stock changes was minimal and varied from state to state. In the reference documentation (Domke et al., 2012) and in Woodall (2012)[11] it is shown that this change in method results in a drop of the carbon stock in above-ground biomass of 14–16 per cent. The ERT is of the opinion that such change should be well described in the recalculations section of the NIR and documented in the related annex. The ERT recommends that the Party present more transparent information on this change of method in its next inventory submission.

103. For estimating the soil organic carbon, the United States uses a constant value for all years of the time series, which corresponds to the average carbon density per region and

[10] Jenkins JC, Chojnacky DC, Heath LS, and Birdsey RA. 2003. National-scale biomass estimators for United States tree species. *Forest Science* 49(1): pp.12–35. Reference provided in the NIR, p. 11-45.

[11] Woodall CW. 2012. Where did the US forest biomass/carbon go? *Journal of Forestry*. pp.113–114.

forest type, corresponding to an average year of 2007. These data are presented in table A-223 in the annex to the NIR. This approach is not a common one, especially as the Party includes land converted to forest land in this category. As more accurate information is becoming available based on the more recent Forest Inventory Analysis (FIA) database of the United States, the ERT recommends that the Party estimate the soil organic carbon for each year based on the most recent data in the FIA database and explore the use of extrapolations for those years where these data are not available.

104. The United States reports a change of method for the forest inventories, which includes the introduction of a new national plot design and annualized sampling by FIA for most new surveys beginning after 1998. These surveys include the sampling of all forest land including reserved and lower-productivity lands. Most states have annualized inventory data available as of August 2011. The reported changes in the $CO_2$ flux show an overall annual level of about 100 Tg of carbon storage in above-ground biomass in the 1990s; however, since the full implementation of the new forest inventories these values are shown as being around 120 Tg of carbon stored. The ERT recommends that the Party assess whether the time series is consistent (i.e. whether this change corresponds to a real change in carbon stored) or whether the change in method has caused these changes in the values of carbon stored. The ERT also recommends that the Party provide documentation on this assessment in its 2014 inventory submission.

105. The United States reports the results of the uncertainty analysis for forest land remaining forest land in annex 3.12 to the NIR only, but not in the main text of the NIR, which is contrary to the Party's approach for other categories. The ERT recommends that the Party improve consistency by reporting the uncertainties in the main text of the NIR, as well as in the annex.

Cropland remaining cropland – $CO_2$

106. In this category, the United States reports $CO_2$ emissions from urea fertilization, in line with the reporting method provided in the 2006 IPCC Guidelines. In accordance with the Revised 1996 IPCC Guidelines these should have been reported in the industrial processes sector (see also para. 73 above). The ERT recommends that the Party reallocate these emissions to ammonia production in the industrial processes sector in accordance with the Revised 1996 IPCC Guidelines in its next inventory submission.

107. The United States reports no change in living biomass and dead organic matter. The ERT considers that it is likely that there are changes in the carbon stocks in living biomass in perennial crops (e.g. fruit orchards and vineyards). The ERT recommends that the Party estimate the carbon stock changes in living biomass for all years of the time series and report these changes in its next inventory submission.

108. The United States uses data from the NRI when estimating all carbon stocks, except living biomass, in this category. As the most recent data are from 2007, the data from that year are used for all subsequent years of the time series. The ERT recommends that the Party use more recent data as soon as possible and, in the meantime, use extrapolation methods in line with the IPCC good practice guidance in its next inventory submission.

Grassland remaining grassland – $CO_2$

109. The United States does not include all grassland remaining grassland in the reported area and in the estimates of the changes in the carbon pools, because not all federal land is currently included in the inventory. In the NIR, the Party reports on ongoing research to incorporate this land into the inventory and assumes that this will result only in minor changes in annual flux changes. The ERT commends the United States for this effort to

enhance the completeness of its reporting and recommends that the Party include the data on grassland on federal land in the next inventory submission.

Settlements remaining settlements – $CO_2$

110. The United States reports the carbon changes in settlements remaining settlements for urban trees. The estimates are based on data for 14 cities and the sequestration estimates (median values) for these cities, in units of carbon sequestered per unit area of tree cover. As reported in the addendum to annex 7 to the NIR, the median values for gross carbon sequestration range from 150 kg/ha/year to 1,230 kg/ha/year. The urban area is estimated from United States census data for two years (1990 and 2000) and, in addition, the urban tree cover area is estimated from remote sensing data for these same two years. The Party also reports that sufficient data are not yet available to separately determine the inter-annual gains and losses in carbon stocks in the living biomass of urban trees. The ERT noted that the reported annual changes in net carbon flux from urban trees are based solely on changes in the total urban area in the United States from 1990 to 2000 and using extrapolation methods for more recent years of the time series. The Party also reports planned improvements, which it considers will probably result in higher removals. Given the magnitude of removals from this category (approximately 10 per cent of total net removals) the ERT recommends that the Party improve the documentation on the method used for this category in the annex to the NIR in its next inventory submission. The ERT suggests that the Party give special attention to documenting the impact of the use of median values on the estimated removals.

111. The United States reports in the CRF tables an annual increasing area of settlements remaining settlements, but reports land converted to settlements using the notation key "NA". The method used for estimating the carbon stock changes in urban trees, on the other hand, includes a bigger urban area for the year 2000 than for the year 1990, suggesting land conversions to settlements. The ERT notes that the Party reports the carbon stock changes for settlements remaining settlements and for land converted to settlements together in the same category. The ERT therefore recommends that, as part of its integrated effort to develop a more complete land-use change data set, the United States conduct research to develop a land-use change data set that allows the Party to determine which land uses are converted to settlements. Emissions from land conversions might be included in the urban tree areas in "new urban areas", while the growth of (new) trees might be not the same as those in "existing urban areas" and, therefore, the median values for "existing urban areas" might be different from those for "new urban areas". The ERT also recommends that the Party improve the transparency of its reporting and document, in the annex to the NIR, the carbon stock changes in urban trees for "new urban areas".

Other (LULUCF) – $CO_2$

112. The United States reports in this category the carbon sequestration from yard trimmings and food scraps in landfills, and HWPs. In the method presented in the NIR to estimate the carbon stock changes, specific decay values for yard trimmings and food scraps are used. On the other hand, an aggregated value for all landfilled municipal solid waste is used for reporting emissions from landfills in the waste sector (see para. 125 below). To ensure the consistent use of decay values across the whole inventory, the ERT recommends that the Party reflect the intersectoral linkages and document the differences in the decay values in the next inventory submission.

113. The accumulation of yard trimmings and food scraps is reported as starting in 1990. As the United States compares the carbon stocks between years this reporting might result in increased carbon sequestration in the 1990s. However, during the review, the United States informed the ERT that the methodology used in the inventory to estimate the carbon stock changes in yard trimmings and food scraps tracks the carbon disposed in landfills

from 1960 (when records began) onwards, so that the total carbon stock changes in 1990 reflect the carbon stock changes from yard trimmings and food scraps prior to 1990. The ERT recommends that the Party include this information in its next inventory submission.

114. The United States reports HWPs in section 7.2 of the NIR, corresponding to forest land remaining forest land, while in the CRF tables HWPs are reported under other (LULUCF) (category 5.G). The ERT recommends that the Party improve transparency by reporting HWPs in the NIR under the category other (LULUCF).

Biomass burning – $CH_4$ and $N_2O$

115. The United States estimates emissions of non-$CO_2$ gases from forest fires using the default methodology from the IPCC good practice guidance for LULUCF and the emission ratios and default combustion factor for wildfires from the 2006 IPCC Guidelines. The ERT recommends that the Party justify the use of the emission ratios and default combustion factor from the 2006 IPCC Guidelines or use the formula in line with the IPCC good practice guidance for LULUCF, as well as the default EFs, or use country-specific EFs in its next inventory submission.

116. The United States applies the same formula for wildfires and prescribed fires. While wildfires develop uncontrolled, prescribed fires are used in combination with forest management and for the prevention of wildfires. In recent years, the forest area burned for these two types of fires is becoming of the same order of magnitude and so the relative impact of the prescribed fires is increasing. As this is a key category, the ERT recommends that the Party explain the use of a method other than the more detailed equation 3.2.20 on page 3.49 of the IPCC good practice guidance for LULUCF.

### 3. Non-key categories

Land converted to grassland – $CO_2$

117. The United States reports in the NIR several land-use categories for which changes to grassland occur and reports, in particular, that the land-use changes from cropland to grassland led to an increase in soil carbon stocks. Also, the methods described in annex 3.13 to the NIR show that different carbon stock changes are applied to different types of land converted to grassland. However, the ERT noted that in CRF table 5.C the Party reports all land-use changes as changes from "other land". The ERT recommends that the Party report, in CRF table 5.C of its next inventory submission, the areas, the changes in the carbon stock pools and the resulting emissions or removals, as estimated for the specific types of land converted to grassland, in line with the methods used.

Wetlands remaining wetlands – $CO_2$

118. The United States estimates emissions on peat land and reports these in the NIR and in CRF table 5, but uses the notation keys "NA" and "NE" in CRF table 5.D. The ERT recommends that the Party improve the consistency between the NIR and the CRF tables and report the areas, the changes in the carbon stock pools and the resulting emissions or removals in CRF table 5.D in the next inventory submission.

## F. Waste

### 1. Sector overview

119. In 2010, emissions from the waste sector amounted to 132,544.91 Gg $CO_2$ eq, or 1.9 per cent of total GHG emissions. Since 1990, emissions have decreased by 21.0 per cent. The key drivers for this fall in emissions (which is mainly the result of the decrease in $CH_4$

emissions from landfills) are the increase in $CH_4$ recovery from landfills, as well as the development of other management practices such as composting, incineration with energy recovery and recycling, all of which reduce the quantity of landfilled solid waste regardless of the increasing population. Within the sector, 81.4 per cent of the emissions were from solid waste disposal on land, followed by 16.1 per cent from wastewater handling. The remaining 2.5 per cent were from composting, reported under the category other (waste).

120. The Party has made recalculations for the waste sector between the 2011 and 2012 submissions following changes in AD and EFs. The impact of these recalculations on the waste sector is a decrease in emissions of 9.6 per cent for 2009. The main recalculations took place in the following categories:

(a) Solid waste disposal on land (–5.3 per cent);

(b) Wastewater handling (–27.2 per cent);

(c) Other (waste) (–5.0 per cent).

121. The inventory is generally complete in terms of categories, gases and geographic coverage, and the descriptions of the sector-specific methods and calculations are generally transparent. However, the completeness and transparency of the inventory need further improvement regarding the following issues: (a) some sources of emissions (e.g. industrial waste, industrial wastewater and medical waste incineration) are not included in the inventory; (b) there is lack of clarity with regard to the solid waste and sludge distribution between subcategories in the waste sector; (c) there is a lack of descriptions of the solid waste management practices and composition of incinerated waste, as well as the assumptions used; and (d) no references are provided in the NIR for the emissions from waste incineration that are reported in the energy sector and the emissions from sludge treatment that are reported in the agriculture sector. After the review week, the Party informed the ERT that it is planning to provide descriptions of the waste management practices used in the country in its next inventory submission and to make other additional efforts to improve its future inventory submissions. The ERT recommends that the Party do so and further improve completeness and transparency regarding these issues in its next inventory submission.

122. The ERT commends the Party for updating the AD and EFs. However, the ERT noted that there are ongoing problems in data collection: many AD are outdated and/or are estimated from the latest available year, which increases the uncertainty of the estimates and sometimes leads to inconsistent time series. The ERT recommends that the Party implement its plan to integrate data from the GHGRP in future inventories for this sector and recommends that the Party enhance its efforts with regard to data collection and literature review in order to update the data and coefficients, thus increasing the certainty of the estimates and ensuring time-series consistency.

123. The ERT noted some lack of clarity in the intersectoral (e.g. agriculture, energy, forestry) and intrasectoral (e.g. solid waste disposal on land, wastewater handling, waste incineration, composting) distribution and balance of quantities of all waste generated in the country, thereby complicating the comparability between estimates. The ERT recommends that the Party provide information in the NIR on the pathways of the different parts of solid waste and sludge, both intrasectorally and intersectorally, with balanced quantities of the parts and the whole, and provide the necessary explanations and references in documentation boxes in the CRF tables and in the NIR of its the next inventory submission.

## 2. Key categories

Solid waste disposal on land – $CH_4$

124. This category is estimated using a tier 2 first order decay method, which is in line with the IPCC good practice guidance. The category covers emissions from both municipal and industrial landfills. The main source of AD (waste generated and landfilled) for municipal solid waste (MSW) is a biennial survey *State of Garbage in America* (Van Haaren et al., (2010)). However, this does not cover the United States territories. Instead, the population is used as a proxy for the calculation of the nationwide AD, the time series and for the interpolation and extrapolation for filling the missing data between the years of publication of the survey. The AD for the current inventory year, 2010, are also estimates. The ERT noted that total waste generated, as reported in table A-248 of the NIR, was steadily increasing until 2004 and has decreased since then. During the review, the Party could not provide an explanation for this trend. The ERT noted that, although the waste generation was reported to have decreased by 3.3 per cent since 2004, the population actually increased by 5.4 per cent between 2004 and 2010. The ERT recommends that the Party investigate the reasons for the trend of total waste generated and provide explanations in its next inventory submission. The ERT encourages the United States to take into account changes in economic conditions along with the population number for interpolation and extrapolation, in order to reflect the economic crisis of recent years, and also recommends that the Party continue updating the AD with new data as they become available.

125. The ERT noted that the value of the parameter degradable organic carbon (DOC) degraded remains constant across the time series, and most of the other parameters and coefficients are IPCC defaults and/or values recommended by the 2006 IPCC Guidelines. The ERT takes note of the information on the new GHGRP and the United States' planned improvements related to the use of the GHGRP in future inventories, and reiterates the recommendation in the previous review report that the Party use the GHGRP data for updating the data and establishing country-specific values for the parameters, including the DOC and $CH_4$ generation rate constant. The ERT also noted that there is a wide range of literature on the composition of landfilled waste in the United States and recommends that the Party report the composition of waste landfilled, with the amounts/shares and corresponding coefficients, in the NIR of its next inventory submission, in order to increase transparency. The ERT also recommends that the Party investigate the differentiation of landfill management practices in the country, including both active and closed landfills, and take this information into consideration when choosing the oxidation factor and MCF parameters for the calculation of emissions.

126. Emissions from industrial landfills were estimated for solid waste from two industries (the pulp and paper industry, and food processing), which account for 99 per cent of the organic waste of all industries, according to a study from 1993. The ERT reiterates the recommendation in the previous review report that the Party include the data from recent literature in the next inventory submission and reassess the sources in order to include all major sources of $CH_4$ emissions in the estimates. The ERT also reiterates the recommendation in the previous review report that the Party enhance its efforts in order to obtain $CH_4$ recovery data from industrial landfills, as confirmed by the Party after the review, and improve the data on $CH_4$ flaring in order to increase the completeness and accuracy of its reporting.

### 3. Non-key categories

Wastewater handling – $CH_4$ and $N_2O$

127. $CH_4$ and $N_2O$ emissions are estimated for both industrial wastewater and domestic and commercial wastewater. The ERT noted a few cases where the notation keys were incorrectly used in the reporting of the category: the notation key "NE" is used instead of "IE" to report $N_2O$ and $CH_4$ emissions from sludge from industrial wastewater, as well as for $CH_4$ recovery and $N_2O$ emissions from domestic and commercial wastewater and sludge; and the notation key "NE" is used instead of "NO" to report $CH_4$ recovery from industrial wastewater and sludge. The ERT recommends that the Party make corresponding changes in CRF table 6.B and enhance its QC of the category in order to avoid the incorrect use of the notation keys in the next inventory submission.

128. Five industries with major $CH_4$-emitting potential are chosen for the estimation of emissions from industrial wastewater. A recently conducted review has investigated other industries' $CH_4$-emitting potential and found them not sufficiently significant to be reflected in the inventory. The ERT encourages the Party to continue with its plan for investigating the industry data; to critically review the literature, including EPA's research dated 1974 for assessing the $CH_4$-emitting potential in seafood production in the United States, in order to update the information and assumptions; and to explore the possibility of including all major sources of $CH_4$ (and $N_2O$) emissions in the inventory.

129. $CH_4$ emissions from domestic and commercial wastewater are assessed for different wastewater flow streams and treatment systems. However, the assumptions regarding the proportions are provided without justification and the source of the $CH_4$ recovery amount, shown in CRF table 6.B, is not provided in the NIR. The ERT noted that the data are based on a few sources of information: country-specific parameters taken from publications dating from 1991 and 2003 (e.g. biological oxygen demand, percentage of biological oxygen demand removed, $CH_4$ content in biogas and digester gas per capita), and water flow data dating back to 2004. The ERT recommends that the Party enhance its data collection for estimating $CH_4$ emissions from this category to ensure that the data are up to date, and increase the transparency of the NIR in the next inventory submission by providing the source of the $CH_4$ recovery values and a justification for the assumptions used for the different flows of wastewater treatment.

130. $CH_4$ emissions from sludge are reported as "IE" with reference to the use of sludge in agriculture. The NIR does not provide information or references on other pathways of the sludge removed during wastewater treatment. The ERT encourages the Party to include a table showing a balance of the different quantities of sludge removed during wastewater treatment and their final destination (e.g. agriculture, landfills, waste incineration) in the NIR of its next inventory submission.

Waste incineration – $CO_2$, $CH_4$ and $N_2O$

131. The United States reports all emissions from waste incineration, with and without energy recovery, in the energy sector. However, the NIR does not provide references to the energy categories where these emissions are reported. In addition, there is no indication of the share of biogenic and non-biogenic waste incinerated, which may introduce an error in the $CO_2$ emission estimates because biogenic emissions are not to be accounted for in total emissions. The NIR reports on the parts of MSW incinerated for energy purposes only and does not provide information on other waste types that are also incinerated in the country (e.g. medical, hazardous). In response to questions raised by the ERT during the review, the Party provided references to the categories in the energy sector that include emissions from incinerated MSW and hazardous waste and explained that medical waste was not estimated due to the unavailability of AD.

132. The ERT recommends that the Party enhance its data collection, focusing resources as appropriate on improvements in line with the IPCC good practice guidance, in order to ensure the full coverage of all types of waste incinerated in the country, include notation key "NE" in CRF table 6.C and an appropriate justification in the NIR for the categories not estimated, identify the biogenic and non-biogenic parts of incinerated waste and report the emissions from waste incineration without energy recovery in the category waste incineration, in accordance with the Revised 1996 IPCC Guidelines and the reporting recommendation contained below CRF table 6.C. The ERT also recommends that the United States improve the transparency of its reporting in the NIR of its next inventory submission by providing a list of all waste types incinerated in the country, with their specific characteristics as well as descriptions and references to the categories in the energy sector where emissions from waste incineration with energy recovery are reported.

Other (waste) – $CH_4$ and $N_2O$

133. Composting is showing a growing emissions trend, representing an alternative way (to landfilling) of solid waste treatment along with recycling. The ERT commends the Party for assessing this category of GHG emissions. However, the ERT considers that transparency could be improved by providing further information on the material composted, in addition to trimmings from garden wood and food scraps, and on the balance of the quantities of wood trimmings and food scraps composted and landfilled, taking also into consideration the corresponding amounts reported in the LULUCF sector (see para. 112 above). The ERT encourages the Party to include the corresponding information in the NIR of its next inventory submission.

# III. Conclusions and recommendations

## A. Conclusions

134. The United States made its inventory submission on 13 April 2012. The inventory submission contains the GHG inventory comprising CRF tables and an NIR. This is in line with the UNFCCC reporting guidelines.

135. The ERT concludes that the inventory submission of the United States has been prepared and reported in accordance with the UNFCCC reporting guidelines. The inventory submission is complete and the Party has submitted a complete set of CRF tables for the years 1990–2010 and an NIR; these are complete in terms of geographical coverage, except for some categories in the LULUCF sector (see paras. 97 and 109 above), years and sectors, as well as generally complete in terms of categories and gases. Some of the categories, particularly in the energy sector (e.g. $CH_4$ and $N_2O$ emissions from other transportation) and the LULUCF sector (e.g. the carbon stock changes in living biomass for cropland and grassland), were reported as "NE".

136. The Party's inventory is generally in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. With regard to methodological choices, the emissions for many categories have been estimated on the basis of the methods provided in the 2006 IPCC Guidelines without an adequate explanation in the NIR for this choice. While the 2006 IPCC Guidelines represent an authoritative source of information, their use should not decrease the overall transparency of the inventory submission.

137. The Party has made recalculations for the inventory between the 2011 and 2012 submissions following changes in AD and EFs. The impact of these recalculations on the

national totals is a decrease in emissions of 0.3 per cent for 2009. The main recalculations took place in the following sectors/categories:

(a) Forest land remaining forest land ($CO_2$ emissions and removals);

(b) Refrigeration and air-conditioning equipment (HFCs);

(c) Solid waste disposal on land ($CH_4$);

(d) Wastewater handling ($CH_4$).

138. The institutional arrangements implemented by the United States for the preparation of the inventory continue to perform their required functions.

## B. Recommendations

139. The ERT identifies issues for improvement as listed in table 3 below.

Table 3
**Recommendations identified by the expert review team**

| *Sector* | *Category* | *Recommendation* | *Paragraph reference* |
|---|---|---|---|
| Cross-cutting | Completeness | Further improve the coverage of categories in the inventory, particularly by providing estimates for those categories for which the IPCC good practice guidance, the Revised 1996 IPCC Guidelines and the IPCC good practice guidance for LULUCF provide methodologies and/or EFs | 8 |
| | Inventory planning | Report on all the planned improvements according to the annotated outline of the NIR provided in the UNFCCC reporting guidelines, in the relevant recalculations chapter | 13 |
| | Time-series consistency | Improve the transparency of the inventory submission by ensuring that information is reported at the aggregation level provided by the UNFCCC reporting guidelines | 20 |
| | Verification and QA/QC approaches | Implement the appropriate further developments of the QA/QC plan to reduce inconsistencies | 23 |
| | Transparency | Improve transparency by including in the NIR the additional information required in the relevant sectors | 25 |
| | | Report emissions according to the current UNFCCC reporting guidelines and include $CO_2$ emissions from urea in the national totals without LULUCF | 25 |
| Energy | Overview (completeness) | Obtain the necessary AD and EFs to prepare emission estimates for the combustion of biomass and other fuels used in the United States territories, focusing resources, as appropriate, on improvements in line with the IPCC good practice guidance, and report the emissions in the next inventory submission; and ensure that emissions from solid fuels, gaseous fuels, biomass and other fuels used by the military, are either estimated and reported or that the appropriate notation key is used | 32 |
| | Overview | Do not deduct the amount of fuel used for the production of | 33 |

| *Sector* | *Category* | *Recommendation* | *Paragraph reference* |
|---|---|---|---|
| | (accuracy) | intermediate products that are exported from the United States from the amount reported under the category other (stationary) | |
| | Overview (transparency) | Improve transparency by reporting emissions from these categories at the most disaggregated level, in line with the UNFCCC reporting guidelines | 35 |
| | Overview (comparability) | Endeavour to follow the UNFCCC reporting guidelines, without compromising accuracy, in order to improve the comparability of the emission estimates with those of other Parties included in Annex I to the Convention, including by providing justifications for the decision to use default EFs from the 2006 IPCC Guidelines and by disaggregating the emissions by category, in accordance with the UNFCCC reporting guidelines | 36 |
| | Overview (transparency) | Include information on the progress made in using the new data from the GHGRP to improve the accuracy of the inventory and the emission estimates and describe in detail the expected outcome of implementing the use of these new data | 38 |
| | Reference approach | Make no further corrections in CRF table 1.A(b), except the correction made for the inclusion of the United States and address that correction in the NIR in a transparent manner | 41 |
| | | Estimate and report the reference approach by strictly following the Revised 1996 IPCC Guidelines or provide appropriate justification for the use of the 2006 IPCC Guidelines | 41 |
| | | Clearly explain the differences between the reference and sectoral approach in the NIR and include this comparison in the internal QA/QC procedures | 41 |
| | Feedstocks and non-energy use of fuels | Follow the IEA/OECD structure of the energy balance and benefit from this structure in order to assess all input and output from the transformation sector in a transparent manner and to avoid any additional import/export adjustments | 46 |
| | | Further improve transparency and provide relevant data in the NIR | 46 |
| | | Reallocate the relevant emissions currently reported under the subcategories of the category other (non-energy use of fuels and part of the fuel used in the United States territories) in order to improve the transparency and comparability of the inventory | 47 |
| | Stationary combustion | Report a full GHG inventory for all categories required in the CRF tables in accordance with the UNFCCC reporting guidelines and the Revised 1996 IPCC Guidelines | 49 |
| | Stationary combustion – $CO_2$, $CH_4$ and $N_2O$ | Update annually the carbon content of fuel used for the estimation of emissions from stationary combustion | 51 |
| | | Provide justification in the NIR for the use of the tier 1 EFs from the 2006 IPCC Guidelines to calculate the $CH_4$ and $N_2O$ estimates for manufacturing industries and construction and other sectors, | 52 |

| *Sector* | *Category* | *Recommendation* | *Paragraph reference* |
|---|---|---|---|
| | | including commercial and residential | |
| | Civil aviation – $CO_2$, $CH_4$ and $N_2O$ | Assess the discrepancy between the decreasing fuel consumption and the drivers for domestic air transportation, provide additional relevant information in the NIR and, if appropriate, recalculate the GHG emissions, taking into account the above-mentioned drivers, and provide an appropriate recalculation of the complete time series from 1990 onwards | 53 |
| | Road transportation – $CO_2$, $CH_4$ and $N_2O$ | Either add individual liquid fuel categories in the CRF tables as necessary and report $CO_2$ emissions together with $N_2O$ and $CH_4$ emissions and fuel consumption for each liquid fuel type if appropriate, or aggregate specific $N_2O$ and $CH_4$ emissions under biomass, taking into account that alternative-fuelled vehicles use biomass | 55 |
| Industrial processes | Overview (accuracy) | Continue the efforts to collect more detailed data to allow for the more accurate estimation of emissions from the key categories and provide a time series based on a common data source that is available for all inventory years | 60 |
| | Overview (transparency) | From the 2014 submission onwards, provide a justification where the approaches or EFs from the 2006 IPCC Guidelines are used | 61 |
| | Overview (completeness) | More vigorously pursue ongoing efforts to include estimations for the categories currently not included (e.g. calcium carbide production) or only partly included (e.g. production of fluorinated gases) | 62 |
| | Cement production – $CO_2$ | Use a tier 2 approach with a country-specific EF and cement kiln dust correction factor based on the GHGRP data available from 2015 onwards | 65 |
| | Adipic acid production – $N_2O$ | Use plant-specific data on production and abatement technologies where emissions measurement does not yet take place, in order to increase accuracy and time-series consistency | 66 |
| | Iron and steel production – $CO_2$ | Develop country-specific EFs for the mass balance, and also take into account any data available data under the GHGRP | 67 |
| | | Include the explanation of the method used for the estimation of emissions from natural gas, provided to the ERT during the 2011 review, in the next inventory submission and recalculate these emissions accordingly, ensuring that the double-counting of these emissions in the energy sector is avoided | 69 |
| | Lime production – $CO_2$ | Use either the EF as required by the Revised 1996 IPCC Guidelines or move to a higher-tier approach by determining country-specific EFs | 71 |
| | Ammonia production – $CO_2$ | Report these emissions in line with the Revised 1996 IPCC Guidelines | 73 |
| | Nitric acid | Revert to the default values in the Revised 1996 IPCC Guidelines | 74 |

| *Sector* | *Category* | *Recommendation* | *Paragraph reference* |
|---|---|---|---|
| | production – $N_2O$ | in relation to the type of plant technologies used in the country | |
| | Calcium carbide production – $CO_2$ | Further pursue efforts to obtain the necessary data using appropriate methods to ensure confidentiality and to include emissions from this category in the inventory | 75 |
| Agriculture | Overview (consistency) | Consider surrogate methods or trend extrapolation to fill any data gaps | 81 |
| | Overview (accuracy) | Revise the QA/QC procedures so that large recalculations between inventory submissions are identified and verified in accordance with the general QC procedures as described in the IPCC good practice guidance | 82 |
| | Enteric fermentation – $CH_4$ | Include emissions from calves during the time period when they feed on anything in excess of milk | 85 |
| | Manure management – $CH_4$ and $N_2O$ | Include, mules, burros and donkeys in the emission estimates for manure management | 86 |
| | | Provide, in the NIR, a better description of the type of statistical data on which the animal waste management systems are based | 87 |
| | | Explain the reason for the fluctuating IEFs in the NIR | 88 |
| | | Include more information in the NIR regarding the methodology used to calculate the $CH_4$ subtracted from the emissions from anaerobic digestion systems, and include information in the NIR on the amount of $CH_4$ captured and combusted | 89 |
| | Agricultural soils – $N_2O$ | Explain the reason for the fluctuating IEFs in the NIR | 91 |
| | | Investigate the reason for the inconsistency in the CRF tables regarding total nitrogen excretion on pasture, range and paddock and correct it, and improve the QA/QC procedures to avoid such inconsistencies in future submissions and provide information on these improvements | 92 |
| | | If the Party considers the EFs from the 2006 IPCC Guidelines to be more appropriate to the national conditions, justify the use of those EFs | 93 |
| | | Include weighted national averages for the fractions in CRF table 4.D | 94 |
| LULUCF | Overview (completeness) | Provide a complete, consistent and accurate time series of annual land use and land-use change matrices that cover the whole national territory, including Alaska, and all land use and land-use categories and subcategories, (as provided in CRF table 5) and ensure that the data reported in the NIR and in the CRF tables are fully consistent | 97 |

| *Sector* | *Category* | *Recommendation* | *Paragraph reference* |
|---|---|---|---|
| | | Report the area for which emissions and removals have not been estimated as a subdivision of relevant categories and subcategories so that the total national area is reported throughout the time series while ensuring the comparability of the IEFs | 97 |
| | | Report all the changes in the carbon pools related to the land-use changes | 97 |
| | Overview (transparency) | Improve the transparency and provide information in the NIR consistent with that contained in the CRF tables | 98 |
| | | Check the proper use of EFs and, if applicable, provide documentation on the country-specific EFs used (where those values are equal to the default EFs in the 2006 IPCC Guidelines) or use default values from the IPCC good practice guidance for LULUCF | 99 |
| | Forest land remaining forest land – $CO_2$ | Continue the technical work under way to implement the integrated approach for tracking land-use change including afforestation; and report the area and the changes in the carbon stock pools for forest land remaining forest land separately from those for land converted to forest land as soon as practicable and report, in the next inventory submission, on the progress made | 101 |
| | | Present more transparent information on the change of method used to estimate above-ground biomass | 102 |
| | | Estimate the soil organic carbon for each year based on the most recent data in the Forest Inventory Analysis database and explore the use of extrapolations for those years where these data are not available | 103 |
| | | Assess whether the time series is consistent or whether the change in method caused these changes in the values of carbon stored, and provide documentation on this assessment in the 2014 submission | 104 |
| | | Improve consistency by reporting the uncertainties in the main text of the NIR as well as in the annex | 105 |
| | Cropland remaining cropland – $CO_2$ | Reallocate $CO_2$ emissions from urea fertilization to ammonia production in the industrial processes sector in accordance with the Revised 1996 IPCC Guidelines | 106 |
| | | Estimate and report the carbon stock changes in living biomass for all years of the times series | 107 |
| | | Use more recent data to estimate the carbon stocks in this category as soon as possible and, in the meantime, use extrapolation methods in line with the IPCC good practice guidance | 108 |
| | Grassland remaining grassland – $CO_2$ | Include the data on grassland on federal land in the next inventory submission | 109 |
| | Settlements remaining settlements – | Improve the documentation on the method used for this category in the annex to the NIR, giving special attention to documenting the | 110 |

| *Sector* | *Category* | *Recommendation* | *Paragraph reference* |
|---|---|---|---|
| | $CO_2$ | impact of the use of median values on the estimated removals | |
| | | Improve the transparency and document, in the annex to the NIR, the carbon stock changes in urban trees for "new urban areas" | 111 |
| | Other (LULUCF) – $CO_2$ | Reflect the intersectoral linkages and document the differences in the decay values | 112 |
| | | Include the information provided to the ERT during the review regarding the methodology used to estimate the accumulation of yard trimmings and food scraps | 113 |
| | | Improve transparency by reporting harvested wood products in the NIR under the category other (LULUCF) | 114 |
| | Biomass burning – $CH_4$ and $N_2O$ | Justify the use of the emission ratios and default combustion factor from the 2006 IPCC Guidelines or use the formula from the IPCC good practice guidance for LULUCF as well as the default EFs, or use country-specific EFs | 115 |
| | | Explain the use of a method other than the more detailed equation 3.2.20 on page 3.49 of the IPCC good practice guidance for LULUCF | 116 |
| | Land converted to grassland – $CO_2$ | In CRF table 5.C, report the areas, the changes in the carbon stock pools and the resulting emissions or removals, as estimated for the specific types of land converted to grassland, in line with the methods used | 117 |
| | Wetlands remaining wetlands – $CO_2$ | Improve the consistency between the NIR and the CRF tables and report the areas, the changes in the carbon stock pools and the resulting emissions or removals in CRF table 5.D | 118 |
| Waste | Overview (completeness) | Further improve completeness and transparency | 121 |
| | Overview (consistency) | Implement the plan to integrate data from the GHGRP in future inventories for this sector and enhance the efforts with regard to data collection and literature review in order to update the data and coefficients | 122 |
| | Overview (transparency) | Provide information in the NIR on the pathways of the different parts of solid waste and sludge, both intrasectorally and intersectorally, with balanced quantities of the parts and the whole, and provide necessary explanations and references in documentation boxes in the CRF tables and in the NIR | 123 |
| | Solid waste disposal on land – $CH_4$ | Investigate the reasons for the trend of total waste generated and provide explanations in the next inventory submission | 124 |
| | | Continue updating the AD with new data as they become available | 124 |
| | | Use the GHGRP data for updating the data and establishing country-specific values for the parameters, including the degradable organic carbon and $CH_4$ generation rate constant | 125 |

| *Sector* | *Category* | *Recommendation* | *Paragraph reference* |
|---|---|---|---|
| | | Report the composition of waste landfilled, with the amounts/shares and corresponding coefficients | 125 |
| | | Investigate the differentiation of landfill management practices in the country, including both active and closed landfills, and take this information into consideration when choosing the oxidation factor and methane conversion factor parameters for the calculation of emissions | 125 |
| | | Include the data from recent literature in the next inventory submission and reassess the sources in order to include all major sources of $CH_4$ emissions in the estimates; and enhance efforts in order to obtain $CH_4$ recovery data from industrial landfills and improve the data on $CH_4$ flaring in order to increase the completeness and accuracy of the reporting | 126 |
| | Wastewater treatment – $CH_4$ and $N_2O$ | Make corresponding changes to the notation keys in CRF table 6.B and enhance the QC of the category in order to avoid the incorrect use of notation keys | 127 |
| | | Enhance the data collection for estimating $CH_4$ emissions from this category to ensure that the data are up to date, and increase the transparency of the NIR by providing the source of the $CH_4$ recovery values and a justification for the assumptions used for the different flows of wastewater treatment | 129 |
| | Waste incineration – $CO_2$, $CH_4$ and $N_2O$ | Enhance the data collection, focusing resources as appropriate on improvements in line with the IPCC good practice guidance, in order to ensure the full coverage of all waste types incinerated in the country, include notation key "NE" in CRF table 6.C and an appropriate justification in the NIR for the categories not estimated, identify the biogenic and non-biogenic parts of incinerated waste and report the emissions from waste incineration without energy recovery under waste incineration (6.C) in accordance with the reporting recommendation contained below CRF table 6.C | 132 |
| | | Improve the transparency of the reporting in the NIR by providing a list of all waste types incinerated in the country, with their specific characteristics, as well as descriptions and references to the categories in the energy sector where emissions from waste incineration are reported | 132 |

*Abbreviations*: AD = activity data, CRF = common reporting format, EF = emission factor, ERT = expert review team, GHG = greenhouse gas, GHGRP = Greenhouse Gas Reporting Program, IEA = International Energy Agency, IEF = implied emission factor, IPCC = Intergovernmental Panel on Climate Change, IPCC good practice guidance = IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, IPCC good practice guidance for LULUCF = IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, LULUCF = land use, land-use change and forestry, NE = not estimated, NIR = national inventory report, OECD = Organisation for Economic Co-operation and Development, QA/QC = quality assurance/quality control, Revised 1996 IPCC Guidelines = Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

# Annex I

## Documents and information used during the review

### A. Reference documents

Intergovernmental Panel on Climate Change. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.

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"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories". FCCC/SBSTA/2006/9. Available at <http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf>.

"Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention". FCCC/CP/2002/8. Available at <http://unfccc.int/resource/docs/cop8/08.pdf>.

Status report for the United States of America 2012. Available at <http://unfccc.int/resource/docs/2012/asr/usa.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2012. Available at <http://unfccc.int/resource/webdocs/sai/2012.pdf>.

FCCC/ARR/2011/USA. Report of the individual review of the inventory submission of the United States of America submitted in 2011. Available at <http://unfccc.int/resource/docs/2012/arr/usa.pdf>.

### B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Leif Hockstad (Environmental Protection Agency), including additional material on the methodology and assumptions used. The following documents[1] were also provided by the United States:

EPA, 2012, US GHG inventory 1990-2010 QAQC.

EPA, 2002, *Quality assurance/ quality control and uncertainty management plan for the U:S: greenhouse gas inventory: procedures manual for QA/QC and uncertainties analysis*, EPA 430-R-02-007B, version 1.0, June 2002.

[1] Reproduced as received from the Party.

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EPA, 2012, Log of comments received during the public review of U.S. GHG Inventory emissions and sinks 1990-2010: LULUCF sector, PR_Comment_Log_5 4 2012.xlsx.

Leif Hockstad, 2011, Memorandum for the 1990-2010 U.S. Greenhouse Gas Inventory Preparation Guidelines, July 2011.

U.S Government, 2009, Federal Register / Vol. 74, No. 209 / Friday, October 30, 2009/Rules and Regulations, PART 98—Mandatory Greenhouse gas Reporting.

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J. Schakenbach, R. Vollaro, R. Forte, 2006, *Fundamentals of successful monitoring, reporting and verification under a cap and trade program*, Journal of the air and waste management association, 2006,56:1576-1583.

E. Kebreab, K. A. Johnson, S. L. Archibeque, D. Pape, and T. Wirth. 2008. *Model for estimating enteric methane emissions from United States dairy and feedlot cattle*, J Anim Sci 2008.86:2738-2748.

G. Domke, C. Woodall, J. E. Smith, J. A. Westfall, R. McRoberts, 2012, *Consequences of alternative tree-level biomass estimation procedures on U.S. forest carbon stock estimates*, Forest Ecology and Management, 270/2012, page 108-116.

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EPA, 2010, Municipal Solid Waste in the USA: 2009 Facts and Figures.

# Annex II

## Acronyms and abbreviations

| | |
|---|---|
| AD | activity data |
| AWMS | animal waste management systems |
| CaO | calcium oxide |
| $CH_4$ | methane |
| CKD | cement kiln dust |
| $CO_2$ | carbon dioxide |
| $CO_2$ eq | carbon dioxide equivalent |
| CRF | common reporting format |
| DOC | degradable organic carbon |
| EF | emission factor |
| ERT | expert review team |
| GCV | gross calorific value |
| F-gases | fluorinated gases |
| GHG | greenhouse gas; unless indicated otherwise, GHG emissions are the sum of $CO_2$, $CH_4$, $N_2O$, HFCs, PFCs and $SF_6$ without GHG emissions and removals from LULUCF |
| HFCs | hydrofluorocarbons |
| HWPs | harvested wood products |
| IE | included elsewhere |
| IEA | International Energy Agency |
| IEF | implied emission factor |
| IPCC | Intergovernmental Panel on Climate Change |
| kg | kilogram (1 kg = 1,000 grams) |
| LULUCF | land use, land-use change and forestry |
| MCF | methane conversion factor |
| MgO | magnesium oxide |
| MSW | municipal solid waste |
| N | nitrogen |
| NA | not applicable |
| NE | not estimated |
| $N_2O$ | nitrous oxide |
| NIR | national inventory report |
| NO | not occurring |
| PFCs | perfluorocarbons |
| QA/QC | quality assurance/quality control |
| $SF_6$ | sulphur hexafluoride |
| Tg | teragram (1 Tg = 1 million tonnes) |
| TJ | terajoule (1 TJ = $10^{12}$ joule) |
| UNFCCC | United Nations Framework Convention on Climate Change |
| $Y_m$ | methane conversion rate |