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Report of the individual review of the greenhouse gas inventory of the United States of America submitted in 2006*

* In the symbol for this document, 2006 refers to the year in which the inventory was submitted, and not to the year of publication.

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I. Overview

A. Introduction

1. This report covers the centralized review of the 2006 greenhouse gas (GHG) inventory submission of the United States of America, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 15 to 19 January 2007 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: generalist – Ms. Inga Konstantinaviciute (Lithuania) and Mr. Paul Filliger (Switzerland); energy – Mr. Christo Christov (Bulgaria), Mr. Francis Yamba (Zambia) and Mr. Javier Gonzalez (Spain); industrial processes – Mr. Hongwei Yang (China) and Mr. Menouer Boughedaoui (Algeria); agriculture – Mr. Paul Duffy (Ireland) and Mr. Mahmoud Medany (Egypt); land use, land-use change and forestry (LULUCF) – Mr. Sandro Federici (Italy) and Mr. Leandro Buendia (Philippines); waste – Ms. Tatiana Tugui (Moldova) and Mr. Hiroyuki Ueda (Japan). Ms. Tatiana Tugui and Mr. Paul Duffy were the lead reviewers. The review was coordinated by Mr. Javier Hanna (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, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

B. Inventory submission and other sources of information

3. In its 2006 submission, the United States has submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR) supported by a set of comprehensive annexes. Where needed the expert review team (ERT) also referred to the previous year's submission, additional information provided during the review and other information. The full list of materials used during the review is provided in the annex to this report.

C. Emission profiles and trends

4. In 2004, the most important GHG in the United States was carbon dioxide (CO_2), contributing 84.7 per cent to total[1] national GHG emissions, followed by methane (CH_4), 7.9 per cent, and nitrous oxide (N_2O), 5.4 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) taken together contributed 2.0 per cent of the total GHG emissions in the country, most of that share being HFCs. The energy sector accounted for 86.4 per cent of total GHG emissions, followed by agriculture (6.2 per cent), industrial processes and solvent and other product use (4.6 per cent) and waste (2.7 per cent). In 2004 total GHG emissions amounted to 7,067,569.56 Gg CO_2 equivalent, and had increased by 15.8 per cent between 1990 and 2004 and by 1.7 per cent between 2003 and 2004. In 2004, the LULUCF sector in the United States represented a net sink of 780,094.17 Gg CO_2. Over the period 1990–2004, CO_2 emissions increased by 19.6 per cent, whereas CH_4 and N_2O emissions decreased by 9.9 and 2.4 per cent, respectively.

D. Key categories

5. The United States has reported a key category tier 1 analysis, using both level and trend assessment, and has applied a qualitative approach in determining the key categories as part of its 2006 submission. The United States has included the LULUCF sector in its key category analysis. The key category analyses performed by the United States and the secretariat[2] produced different results. The

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

[2] The secretariat identified, for each Party, those source 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

United States identified 29 key categories in its quantitative analysis and one key category (international bunker fuels) in its qualitative analysis, while the secretariat identified 33 key categories. The most important differences are: (a) the United States disaggregates category 1.A.3 transport into three categories – road and other, aviation, and marine but the secretariat uses the categories civil aviation, road transportation, railways, navigation, and other transportation; (b) the United States adds together 5.A forest land and 5.G. other (harvested wood products); and (c) the United States adds together 4.D.1 direct soil emissions and 4.D.2 pasture, range and paddock manure. The ERT recommends the United States to use the categories suggested by the Intergovernmental Panel on Climate Change (IPCC) where possible.

6. The United States reports in the NIR that a tier 2 key category analysis will be incorporated into future inventories if estimates of uncertainty become available for all sources. However, uncertainty estimates are now available for all sources except one, and the ERT therefore encourages the United States to perform a tier 2 key category analysis for its next submission.

E. Main findings

7. The quality of the inventory is high and the NIR and its annexes provide a detailed description of the methodologies used and sources of activity data (AD). An extensive quality assurance/quality control (QA/QC) system is operational and the ERT considers that the key category and uncertainty analyses are of high quality. The ERT recommends investigations on sources currently not estimated, that a tier 2 approach should be used for key category analysis, and that the LULUCF sector should be developed further in terms of complete geographical coverage, complete coverage of sources and improvement of the methodologies used. In the energy sector, industrial emissions should be reported at a more disaggregated level in accordance with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) and 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).

F. Cross-cutting topics

1. Completeness

8. A full CRF time series is available for the years 1990–2004. The inventory is complete in terms of years and GHG gases but not complete in terms of geographical coverage and source/sink categories. In the LULUCF sector Alaska is not included in the estimations of forest land. In cases where a source was designated as "not estimated" ("NE"), the United States indicates that data are not available for the estimation or that these sources do not have IPCC guidelines. For some sources it is indicated that inclusion of the emissions will be investigated. The discussion of completeness is limited in the NIR. The ERT recommends the United States to further investigate the sources currently not estimated, and to extend discussion of the sources not estimated in its next NIR.

2. Transparency

9. The general structure of the NIR follows the UNFCCC reporting guidelines. The NIR provides a considerable amount of information, including annexes, and the documentation boxes are used in the CRF tables. Given the importance of the emissions of the United States, the amount of information provided is adequate, but there are some areas where improvements should be made. The ERT recommends that the documentation boxes be used in the LULUCF sector.

LULUCF. Key categories according to the tier 1 trend assessment were also identified for those Parties that provided a full set of CRF tables for the year 1990. 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.

3. Recalculations and time-series consistency

10. The ERT noted that recalculations of the time series 1990–2004 have been provided, to take into account changes in emission factors (EFs) and AD. The rationale for the recalculations is provided in the NIR. CRF table 8(a) does not contain the correct values for recalculations due to technical problems in transferring data into the CRF Reporter software; however, tables 10–1 and 10–2 in the NIR provide the correct information, giving a very transparent overview of the recalculations made. Most of the important recalculations occur in the LULUCF sector and are due to the use of new methods and new categories. In all other sectors small recalculations have been made. The recalculations have increased the estimates of total national emissions by 0.3 per cent for 1990 and by 0.9 per cent for 2003. The corresponding recalculations including LULUCF result in increases of 1.8 per cent and 3.0 per cent for 1990 and 2003, respectively.

4. Uncertainties

11. The United States has used a tier 2 method for uncertainty estimation (Monte Carlo analysis). The uncertainty estimates have been significantly improved since the 2005 submission. For most sources quantitative uncertainty estimates are available. The quantitative uncertainty for the total inventory is –1.5 per cent to +6.3 per cent, while for individual gases CO_2 has the lowest uncertainty (–1.1 to +5.7 per cent) and N_2O the highest (–39.2 to +47.7 per cent). The uncertainty is dominated by fossil fuel combustion (–1 to +6 per cent). The ERT recommends the United States to provide more information on the asymmetric shape of the uncertainty band in its next NIR. The uncertainty in trend has also been estimated by a tier 2 method. The uncertainty range for the increase of total emissions from 1990 to 2004 is +8 to +21 per cent. The uncertainty analysis is used to prioritize future improvements.

5. Verification and quality assurance/quality control approaches

12. The United States has a well-established QA/QC system in accordance with the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (the IPCC good practice guidance). The QA/QC plan is contained in the document "Quality Assurance/Quality Control and Uncertainty Management Plan for the U.S. Greenhouse Gas Inventory: Procedures Manual for QA/QC and Uncertainty Analysis", which is referenced in the NIR. In addition to this plan, the NIR mentions source-specific QA/QC plans. Detailed information on QA/QC is given in the NIR for most sectors. In the industrial processes sector the NIR presents an overview of the tier 1 QA/QC procedures for all sources in this sector. In its response to the draft review report, the United States explained that a large amount of the QA/QC checklists completed for the industrial processes sources is also available. Extended QA procedures are carried out annually through expert and public reviews. Special source-specific peer review processes involving relevant experts from industry, government and universities are also conducted if estimates for a new source category are being developed or the methodology for an existing source is being changed.

6. Follow-up to previous reviews

13. The completeness and quality of the inventory have improved since the previous (2005) submission. The United States has made improvements in calculating forest carbon stocks in the LULUCF sector. The model for calculation of agricultural soil emissions has been revised and refinements in the field of non-energy use of fuels have been made. The current inventory is an improvement over previous submissions in that a tier 2 uncertainty analysis has been undertaken. In the 2005 submission all but 10 sources were quantified using a tier 2 uncertainty analysis, while in the 2006 submission all but one source was quantified using such an analysis.

G. Areas for further improvement

1. Identified by the Party

14. The NIR identifies several areas for improvement. The improvements identified are aimed at incorporating some emission sources currently not estimated, improving the accuracy of emission factors, collecting more detailed AD, improving the quality of the uncertainty estimates by refining the category and the overall uncertainty estimates, and including global warming potential uncertainty in the analysis. Improving the analysis of uncertainty in the trend is also identified in the NIR as an area for improvement.

2. Identified by the ERT

15. The ERT identifies the following cross-cutting issues for improvement. The United States should:

(a) Develop a tier 2 key category analysis;

(b) Carry out further investigations of sources currently not estimated;

(c) Include Alaska and Hawaii in the estimations for the LULUCF sector.

16. Recommended improvements relating to specific source/sink categories are presented in the relevant sector sections of this report.

II. Energy

A. Sector overview

17. In 2004, the energy sector accounted for 86.4 per cent of the United States' total GHG emissions. Overall emissions due to energy-related activities had increased by 18.6 per cent since 1990.

18. In 2004, CO_2 emissions from fuel combustion contributed 82.4 per cent of total national emissions and 95.4 per cent of total energy sector emissions. Between 1990 and 2004, total emissions from fuel combustion increased by 20.5 per cent, from 4,893,438.3 Gg to 5,895,716.3 Gg, due to a generally growing domestic economy over the past 15 years and significant growth in emissions from transport (28.1 per cent) and energy industries (27.6 per cent).

19. The inventory addresses all the IPCC categories for the energy sector and covers all years and all gases. The level of disaggregation for the allocation of fuel consumption to individual end-use sectors in the category manufacturing industries and construction is still not in accordance with the Revised 1996 IPCC Guidelines and the UNFCCC reporting guidelines. The ERT strongly supports previous ERTs' recommendations and encourages the United States to make the necessary efforts to report emissions at a more disaggregated level in its next submission.

20. AD were obtained from the Energy Information Administration (EIA) and official statistical agencies in the United States Federal Government, and are considered by the United States to be the most appropriate choice for calculating the inventory estimates. Significant discrepancies can be found when the data reported in the inventory are compared to the International Energy Agency (IEA) data (e.g. apparent consumption of solid fuels, fuel consumption in civil aviation). The United States confirms that the data supplied by the country internationally are consistent with the data used domestically according to sources at the United States Energy Information Administration, the official energy statistics agency for the Government, and that the discrepancies occur during the data processing at the IEA.

21. The reporting of the energy sector estimations is transparent as the calculation methodologies are well documented in the NIR. The NIR provides sufficient back-up information to make it possible to follow the calculations. However, the ERT noted that a number of categories that are reported as "NE"

and "included elsewhere" ("IE") could be significant (e.g. emissions from other fuels in other sectors, emissions from petroleum refining). The ERT recommends the United States to make efforts to estimate these emissions and to include these estimates at a disaggregated level.

22. In 2004, the United States continued to carry out recalculations which are well documented in the NIR. These have been undertaken as a result of changes of methodology and changes in the historical information. For example, under fuel combustion, the recalculations involve changes affecting the time series of emissions estimates for fossil fuel combustion in the industrial sector, which were previously overestimated as some fuels used as feedstocks were included. As a result of the recalculations, the estimates of total sectoral emissions for 2003 have increased by 0.8 per cent compared to the 2005 submission, while the estimates of total sectoral emissions in 1990 have increased by 0.1 per cent. Under the oil and natural gas category, the changes involved new analysis yielding comprehensive EFs for gas platforms. The recalculations result in increases of total estimated emissions for 1990 (5.2 per cent) and for 2003 (8.3 per cent).

23. The United States reports energy data in British thermal units (BTUs) in the NIR, while the natural data are reported in units that differ from the units of the International System of Units (SI) (short tons, barrels of oil US, and cubic feet), and this hindered the review tasks of the ERT. The ERT encourages the United States to provide a conversion table in the NIR and to make a gradual transition in its reporting of the natural and energy data away from the units currently used to the units of the SI system.

B. Reference and sectoral approaches

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

24. CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. For the year 2004, there is a difference of 0.3 per cent in the CO_2 emission estimates between the two. Explanations are provided in the documentation box of CRF table 1.A(c). In addition, the NIR provides explanations for the fluctuations in the differences between the two approaches over the years. The oxidation factors used in the reference approach (0.99 for solid fuels) are based on a 1993 study and are higher than IPCC default values.

25. The apparent consumption in the United States' reference approach for 2004 corresponds closely to the IEA data. For 2004, there is a difference of 0.6 per cent in apparent consumption between the reference approach and the IEA data, and for 1990 there is a difference of 1.6 per cent. The figures in the CRF tables are systematically lower than the IEA data; the discrepancies are within 2.5 per cent for all years. The growth rate for total apparent consumption over the period 1990–2004 is 21 per cent in the CRF tables, while it is 20 per cent according to the IEA data.

2. International bunker fuels

26. The consumption in international aviation and international marine bunkers reported in CRF table 1.C differs from that reported to the IEA. In particular, for international aviation, consumption of jet kerosene is always higher in the CRF tables than in the IEA data, with discrepancies of up to about 20 per cent, and for international marine bunkers consumption of gas/diesel oil and residual fuel oil is always lower in the CRF tables than in the IEA data, by up to 70 per cent. In the CRF tables, there are discrepancies between table 1.C and table 1.A(b) for jet kerosene (international aviation) for all years and for gas/diesel oil (international marine bunkers) for 2004. The United States considers that the AD reported are the most accurate for estimating emissions from these sources.

3. Feedstocks and non-energy use of fuels

27. The ERT welcomes the recalculations of feedstocks and non-energy use of fuels undertaken by the United States to correct its accounting of fuel combustion emissions. Nevertheless, the United States reports coking coal consumption for coke production as feedstock in the industrial processes sector

instead of reporting it under manufacture of solid fuels and other energy industries. The ERT recommends the United States to undertake further improvement of the reporting of coke production and utilization of the coke oven gas in the energy sector.

C. Key categories

1. Manufacturing industries and construction: all fuels – CO_2

28. AD and emissions for the categories iron and steel, non-ferrous metals, chemicals, pulp, paper and print, and food processing, beverages and tobacco are reported under the category other. The United States has provided explanations in the relevant documentation box of the CRF. In the view of the ERT, aggregating the energy consumption of these sectors makes it difficult to apply a technology-dependent higher tier approach to the calculation of emissions. The ERT reconfirms the recommendation of previous ERTs that the United States make the necessary efforts to disaggregate the fuel consumption currently included under other into the relevant IPCC categories.

2. Road transportation: liquid fuels – CO_2

29. As is mentioned in previous review stages, the CO_2 implied emission factors (IEFs) for gasoline for the period 1990–2004 (ranging from 70.71 t/TJ to 71.15 t/TJ) are lower than the IPCC default value for North America (72.10 t/TJ). The trend is unstable. Moreover, the CO_2 IEFs for diesel oil for the period 1990–2004 (72.25 t/TJ) are higher than the IPCC default value for North America (72.10 t/TJ). The inter-annual variations in the CO_2 EFs for gasoline and diesel oil are well documented in the NIR. The United States uses significant volumes of renewable liquid fuels in road transportation (methanol and ethanol added to gasoline and biodiesel). The NIR describes in detail how these fuels are subtracted from the AD and emissions but it is not clear where they are reported. The ERT encourages the United States to provide explanations as to how the AD and CO_2 emissions from these renewable fuels are accounted and reported in the CRF tables.

3. Road transportation: other fuels – CH_4, N_2O

30. The CH_4 and N_2O emissions from liquefied petroleum gas (LPG), gaseous fuels and biomass used in road transportation are reported as "IE". These emissions are reported in an aggregated way under other fuels (alternative fuelled vehicles). Meanwhile, CO_2 emissions estimates from these fuels are reported disaggregated under the respective fuels. The United States is encouraged to report disaggregated CH_4 and N_2O emissions from these fuels in its next submission.

4. Other transportation: gaseous fuels – CH_4, N_2O

31. The CH_4 and N_2O emissions from the transport of natural gas by pipelines are reported as "NE" due to difficulties in obtaining the necessary data. The United States is encouraged to estimate emissions from this category in its next submission.

5. Coal mining and handling – CO_2

32. The United States has reported CO_2 emissions from coal mining and handling, including likely coal seam gas emissions, as "NE". The United States is encouraged to attempt to provide information on CO_2 emissions from coal seam gas in its next submission.

III. Industrial processes and solvent and other product use

A. Sector overview

33. In 2004, total emissions from the industrial processes sector amounted to 320,654.33 Gg CO_2 equivalent, or 4.5 per cent of total national GHG emissions, while total emissions from the solvent and other product use sector contributed 0.1 per cent. Emissions from these sectors increased by 6.5 per cent between 1990 and 2004.

34. Emissions from consumption of halocarbons and SF_6 represented 38.0 per cent of industrial processes total emissions in 2004, while emissions from mineral products represented 21.9 per cent and metal production 20.1 per cent. Consumption of halocarbons and SF_6 emissions increased by 281.4 per cent between 1990 and 2004, while mineral products emissions increased by 29.5 per cent and those from metal production decreased by 46.6 per cent.

B. Key categories

1. Cement production – CO_2

35. Emissions of CO_2 from cement production in 2004 are estimated to be 45,558.83 Gg. They increased by 36.9 per cent between 1990 and 2004. The cement kiln dust (CKD) correction factor used by the United States is the IPCC default value of 2 per cent. Since CKD depends on plant characteristics and the CKD factor varies between 1.5 and 8 per cent, the ERT encourages the United States to develop its own country-specific CKD correction factor to improve its estimates for this source. In response to the draft of this report, the United States informed that it had already initiated efforts to develop a country-specific CKD correction factor, which would be incorporated once an accurate factor has been obtained.

2. Lime production – CO_2

36. Net CO_2 emissions from lime production in 2004 are estimated to amount to 13,697.55 Gg. CO_2 recovery is reported for lime use in sugar refining and precipitated calcium carbonate. There is no information in the NIR on the chemical/physical principles of this CO_2 recovery. During the review, the United States informed the ERT that milk of lime is used in sugar refining to raise the pH of the product steam, whereby the lime itself is removed to form a calcium carbonate precipitate which is assumed to remain as a solid. The United States plans to conduct future research to determine if there are indeed emissions from any end use of this precipitate. The ERT recommends that the United States report this information and the research results in its next inventory submission.

3. Ammonia production – CO_2

37. The CO_2 IEFs reported for this category fluctuate over the period 1990–2004 and are lower than the IPCC range (1.5–1.6 t/t) except in 2001 and 2004. The United States explained that it has used an EF from the European Fertilizer Manufacturers Association (EFMA), which accounts for only non-combustion CO_2 emissions. The United States believes that this EF reflects national circumstances. The United States explained that in 2000 a small amount of ammonia was produced using petroleum coke, which is a more emissive process per tonne of ammonia produced. Since the United States is using the EFMA EF as a country-specific EF, the ERT recommends that in its next submission it provide explanations as to why the IEF increased from 1990 (1.25 t/t) and reached the IPCC default range during 2001 and 2004. The ERT recommends including all these comments in its next NIR.

4. Adipic acid production – N_2O

38. For its estimations the United States has used measurements for two adipic acid plants and the IPCC default EF of 0.3 t/t for the other two plants where no measurements are made. The N_2O IEF fluctuates in a range from 0.018 to 0.067 t/t. The United States explains that the significant decrease in N_2O emissions in 1997 is due to the installation of catalytic destruction at one of the four plants. Operation of the abatement technology increased in subsequent years and emissions continued to decline.

5. Iron and steel production – CO_2

39. Process emissions from this category are accounted for under the industrial processes sector. Emissions from pig iron are reported as “NE” in the CRF tables, but AD are reported in the NIR (table 4–6, page 4–6) and in the CRF tables. During the review the United States informed the ERT that, due to problems of data availability, its figures for CO_2 emissions from integrated iron and steel plants are estimated based on coke consumption, and not on quantities of pig iron and steel produced, and that for

this reason CO_2 emissions are reported under the category other – coke consumption category. The United States also informed the ERT that it will report CO_2 emissions under the steel category in its 2007 inventory submission. It will also improve the reporting by including CO_2 emissions from pig iron production used for steel manufacture under the steel category. The ERT welcomes these planned improvements in the reporting of this category and appreciates the responses to questions raised during the review.

6. Aluminium production – PFCs

40. In the NIR the United States explains the reduction of PFC emissions over the period 1990–2004 as being due to the reduction of aluminium production in the country and actions taken by the companies to reduce the frequency and duration of anode effects. During the review, the United States provided further clarification about the number of smelters operating by 2004, those closed since 1990, and the data reported by plants for 2001 and 2002. The United States has improved its emissions estimates by developing the methodology, using a combination of country-specific and the Revised 1996 IPCC Guidelines methods.

7. Production of halocarbons and SF_6 – HFCs

41. The HFC emissions trend fluctuates over the period 1990–2004. In 2004 HFC emissions were 55.4 per cent lower than in 1990. The United States reports in the NIR that emissions decreased because of reductions in emissions in the three plants in the country, as two are using thermal oxidation, which significantly reduces emissions of HFC-23. The United States informed the ERT that plant emission rates cannot be provided for reasons of confidentiality. The ERT encourages the United States wherever possible to provide relative emission rates and to provide in its next submission more details about the reduction of the emission rates in the plants since 1990.

8. Electrical equipment – SF_6

42. The SF_6 IEF "product life factor" decreased by 53.5 per cent between 1990 and 2004. The "disposal loss factor" is reported as "NE", which will be corrected to "IE" in the next submission. A release rate of 10 per cent is reported in the NIR, while the quantity of SF_6 charged in electrical equipment has been kept constant for the past five years. Since the trend is not constant for the first decade of the time series, the ERT recommends that the United States provide in the NIR more explanations about the single year that is taken as a basis reference for the quantity of SF_6 changed in new equipment. The ERT also recommends that emissions at the disposal stage be estimated in the United States' next submission.

C. Non-key categories

1. Solvent and other product use – CO_2 and N_2O

43. For many categories of this sector emissions and AD are reported either as "NE" or as "not applicable" ("NA").

44. N_2O emissions from this sector are reported as constant for the periods 1993–1996 (14.45 Gg) and 1997–2004 (15.37 Gg). The ERT recommends the United States to provide further information on the data used to estimate emissions from this sector during these periods in its next NIR.

IV. Agriculture

A. Sector overview

45. In 2004, the most important GHG in the agriculture sector was N_2O, contributing 4.0 per cent to total national GHG emissions, followed by CH_4 with 2.3 per cent. The agriculture sector accounted for

6.2 per cent of total national GHG emissions. Total emissions from the sector amounted to 440,124.54 Gg CO_2 equivalent and increased by 0.1 per cent between 1990 and 2004.

46. Emissions of N_2O decreased by 1.1 per cent between 1990 and 2004, whereas CH_4 emissions increased by 2.3 per cent over the same period. The bulk of the CH_4 increase is attributed to an increase in domestic animal populations and a shift in the composition of the swine and dairy industries towards larger facilities. Enteric fermentation was the source of 20.2 per cent of the United States' CH_4 emissions, and of 70.2 per cent of the CH_4 emissions from the agriculture sector, in 2004. The other main agricultural source of CH_4 emissions in 2004 was manure management, which produced 7.1 per cent of national CH_4 emissions and 24.5 per cent of the CH_4 emissions from the sector. In 2004, agricultural soils management accounted for 67.6 per cent of national N_2O emissions, and N_2O emissions from managed manure systems were responsible for4.6 per cent of national N_2O emissions.

B. Key categories

1. Enteric fermentation – CH_4

47. The United States identified CH_4 from enteric fermentation as a key category, and has used a tier 2 method (detailed model) for estimating CH_4 from dairy and non-dairy cattle and tier 1 methods for other animal categories. Tier 2 equations have been used to produce the EFs for cattle, whereas the IPCC default EFs have been used for other animals. The United States has collected the population data for each animal category from national sources, except for horses. The ERT noticed a slight (4.4 per cent) difference between the data on national cattle population contained in the inventory submission and the Food and Agriculture Organization of the United Nations data on cattle population. This difference was mainly due to the use of national cattle population data in a cattle transition matrix in the Cattle Enteric Fermentation Model (CEFM). The ERT encourages the United States to include all explanations related to this transition in its future submissions.

2. Agricultural soils – N_2O

48. The United States identified N_2O direct soil emissions and N_2O indirect emissions from agricultural soil management as key categories. It has used a combination of approaches to estimate direct and indirect N_2O emissions from agricultural soils. The DAYCENT process-based biogeochemical model has been applied to estimate direct N_2O emissions resulting from mineral soil croplands producing major crop types, and the IPCC tier 1 methodology has been applied for non-major crop types on mineral soils. Direct N_2O emissions from grasslands have been calculated using a combination of DAYCENT and IPCC tier 1 methods. CRF table 4.D reports "IE" for the CRF categories of direct and indirect N_2O soil emissions; however, these emissions are reported under other categories (Direct Soil Emissions (DAYCENT) and Indirect Soil Emissions (DAYCENT)). The ERT was not able to assess the DAYCENT model methods or the quality of the N_2O estimates derived by using it because the description and discussion of the DAYCENT model in the NIR and its annex 3 are not sufficiently transparent. The ERT encourages the United States to improve the description of the model in its next NIR, and to consider, for example, including AD and EFs from the DAYCENT model as outputs under the different sub-categories; direct soil emissions 4.D.1 (1–6) and indirect soil emissions 4.D.3 (1–2).

C. Non-key categories

1. Manure management – N_2O

49. The United States has used both tier 1 and tier 2 methods with a combination of IPCC default factors and country-specific factors for estimating N_2O emissions in this category.

50. The United States has provided in the NIR a detailed explanation of the method for calculating the nitrogen (N) excretion from pasture range and paddock. During the review, the ERT identified a discrepancy between the figure for N from excretion from pasture, range and paddock given in CRF table 4.B(b) and that given in CRF table 4.D. The United States explained that this may have been due to

a problem in transferring data into the CRF Reporter, and assured that any data transfer problems will be corrected in the 2007 inventory submission. The ERT encourages the United States to correct the problems identified that are related to animal waste management systems.

V. Land use, land-use change and forestry

A. Sector overview

51. In 2004, the LULUCF sector in the United States represented a net sink of 780,094.17 Gg CO_2 which offset 13.0 per cent of total national CO_2 emissions. The time series shows that the sector has been a net sink since 1990, when net removals were 910,373.10 Gg CO_2. Comparing net CO_2 removals by the LULUCF sector in 2004 with those for 2003, there is a slight increase, of 0.7 per cent.

52. The ERT noted that there is a general problem of completeness and transparency which derives from the United States' system for detecting land use and tracking land-use changes, as required by section 2.1 of the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the good practice guidance for LULUCF). This problem has two major consequences: the United States has not been able to report data for any kind of land use and land-use change in accordance with section 2.1 of the IPCC good practice guidance for LULUCF; and it has not reconstructed a complete and consistent time series for relevant land uses and land-use changes since 1971. The ERT recommends that the United States further disaggregate its estimates between land uses (land remaining in the same category) and land-use changes (land converted to another category) because of the implications for the level and dynamic of carbon (C) stocks in the different LULUCF categories or else to provide explanations of the specific difficulties it faces in disaggregating data, as recommended in the IPCC good practice guidance for LULUCF. The United States has acknowledged this issue and is undertaking a land area reconciliation effort that will ultimately allow for a consistent representation of the land use and the tracking of land use change over the time series in the United States.

53. Under the land converted to cropland, land converted to grassland and land converted to settlements categories, the United States reports carbon stock changes in living biomass and dead organic matter (DOM) pools as "IE", while in the opinion of the ERT they should be reported as "NE". Moreover, under the forest land remaining forest land category, CO_2 emissions have been reported as "NE" while they should be reported as "IE", since the stock change method has been used. Under the biomass burning category, CO_2 emissions from forest land remaining forest land have been reported as "NE" but they too should be reported as "IE", since the stock change method is used; and N_2O emissions from disturbance associated with land-use conversion to cropland have been reported as "IE" while they should be reported as "NE". The United States has acknowledged that these notation key issues will be addressed in its 2007 inventory submission.

54. The United States has reported harvested wood products (HWP) as two additional pools of the forest land category both in the NIR structure and in the key category analysis. According to the IPCC good practice guidance for LULUCF, however, they are not part of forest land use; the ERT therefore recommends the United States to separate them from the forest land category both in the NIR and in the key category analysis and to report them under category 5.G other. In the 2007 submission, the United States will report this source under 5.G other. However, the CRF Reporter developed unexpected technical complications when the 5.G other node is created, so the United States has to report under 5.E settlement in the CRF tables. The United States will examine this problem with the CRF Reporter and attempt to solve it for future submissions.

B. Key categories

1. Forest land– CO_2

55. The United States reports forest data only for the conterminous territory excluding forest area in important parts of the United States territory, in particular Alaska. The ERT repeats the recommendation

of the previous (2005) review report and recommends the United States to report forest data for the whole territory of the United States in its next submission, at tier 1 at least. The United States indicated that it is working towards utilizing the limited Forest Service survey data available for Alaska in conjunction with models and/or supplementary sources of data to include in future inventory submissions.

56. The ERT noted that from 2000 to 2004 the net C stock changes from the forest land category remain constant (114,598.80 Gg C) while in table 7.1 of the NIR different data are reported. During the review the United States indicated that this difference is due to problems in transferring data to the CRF tables and that the data reported in table 7.1 of the NIR are correct. The United States also indicated that any data transfer problems will be corrected in the 2007 inventory submission.

57. As reported in tables 7–5 and 7–6 of the NIR, from 1998 to 1999 the annual net change in the litter carbon pool doubled, while the annual net change in the soil carbon pool passes from being a sink to become a source. The ERT suggests that the United States revise its method for soil carbon taking into account that those significant inter-annual changes in the soil and DOM carbon stocks are unlikely to occur on the very large forest area reported by the United States (ca. 200 Mha). The United States does not estimate non-CO_2 emissions caused by forest fires. However, since 1990 fire has consistently affected forests in the United States. The ERT therefore considers that emissions of CH_4 and N_2O from forest fires could be significant. The United States has acknowledged the issue; estimates of CH_4 and N_2O emissions from forest fires will be included in the 2007 United States inventory submission.

2. Cropland – CO_2

58. The ERT noted that, for the land converted to cropland categories , the land-use change results in an increase of the carbon stocks in the soil carbon pools. During the review the United States explained that it had also been found that the figure for root production used for the estimations was unreasonably high in the Century model simulations for irrigated crops. Those values have been adjusted to better reflect root production, and this has reduced the carbon gain in those systems. Thus, recalculations in the United States' 2007 inventory submission will show losses associated with conversion from grassland to cropland, which is consistent with the findings of experimental studies.

3. Settlements – CO_2

59. The ERT noted that the United States, for estimates of net CO_2 removals from urban trees, reported only a net increase in carbon stock change in CRF table 5.E, and that decreases are noted as "NA". Moreover, the United States does not subtract from the living biomass pool the whole mass of trees that die annually, but only the portion of carbon released in the relevant year because of decomposition of dead trees. Furthermore, carbon stock changes of DOM have been reported as "NE". Therefore, the ERT considers the methodology to be not in line with the IPCC good practice guidance for LULUCF and recommends the United States to review it in order to report both increases and decreases in the living biomass pool and to report changes in carbon stocks due to decomposition in the correct DOM pool. The United States is reviewing the method applied for urban trees to determine whether gains and losses can be broken down distinctly for reporting purposes.

60. The United States reports carbon stock change of "landfilled yard trimmings and food scraps" under category 5.E.1 settlements remaining settlements, and does not consider that this carbon stock should be reported as part of the HWP pool. The ERT noted that the United States reports the HWP pool correctly under category 5.G other. In the 2007 submission, the United States will report this source under 5.G other. However, the CRF Reporter developed unexpected technical complications when the 5.G other node is created, so the United States has to report under 5.E settlements in the CRF tables. The United States will examine this problem with the CRF Reporter and attempt to solve it for future submissions. However, although there is no definitive guidance on this issue, the ERT believes that this stock should be regarded as a portion of the HWP pool even if it is mainly composed of non-wood biomass. This ERT's view is based on the evidence that the same principles and reporting methodologies are applied to both the carbon stocks. Thus, the ERT repeats the recommendation of the

previous (2005) review report and recommends that the United States report the carbon stock changes of "landfilled yard trimmings and food scraps" together with other HWP carbon stocks in category 5.G of the LULUCF sector in its next submission, and that it provide improved explanations and justifications, in the light of the recent scientific literature, and if necessary reconsider the appropriateness of the factors and assumptions applied in the calculation. Finally, the ERT noted that, because a portion of the food scraps landfilled in the United States comes from foreign countries, the United States is reporting in its inventory removals of carbon that occurred outside its boundaries.

VI. Waste

A. Sector overview

61. In 2004, emissions of the waste sector in the United States amounted to 193,831.69 Gg CO_2 equivalent, or 2.7 per cent of total national GHG emissions. The inventory submission covers emissions from solid waste disposal on land (SWDL) and waste-water handling. CO_2 emissions from waste incineration are accounted for in the energy sector. In 2004, solid waste disposal sites (SWDS) were the largest source of CH_4 emissions, accounting for 25.3 per cent of total national CH_4 emissions. Additionally, waste-water handling contributed 6.6 per cent of the United States' CH_4 emissions.

62. The United States has used a methodology based on the first order decay (FOD) model and the information contained in a background paper[3] for estimating CH_4 emissions from solid waste disposal on land, as well as the default IPCC methodologies for CH_4 and N_2O emissions from waste-water handling.

63. The methodologies and assumptions used for estimating emissions from the waste sector are described in the NIR and comprehensive background data are included in the annexes. However, the ERT encourages the United States to improve the structure of the NIR and to provide the background data used for estimations directly in the waste chapter.

64. The United States has provided recalculated CH_4 estimates for the complete time series for the SWDL category due to the updating of the EIA database for gas recovery. These changes resulted in an average annual decrease of 2.8 per cent over the time series in CH_4 recovered by gas-to-energy utilities, and increases in the estimates of CH_4 emissions of 0.05 per cent in 1990 and 8.6 per cent in 2003. Recalculation tables are provided in the CRF for the inventory years 1990–2003, and explanations are provided in the NIR.

B. Key categories

1. Solid waste disposal on land – CH_4

65. Solid waste disposal on land is a key category and CH_4 emissions from this category contributed 2.0 per cent to total national emissions in 2004. During the period 1990–2004, CH_4 emissions from landfills decreased by 18.2 per cent, with small increases occurring in some interim years. The United States explained in its response to previous review stages that this downward trend of emissions is the result of increases in the amount of landfill gas recovery.

66. In 2004, landfills generated approximately 6,709 Gg of CH_4. CH_4 emissions from municipal landfills, which received about 61 per cent of total solid waste generated in the United States, accounted for 79.2 per cent of sectoral CH_4 emissions.

67. In CRF table 6.A the United States has used the notation key "NA" for many parameters (the methane correction factor (MCF), degradable organic carbon (DOC), the fraction of degradable organic carbon dissimilated (DOC_F), etc.), because values for the CH_4 generation potential (L_0) were derived from

[3] Jensen, J. and R. Pipatti (2002). CH_4 Emissions from Solid Waste Disposal. Background Papers – IPCC Expert Meetings on Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

landfill gas recovery data. The ERT recommends the United States to reflect this in the description of the methodology in the NIR.

68. CH_4 generation at industrial landfills is assumed to be equal to 7 per cent of CH_4 emissions from municipal landfills, based on an Environmental Protection Agency study of 1993. As in the 2005 review report, the United States is recommended to re-evaluate this method for its next submission and to consider basing its estimates on industrial production data, which might be more appropriate as a proxy indicator. The United States explained during the review that it is updating its methodology to account for emissions from industrial landfills in the 2007 submission.

2. Waste-water handling – CH_4

69. In 2004, CH_4 emissions from waste-water handling amounted to 36,918.90 Gg and had increased by 49 per cent since 1990, reflecting the increase of the country's population. CH_4 emissions from waste-water handling are identified as a key category by trend. The default IPCC methodology has been used to estimate CH_4 emissions from waste-water handling.

70. The 2004 estimates do not include any information concerning methodological changes; however, the time series for domestic waste-water has been recalculated because population estimates for the United States and the United States territories have changed slightly since the 2005 submission. This change resulted in a less than 1 per cent decrease in the emission estimates over the times series (0.5 per cent in CH_4 emissions for 2003).

C. Non-key categories

1. Waste-water handling – N_2O

71. The IPCC default methodology has been used to estimate N_2O emissions from human sewage. N_2O emissions from waste-water processes have gradually increased (by 24.1 per cent) as a result of the increasing population and increased protein consumption.

2. Waste incineration – CO_2

72. Emissions from waste incineration have been reported as "IE" in CRF table 6.C and included in the energy sector (under 1.A.5), which is consistent with the Revised 1996 IPCC Guidelines. In the NIR, however, CO_2 from waste incineration is reported as a key category under the waste sector. The United States informed that this error will be corrected in its 2007 submission.

Annex

Documents and information used during the review

A. Reference documents

IPCC. Good practice guidance and uncertainty management in national greenhouse gas inventories, 2000. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

IPCC. Good practice guidance for land use, land-use change and forestry, 2003. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

IPCC/OECD/IEA. Revised 1996 IPCC Guidelines for national greenhouse gas inventories, volumes 1–3, 1997. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

UNFCCC. 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/2004/8. Available at: <http://unfccc.int/resource/docs/2004/sbsta/08.pdf>.

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UNFCCC secretariat. Synthesis and assessment report on the greenhouse gas inventories submitted in 2006. FCCC/WEB/SAI/2006. Available at: <http://unfccc.int/resource/docs/webdocs/sai/sa_2006.pdf>.

UNFCCC secretariat. The United States of America: Report of the individual review of the greenhouse gas inventory submitted in the year 2005. FCCC/WEB/ARR/2005/USA. Available at: <http://unfccc.int/resource/docs/2006/arr/usa.pdf>.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Leif Hockstad (United States Environmental Protection Agency) including additional material on the methodology and assumptions used.

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