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REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY OF THE UNITED STATES OF AMERICA SUBMITTED IN THE YEAR 2000[1] (Desk review)

EXECUTIVE SUMMARY

1. Overall objective

1. The overall objective of the desk review of the GHG inventories was to ensure that the Conference of the Parties had adequate information on the GHG inventories. The review team checked the consistency with the UNFCCC reporting guidelines and the *Revised 1996 IPCC Guidelines for National Greenhouse Inventories* (hereinafter referred to as the IPCC Guidelines). The team has also assessed to a certain degree whether the reporting fulfils the requirements included in the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Good Practice Guidance), although the IPCC Good Practice Guidance was not published at the time the inventory was submitted and could not, therefore, have been used in the compilation of the inventory.

2. Completeness and consistency of reporting

2. The United States submitted a GHG inventory report for the years 1990 to 1998 using the common reporting format (CRF), accompanied by a comprehensive national inventory report (NIR) which includes information on methodologies, activity data, emission factors and differences compared to previous submissions. The data seem largely consistent. The Party's inventory submission, in general, conforms to the UNFCCC reporting guidelines and the IPCC Guidelines.

3. Transparency of reporting

3. The data provided using the CRF in electronic format were reproduced in the NIR. In general the CRF includes necessary activity data and emission factors and the NIR gives a good description of methods and assumptions, explanation of the rationale for method selection and references to sources.

4. The emission data in the NIR are often reported in other units than the CRF. It would assist the review if activity data could be converted to international standard units. The United States, in its response to above comments, explained that it is investigating the conversion of the

[1] In the symbol of this document, 2000 refers to the year in which the inventory was submitted, and not to the year of publication. The number (1) indicates that for the United States this is a desk-review report.

entire inventory, including activity data, into SI units and that an annex is provided with unit conversion factors.

4. Uncertainties, verification and QA/QC procedures

5. Information on quality control/quality assurance (QA/QC) procedures implemented is not provided. The United States, in its response to above comments, explained that the inventory already undergoes several stages of quality control checks. It was also explained that it is currently developing a detailed QA/QC plan that will formalize the existing informal QA/QC system. However, the NIR provides a detailed qualitative discussion of uncertainties in relation to the methods used. For some source categories (but not for all), especially for those with higher uncertainties, quantitative estimates are also provided in the NIR.

6. Table 7 (Overview) of the CRF that requires reporting of the quality of estimates was not filled in.

7. No specific information was provided as to what and how self-verification procedures were undertaken. However, reports and documents (e.g. from the Emission Inventory Improvement Program (EIIP) 1997) have been produced in the United States which explain quality assurance and quality control of inventories in general. It would be useful to know whether the procedures outlined in these reports have been applied to the 1998 GHG submissions. The United States, in its response to above comments, explained that the inventory undergoes separate expert and public reviews.

5. Recalculations

8. Recalculation tables were not provided in the CRF (reported as NA) but information as to revisions in methodologies and updates of data was provided in the NIR including the magnitude of the changes with regard to emissions.

6. Summary of findings for each sector

Energy sector

9. In the energy sector, the United States has covered key source energy categories, viz. CO_2 emissions from the energy industry, manufacturing industries and construction and transport. Petroleum refining, manufacture of solid fuels, and other energy industries are covered under the ‘other manufacturing industries and construction’ sub-category.

10. An NIR was submitted providing information on methodologies, activity data, emission factors, differences compared to previous submissions and explanations of trend developments. The NIR provides extensive discussion of uncertainty for every source category, but not necessarily estimates for all categories.

11. There is considerable divergence between the CRF and the NIR with regard to the reference and the sectoral approach for energy use and CO_2 emissions. The documentation box explained that the reference approach CRF table 1.A(b) could not be completed because the fuel types provided in the CRF tables differ from the fuel types as defined in the United States. In addition to the CRF tables, a reference approach calculation was provided in a separate Excel spreadsheet for the years 1994-1998. The reporting of fuel combustion from United States territories also differs between the NIR and the CRF. In its response, the United States explained that it reports fossil fuel combustion emissions from its territories and from military fuel use

under 1.A.5 Other. It would be helpful to report two separate estimates in the CRF for the territories and for military fuel use, in order to improve transparency and to make comparison with the NIR report easier.

12. The implied CO_2 emission factors for commercial and institutional as well as residential use of solid and gas fuels are low compared with other Parties and with the IPCC default values. The same applies for gaseous fuels in public electricity and heat production, road transportation, civil and international aviation, liquid fuels from manufacturing industries and other sectors. In its response to the draft review report, the United States explained that in the case of CO_2 implied emission factor (IEF) for liquid fuels from manufacturing industries, the information is biased due to subtraction of carbon stored in products from the use of fossil fuel feedstocks. The United States also explained that its fuel carbon content data were the product of significant analysis and are believed to accurately represent the fuel characteristics. The United States will also be publishing a detailed analysis of carbon content values in the coming year.

13. The NIR provides explanations and detailed data tables as to how feedstocks and carbon stored in products were treated in the inventory.

14. With regard to bunker fuels, estimates for all gases were provided in the CRF and the NIR and data are consistent. Detailed explanations as to how the split between international and domestic emissions was derived are contained in the CRF (documentation box) and in the NIR.

Industrial processes

15. According to the key level assessment carried out by the secretariat, industrial processes sector key source categories are identified as CO_2 from iron and steel production and consumption of halocarbons and SF_6.

16. In the United States national inventory report, including the CRF, CO_2 emissions from iron and steel, ammonia, ferroalloy and aluminium production are accounted for in the energy chapter under Non-Energy Uses of Fuel. The CO_2 emissions from these sources are also reported by sector under industrial processes. To avoid double counting, however, the emissions are not accounted for under industrial processes. In these sectors where fossil fuels are used both as feed stocks and for energy purposes, the IPCC Guidelines consider the emissions from these sectors as industrial processes where the primary purpose is feed stocks. The IPCC Guidelines could, however, be understood in such a way that when Parties have difficulties in distinguishing energy-based emissions from industry-based emissions, these emissions can be accounted for under the energy sector. Emissions from these sources in the United States are primarily industry-based and should therefore be accounted for under industrial processes. According to data reported under the CRF and the NIR, it would be possible to separate these emissions into different sub-sectors. The United States, in its response to above comments, explained that now it is in the process of reporting all emissions of fossil fuel feedstocks in the Industrial Processes chapter.

17. For many of the sectors under industrial processes, such as CO_2 from iron and steel production, ammonia manufacturing, ferroalloy and aluminium production, N_2O from nitric acid production and SF_6 from magnesium production, the United States has followed a tier 1 approach. This implies that emissions from these sources have been estimated by multiplying the production data by a default emission factor. Such an approach would normally increase the uncertainty since emission factors differ from plant to plant, and hence the tier 1 approach should be used only for non-key sources. For example, iron and steel production contribute 1 per cent to

the United States' total GHG emissions, and this source has also been identified by the secretariat as a key source in the United States inventory. The review team believes that more accurate data could be reported in the future for this source category as well as other mentioned above, if the United States convert to a tier 2 approach using either national consumption data on feedstock or plant-specific emission data. In its response, the United States explained that Tier 2 methodologies is now used for all of the source categories mentioned in this paragraph, with the exception of Nitric Acid Production (which uses a country-specific emission factor that is also an IPCC default value).

Agriculture

18. According to the key level assessment carried out by the secretariat, the key sources in agriculture sector are CH_4 emissions from enteric fermentation, CH_4 emissions from manure management, and N_2O direct emissions from agricultural soils. Emissions of CH_4 from Rice Cultivation and N_2O/CH_4 from Agricultural Residue Burning were also reported, however, they are not key source categories.

19. Implied CH_4 emission factors for dairy cattle seemed to be very high. The Party has provided a revised IEF which is closer to other Parties and IPCC default values.

20. The CH_4 IEF for manure management for dairy cattle and swine is also high compared with other Parties and IPCC default values. The United States responded that the methodology had been improved and the IEF is now closer to other Parties and IPCC default values.

21. The IPCC default emission factor was used to estimate annual N_2O emissions from agricultural soils. Emission factors used were mid-point estimates based on measurements described in scientific literature, and as such are representative of current scientific understanding.

22. The implied N_2O emission factor for anaerobic lagoons seems higher by a factor of 100 compared to other Parties and IPCC default values. The United States has improved the method and the new value is now more similar to those of other Parties.

Land-use change and forestry

23. The estimates of GHG emissions and removals are calculated for the period 1990 to 1998. The United States reports on changes in land-use and other woody biomass stocks (category 5A), CO_2 emissions and removals from soils (category 5D), and other GHG sources and sink categories (category 5E). For category 5D, only removals for forest soils are reported. Forest and grassland conversion (category 5B) and abandonment of managed lands (category 5C) are not reported in the NIR and CRF, because the data on these categories are not available or their contribution to total net carbon fluxes is minor (in the case of boreal forests).

24. CO_2 emissions from wood harvesting are included in general estimates of CO_2 removal for this category source. It is not clear, however, whether burning of harvesting residues is applied in national forestry practices, and what part of harvested wood is accounted for as CO_2 emissions and what is sequestered in harvested wood products.

25. The United States used country-specific conversion factors to estimate the amount of carbon in aboveground and belowground biomass. The NIR includes appropriate references to studies. However, it is not clear from the NIR what emission and conversion factors were used

to account for CO_2 sequestration in forest floor, understorey vegetation, and harvested wood products.

26. The NIR does not provide a clear description of the methodology for estimating CO_2 sequestration in forest soils. The methodology for accounting for CO_2 removals in organic and mineral soils follows the 1996 Revised IPCC Guidelines with a modification to better address country national conditions and apply available data sources. It is described in the NIR.

27. The United States used a country-specific method to account for CO_2 removals in yard trimmings. The NIR provides a detailed description of this. However, it is not clear from the NIR what method was used to account for CO_2 removals from wood products in landfills.

28. In its response to the comments in paragraphs above, the United States explained that it is developing more transparent documentation on the methodologies for estimating CO_2 fluxes from forest soils and wood products in landfills

Waste

29. According to the key level assessment carried out by the secretariat, CH_4 emissions from solid waste disposal (SWDS) is a key source, while CH_4 and N_2O emissions from wastewater and CO_2 and N_2O emissions from waste incineration are non-key sources.

30. The emissions of CH_4 per capita from SWDS are fairly high compared to those reported by other Parties (the second highest per capita emissions of all reporting Annex I parties). This can probably be attributed to a high waste generation rate and to the fact that a relatively large fraction of the generated waste is disposed of at solid waste disposal sites.

31. The emissions from SWDS on land are calculated by means of a country-specific model, which corresponds directly to neither the default method nor the first order decay method given in the IPCC Guidelines. The guidelines do, however, encourage Parties to use more sophisticated methods which incorporate country-specific data, if available. The method used by the United States clearly fulfils this criterion. The documentation of the model and parameters used should, however, have been done in more detail. According to the response to this comment, the United States will provide more transparent descriptions of the landfill model in future inventory submissions.

32. The emissions from wastewater treatment and human sewage are estimated using IPCC default methods (slightly modified) and the emissions from waste incineration by a country-specific method compatible with the IPCC Guidelines.

33. Estimates for industrial CH_4 emissions from wastewater treatment were not provided due to insufficient data available. However, the United States has now developed an estimate for CH_4 emissions from industrial wastewater consistent with IPCC Good Practice Guidance, and this estimate has been reported in subsequent inventory submissions. N_2O emissions from wastewater treatment were also not provided, for the same reason, but it should be noted that the IPCC Guidelines do not provide a method for this. The failure to provide estimates for the sources and the reasons for this are described in both the NIR and the CRF tables (table 9 on completeness). The United States explained in its response, that the human sewage component of N_2O emissions from wastewater treatment was reported and is believed to be one of the most significant sources of N_2O from wastewater.

Other sources

34. According to the IPCC Guidelines volatile organic compounds (VOCs) and CH_4 emissions from solvents, coal mines, and oil and gas production and transportation should be followed by an estimation of CO_2. When the VOC and CH_4 emissions are caused by combustion of fossil fuels the CO_2 emissions will normally be covered by the CO_2 emissions factor which includes all carbon regardless of whether the carbon is emitted as CO_2, VOC or CH_4. However, when VOC and CH_4 are emitted from non-combustion processes, such as venting, leakages and so on, the CO_2 emissions often have to be calculated separately. In the CRF and the NIR of the United States, CO_2 emissions due to venting and leakages from solvents, coal mines, and oil and gas production and transportation are not estimated (reported as NE). In addition, no information to indicate whether these CO_2 emissions were included elsewhere was provided, such as in the CO_2 estimates calculated according to the reference approach.

35. Under the sector Solvents the United States has not reported emissions from N_2O consumption.

A. OVERVIEW

1. Introduction

36. The Conference of the Parties (COP), at its fifth session, by its decision 6/CP.5, requested the secretariat to conduct, during the trial period, individual reviews of greenhouse gas inventories for a limited number of Parties included in Annex I to the Convention on a voluntary basis, according to the UNFCCC guidelines for the technical review of GHG inventories from Parties included in Annex I to the Convention.[2] In doing so, the secretariat was requested to coordinate the technical reviews and to use different approaches to individual reviews, including desk reviews, centralized reviews and in-country reviews.

37. In response to the mandate by the COP, the secretariat coordinated a desk review of three national GHG inventories (the Netherlands, New Zealand and the United States of America) submitted in 2000, which took place from 30 April to 25 May 2001. The review was carried out by a team of nominated experts from the roster of experts working in their own Parties. The members of the team were: Ms. Branca Americano (Brazil), Mr. Sergio González (Chile), Mr. Michael Gytarsky (Russian Federation), Ms. Anke Herold (Germany), Ms. Katarina Mareckova (Slovakia), Mr. Todd Ngara (Zimbabwe), Ms. Astrid Olsson (Sweden), Ms. Riitta Pipatti, (Finland), Mr. Audun Rosland (Norway) and Mr. Taha Zatari (Saudi Arabia). The review was coordinated by Mr. Stylianos Pesmajoglou (UNFCCC secretariat). Mr. Audun Rosland and Mr. Taha Zatari were the lead authors of the report.

38. The main overall objective of the desk review of the GHG inventories was to ensure that the COP had adequate information on the GHG inventories. The review should further assess the progress of the Parties toward fulfilling the requirement outlined in the UNFCCC reporting guidelines on annual inventories (FCCC/CP/1999/7). In this context, the review team checked the responses of the Parties to questions raised in previous stages of the review process and their consistency with the UNFCCC reporting guidelines and the IPCC Guidelines, and identified possible areas of improvement in the inventories of the three Annex I Parties. Each inventory expert reviewed the information submitted for one IPCC sector and each IPCC sector was covered by two experts.

39. The review team has also assessed to a certain degree whether the reporting fulfils the requirements included in the IPCC Good Practice Guidance, although the IPCC Good Practice Guidance was not published at the time the inventory was submitted and could not, therefore, have been used in the compilation of the inventory.

40. The secretariat provided the review team with all necessary technical guidance, information and data, such as national inventory data reported according to the Common Reporting Format submitted in the year 2000, National Inventory Reports for the year 2000, the synthesis and assessment report of GHG inventories prepared by the secretariat, and comments from the Parties on the synthesis and assessment report.

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[2] Document FCCC/CP/1999/7, in particular the UNFCCC review guidelines (pages 109 to 114), and decision 6/CP.5 (pages 121 to 122).

2. Data sources

41. The following data sources have been used in the review:

(a) National greenhouse gas emission inventory report (NIR) in electronic format (MS-WORD file) as reported in April 2000

(b) Common reporting format (CRF) for all years 1990-1998, available in electronic format (MS-EXCEL file)

(c) Synthesis and assessment report (S&A Report)

(d) The United States' response to the S&A report

(e) The status report

(f) Key source assessment on annual inventories by Annex I Parties, identified by the secretariat based on the IPCC tier 1 method

(g) Preliminary draft of UNFCCC's checklist

(h) Report on the in-depth review of the second national communication of the United States of America, FCCC/IDR.2/USA, 12 May 1999

(i) UNFCCC reporting guidelines

(j) Revised 1996 IPCC Guidelines

(k) IPCC Good Practice Guidance

(l) IEA 2000: CO_2 emissions from fuel combustion 1971 – 1998, IEA statistics 2000 edition.

3. General issues

3.1. Completeness and consistency of reporting

42. The CRF was provided for 1990 to 1998 and included all requested tables. Indicators were used appropriately. CRF Tables 1.A(b) and (c) (reference approach) were not completed. A complete set of CRF tables for the reference approach was provided with the comments to the draft review report. The complete CRF tables also corrected inconsistencies with the documentation of the reference approach in Annex O of the NIR.

43. The emission data in the NIR are often reported in units other than those used in the CRF. The review could be much easier if activity data could be converted into international standard units. The United States, in its response to above comments, explained that it is investigating the conversion of the entire inventory, including activity data, into SI units and that an annex is provided with unit conversion factors.

3.2. Transparency of reporting

44. A comprehensive national inventory report (NIR) was submitted providing information on methodologies, activity data, emission factors, differences compared to previous submissions and uncertainty discussion for all source categories. The data provided using the CRF in

electronic format were reproduced in the NIR. In general the CRF includes necessary activity data and emission factors, and the NIR gives a good description of methods and assumptions, explanations for the rationale used in selecting methods and references to sources.

3.3. Uncertainties, verification and QA/QC procedures

45. Information on quality control/quality assurance (QA/QC) procedures implemented is not provided. The USA, in its response to above comments, generally explained that the inventory already undergoes several stages of quality control checks. It was also explained that it is currently developing a detailed QA/QC plan that will formalize the existing informal QA/QC system. However, the NIR provides a detailed qualitative discussion of uncertainties in relation to the methods used. For some source categories (but not for all), especially for those with higher uncertainties, quantitative estimates are also provided in the NIR. Table 7 (Overview) of the CRF which requires reporting of the quality of estimates was not completed.

46. No specific information was provided as to how and what self-verification procedures were undertaken. However, reports and documents (for example from the Emission Inventory Improvement Program (EIIP) 1997) produced in the United States explain QA/QC of inventories in general. It would be useful to know whether the procedures outlined in these reports have been applied to the 1998 GHG submissions. The United States, in its response to above comments, explained that the inventory undergoes separate expert and public reviews.

3.4. Recalculations

47. Recalculation tables were not provided in the CRF (reported as NA) but information as to revisions in methodologies and updates of data was provided in the NIR including the magnitude of the changes with regard to emissions. However, in some instances where the NIR did not provide explanations, data had to be checked against data in the previous inventory report.

B. ENERGY SECTOR

1. Assessment of the conformity with guidelines

1.1. Completeness

48. In the energy sector, data for the sub-sectors A.1.b, A.1.c, A.2.a-e and A.4.c are not provided. This is explained in the CRF. The reason given is that consumption data for fuel consumption from industry are collected by fuel type, not by end-use sector. Therefore, total fuel consumption by manufacturing industries and construction is listed under Other (1.A.2.f). Fuel consumed and emissions from Petroleum Refining (1.A.1.b) and Manufacture of Solid Fuels and Other Energy Industries (1.A.1.c) are included under Other Manufacturing Industries and Construction (1.A.2.f). Other comments relating to completeness are listed below:

(a) Units are missing in CRF table 1.A.(b) (reference approach);

(b) The reference approach was provided only for the years 1995-1998;

(c) Recalculations tables have not been provided, but recalculations were performed (see recalculation section);

(d) An NIR was submitted providing information on methodologies, activity data, emission factors and differences compared to previous submissions, short explanations for trend developments and uncertainty discussion for all source categories.

1.2. Reference approach for energy use

49. There are considerable divergences between the CRF and the NIR with regard to the reference and the sectoral approach for energy use and CO_2 emissions (see table 1).

Table 1. 1998 CO_2 emissions from fossil fuel combustion by estimating approach (Gg CO_2 equiv.) - comparison of the CRF and NIR submissions

Approach	Coal	Natural Gas	Petroleum	TOTAL
Difference Reference-sectoral NIR	1.26%	-0.24%	0.91%	0.80%
Difference Reference - sectoral CRF submission 1998	-0.91%	1.55%	-36.66%	-15.48%
Difference Reference - sectoral CRF 2002 update incl. Territories	-0.62%	1.55%	-0.47%	-0.12%
Difference Reference - sectoral CRF 2002 update	-0.67%	1.55%	-2.46%	-0.97%

50. The energy consumption and CO_2 emissions, as reported in the CRF, from the reference approach are 2.13 per cent and 15.48 per cent lower than the national approach. However, in annex O of the NIR, energy consumption is 2.0 per cent lower in the reference approach and CO_2 emissions from the reference approach are 0.8 per cent higher than the national approach. The documentation box explained that the reference Approach Table 1.A(b) could not be completed because the fuel types provided in the CRF tables differ from the fuel types as defined in the United States. In addition to the CRF tables, a reference approach calculation was provided in a separate Excel spreadsheet for the years 1994-1998. The responses to the synthesis and assessment report explain that the differences between the reference approach data provided in the NIR (Annex O) and that provided directly in the CRF (tables 1.A. (b) and 1.A.(c)) are a result of an incomplete mapping of United States-specific fuel categories and carbon content factors

into the CRF. The United States recommended to use the separate tables provided together with the CRF and the data in annex O of the NIR as a basis for review. The draft review report presented a detailed analysis of the underlying problems that caused inconsistencies between CRF tables and NIR. The United States, in its response to the review comments, provided updated and completed CRF tables for the comparison of the reference approach with the sectoral approach (CRF tables 1.A.b and 1.A(c)). Updates mainly addressed the conversion factor and carbon emission factors. Table 1 shows that the major inconsistencies disappear in the updated version.

51. In annex O of the NIR, detailed explanations are provided for differences between the reference and the sectoral approach. Reasons include product definitions, data inconsistencies (more accurate consumption data), and carbon coefficients (default vs. category-specific).

52. The total CO_2 emissions for 1998 (NIR data) compare well with the IEA data for the sectoral and the reference approaches, see table below.

Table 1. Comparison of energy data from the CRF and from the IEA

Total CO_2 emissions for 1998	IEA (2000)	US national inventory report	Difference
Reference approach	5,409,750 Gg	5,426,238 Gg	0.30%
Sectoral approach	5,433,280 Gg	5,383,369 Gg	0.92%

1.3. Treatment of feed stocks and non-energy use of fuel

53. The data provided for feed stocks and non-energy use of fuel in the CRF and NIR are slightly different (315.8 Tg CO_2 in CRF and 313.8 Tg CO_2 in NIR table 2-6).

54. Disaggregated fuel data and implied emission factor were provided in CRF table 1.C, which enables review and verification (from the three Parties reviewed, only the United States provided these data).

55. The NIR provides explanation and detailed data tables as to how feedstocks and carbon stored in products were treated in the inventory.

1.4. Bunker fuels

56. Estimates for all gases were provided in the CRF and the NIR and the data are consistent.

57. Detailed explanations as to how the split between international and domestic emissions was derived are contained in the CRF (documentation box) and in the NIR.

1.5. Weather-related adjustments

58. Temperature corrections were calculated for CO_2 emissions from fossil fuel combustion in the NIR to examine the effects of weather conditions on consumption patterns. In accordance with the UNFCCC reporting guidelines, CRF emission estimates have been reported without any adjustments for temperature or any other factors.

1.6. Comparison with previous submissions/Recalculations

59. Recalculation tables were not provided in the CRF (reported as NA) but summary information as to major revisions in methodologies and data as well as regarding sources for revised data and the influence of the recalculations on the emissions was provided in the NIR. However, in some instances where the summary did not provide explanations, data were revised compared with the previous inventory report. This is the case for:

(a) CO_2 emissions from biomass-wood for the years 1994 – 1997 as reported in table 2-2 of the NIR; and

(b) CO_2: fossil-fuel carbon in products/non-energy use carbon stored (1990 – 1997).

60. In its response to the above comments, United States noted that it does not consider a finding related to recalculations for biomass a significant issue for the review report as CO_2 emissions from biomass do not affect total emissions. The review report is only technically summarizing the additional data revisions compared with the explanations of the NIR without any judgement of significance of these findings.

61. The NIR states that the entire time series have been recalculated (1990 through 1998) and specific changes for previous years are discussed in the NIR. Recalculation tables in the CRF were not provided, however.

1.7. Self-verification

62. No specific information was provided as to what and how self-verification procedures were undertaken.

63. In the United States, reports and documents have been produced (for example from the Emission Inventory Improvement Program (EIIP) 1997) which explain quality assurance and quality control of inventories in general. It would be useful to know whether the procedures outlined in these reports have been applied to the 1998 GHG submission.

1.8. Uncertainty

64. The NIR provides a detailed qualitative assessment of uncertainties in relation to the methods used.

65. For some source categories (but not for all), especially for those with higher uncertainties, quantitative estimates are also provided in the NIR.

66. Table 7 (Overview) of the CRF, requiring reporting of the quality of estimates, was not filled in.

2. Synthesis and assessment report

2.1. Consistency of information between the CRF and the NIR

67. In the energy sector, data for the CO_2 reference approach calculations are not consistent between the NIR and the CRF.

68. The United States response explains that the United States reports fossil fuel combustion emissions from United States territories and military fuel use under 1.A.5 Other. For 1998, this

sector accounts for 88,692.73 Gg CO_2 emissions. From the data provided in the NIR on the reference approach, it can be ascertained that CO_2 emissions from United States territories account for 44,300 Gg CO_2 (according to table 2-4 of the NIR, p. 28, the figure is 47,900 Gg CO_2). If all military categories from table 2-8, p. 32 in the NIR are summed, military emissions account for 76,267 Gg CO_2. Thus, military emissions and emissions from territories would together be 120,567 Gg CO_2 – considerably higher than the number given for source category 1.A.5 Other. In its response, the United States explained that the NIR does not include separate estimates of domestic (versus international bunker) military fuel use emissions. Thus, part of the military emissions could be accounted for as international bunkers in the CRF. But this analysis shows that it would be helpful to report two separate estimates in the CRF for the United States territories and for military fuel use, in order to improve transparency and to facilitate comparison with the NIR.

2.2. Responses to questions raised during previous review stages

69. For the issues raised in relation to the key sources, issues are well addressed in the responses; no further explanations seem necessary. Other issues (such as reference approach, recalculations) have been raised again in the draft review report at a more detailed level. The United States, in its response to the draft review report, provided updated and completed CRF tables for the comparison of the reference approach with the sectoral approach (CRF tables 1.A.b and 1.A(c)). Updates mainly addressed the conversion factors and carbon emission factors. The updated tables considerably improved consistency between CRF and NIR data. However, the information in updated CRF data tables is still not identical with information contained in the NIR and minor inconsistencies remain.

3. Source category analysis

70. Key source categories identified by the secretariat based on the IPCC tier 1 method:

(a) 1.A.1 Energy Industries (CO_2);

(b) 1.A.3 Transport (CO_2);

(c) 1.A.2 Manufacturing Industries and Construction (CO_2);

(d) 1.A.4 Other sectors (commercial/institutional/residential etc.) (CO_2);

(e) 1.A.5 Fuel combustion - other (CO_2);

(f) 1.B.1 Solid Fuels (CH_4);

(g) 1.B.2 Oil and Natural Gas (CH_4).

71. The documentation box provides the information that fuel consumed in and emissions from Petroleum Refining (1.A.1.b) and Manufacture of Solid Fuels and Other Energy Industries (1.A.1.c) are included under Other Manufacturing Industries and Construction (1.A.2.f). It is not entirely clear why these emissions could not have been allocated to the respective source categories.

72. The review report is not structured according to the key sources, as this would result in many repetitions. Only the major findings are highlighted, according to the main headings in the following sections.

3.1. Methodologies

73. Description of methodologies and assumptions are provided in annexes to the NIR.

74. Changes in methodologies were also provided.

75. The IPCC Guidelines and IPCC Good Practice Guidance address certain methodological problems, such as the risk of double counting emissions in both Energy and Industrial Processes (for instance for the reduction of iron in a blast furnace through the combustion of coke, the primary purpose of the coke oxidation is to produce pig iron, and the emissions can be considered as an industrial process). Such difficulties are addressed in the NIR for some typical domestic problems. It would be interesting in some further areas to have explanations as to how the United States dealt with these specific problems.

3.2. Emission factors

Comparison with other data sets and other Parties

76. The implied CO_2 emission factors for commercial and institutional as well as residential use of solid and gas fuels are low compared with other Parties. In addition the IEF for the United States are provided in gross calorific values (GCV). The difference between the "net" and the "gross" calorific value for each fuel is the latent heat of vaporization of the water produced during combustion of the fuel. For coal and oil, the net calorific value is 5 per cent higher than the gross, whereas for most forms of natural and manufactured gas the difference is 9-10 per cent. Thus the IEF based on net calorific values (NCV) for solid fuels would be about 85, and for gas about 45, which would represent the lowest factors across all Parties. The same applies for the CO_2 IEF for gaseous fuels in public electricity and heat production, for road transportation and civil and international aviation, and for liquid fuels from manufacturing industries and other sectors. In its response to the draft review report, United States explained that in the case of CO_2 IEF for liquid fuels from manufacturing industries, the information is biased due to subtraction of carbon stored in products from the use of fossil fuel feedstocks.

77. Implied emission factors from the United States inventory were compared with IPCC default values. The comparison shows that the United States values are at the lower range of IPCC default values after the correction for gross calorific values for solid and gaseous fuels. IEF for liquid fuels are still lower than the lowest value of the range provided in the IPCC Guidelines. The response to the draft review report explained that this low IEF is due to the accounting for fossil fuel feedstocks which have the carbon stored portion subtracted from the CO_2 emissions calculation, but are included in the energy consumption activity data.

78. From comparison tables for energy – stationary combustion provided by the secretariat (p. 18, 20), average CO_2 IEF were calculated for several source categories (see table 2). To calculate the average, all IEFs based on GCV were adjusted to NCV according to IEA methodologies. In particular, the CO_2 IEFs for liquid fuels from manufacturing industries and construction seems to be very low as compared with data from other Parties. In its response to the draft review report, the United States explained that in the case of CO_2 IEF for liquid fuels from manufacturing industries, the information is biased due to subtraction of carbon stored in products from the use of fossil fuel feedstocks.

Table 2. Comparison of implied emission factors with the average from Annex I Parties (data from CRF)

Comparison of implied emission factors across Annex I Parties (data from CRF)	USA	USA (adjusted to NCV)	average of Annex I Parties (without US)
	tCO_2/TJ	tCO_2/TJ	tCO_2/TJ
Liquid fuels			
Manufacturing Industries and Construction	38.6	**40.5**	70.5
Other sectors (1.A.4)	66.4	69.7	72.8
Commercial/Institutional	68.2	71.6	73.8
Residential	65.6	68.9	70.1
Gaseous fuels			
Energy Industries	50.0	55.0	57.5
Public Electricity and Heat Production	50.0	55.0	57.4
Manufacturing Industries and Construction	48.2	53.0	53.4
Other sectors (1.A.4)	50.0	55.0	55.4
Commercial/Institutional	50.0	55.0	55.3
Residential	50.0	55.0	55.5

79. The United States CO_2 IEF for gas/diesel oil for navigation (1.A.3.d) seems to be low compared with the IPCC default value of 73 t/TJ and the average of Annex I Parties of 73.5 t/TJ (as reported in the CRF). The United States, in its response to this comment, explained that the difference is believed to be related to the accounting for activity data for military activities in the CRF and did not lead to any errors in the final emissions reported.

80. For international marine transport the opposite situation occurs the United States IEF for CO_2 is very high at 124 t/TJ compared with the IPCC default value of 75 –77.6 t/TJ and the average CO_2 IEF from Annex I Parties of 73.61 (as provided in the CRF). In its response, the United States explained that the difference is believed to be related to the accounting for activity data for military activities in the CRF and did not lead to any errors in the final emissions reported.

81. CO_2 emissions in the CRF sectoral reports for energy were compared with data provided by IEA (2000)[3] for some of the key energy sectors. Table 3 provides the results of this comparison. In the major source categories, the differences are comparably small. A larger difference occurs for domestic air/civil aviation which could be due to different allocations of military aviation in the two data sets. A more detailed analysis regarding the reasons for the differences cannot be performed, as IEA data in the quoted material does not provide underlying calculations. The United States explained in its response that the definition used in the United States submission to IEA on bunker fuel energy consumption is not consistent with the definition used in IPCC Guidelines and that a more rigorous method for estimation of emissions from international bunker fuels was used in order to be in accordance with IPCC Good Practice Guidance.

[3] IEA 2000: CO_2 emissions from fuel combustion 1971 – 1998, IEA statistics 2000 edition.

Table 3. Comparison of key energy data with IEA data

USA CO_2 1998	IEA (2000) - Gg CO_2 -	CRF (2000) - Gg CO_2 -	Difference - % -
Public Electricity and Heat	2,043,500	2,016,379	-1.3%
Other Energy Industries, Manufacturing Industries & Combustion	1,160,170	1,100,141	-5.2%
Transport	1,636,550	1,607,581	-1.8%
Domestic Air / Civil Aviation	184,660	140,217	-24.1%
Residential	336,970	347,578	3.1%
Commercial	209,650	223,129	6.4%

3.3. Activity data

82. 1.A.2 Manufacturing Industries and Construction (CO_2): The documentation box provides the information that fuel consumed in and emissions from Petroleum Refining (1.A.1.b) and Manufacture of Solid Fuels and Other Energy Industries (1.A.1.c) are included under Other Manufacturing Industries and Construction (1.A.2.f). In its response, the United States explained that energy consumption statistics are not collected at the level of detail needed for the disaggregation in categories 1.A.1.b and 1.A.1.c.

4. Ways to improve estimates/ reporting

83. The review could be facilitated if activity data were to be converted to international standard units.

C. INDUSTRIAL PROCESSES

1. General overview

84. For many of the sectors under industrial processes the United States has followed a tier 1 approach, for example CO_2 from iron and steel production, ammonia manufacturing, ferroalloy and aluminium production, N_2O from nitric acid production and SF_6 from magnesium production. This implies that emissions from these sources have been estimated by multiplying the production data by a default emission factor. Such an approach would normally increase the uncertainty, since emission factors differ from plant to plant; hence a tier 1 approach should be used only for non-key sources. For example iron and steel production contribute 1 per cent to the United States' total GHG emissions, and this source has also been identified by the secretariat as a key source in the United States inventory. The review team believes that in the future more accurate data could be reported for this source category as well as others mentioned above, if the United States converts to a tier 2 approach using either national consumption data on feed stock or plant-specific emission data. In its response, the United States explained that Tier 2 methodologies is now used for all of the source categories mentioned in this paragraph, with the exception of Nitric Acid Production (which uses a country-specific emission factor that is also an IPCC default value).

85. In NIR, including the CRF, CO_2 emissions from iron and steel, ammonia, ferroalloy and aluminium production are accounted for in the Energy chapter under Non-Energy Uses of Fuel. The CO_2 emissions from these sources are also reported by sector under industrial processes. However, to avoid double counting the emissions are not accounted for under industrial processes. In these sectors, where fossil fuels are used both as feed stocks and for energy purposes, the IPCC Guidelines consider the emissions from these sectors as industrial processes when the primary purpose is feed stocks. The IPCC Guidelines could, however, be understood in such a way that when Parties have difficulties in distinguishing energy-based emissions from industrial-based emissions, these emissions can be accounted for under the energy sector. Emissions from these sources in the United States are primary industrial-based and should therefore be accounted for under industrial processes. According to data reported in the CRF and the NIR, it would be possible to distribute these emissions into different sub-sectors. The United States, in its response to above comments, explained that now it is in the process of reporting all emissions of fossil fuel feedstocks in the Industrial Processes chapter.

2. Key sources

2.1. Iron and steel production combustion

86. CO_2 emissions from iron and steel production account for approximately 1 per cent of the total United States GHG emissions, and is a key source according to the IPCC Good Practice Guidance. However, the United States has used the tier 1 approach when estimating these emissions (production data multiplied by a default emission factor). The review team believes that it would be more accurate to estimate these emissions by the tier 2 approach which is based on the actual consumption of reducing agent (such as coke) multiplied by the respective carbon content. With regard to the United States response to this comments, see paragraph above.

2.2. Consumption of halocarbons and SF_6

87. Emissions for some chemicals are not reported, such as HFC-32, HFC-152a and HFC-227ea, due to confidentiality. When chemicals are not reported due to confidentiality, it is difficult to provide a comprehensive assessment of the completeness of the reported data.

3. Non-key sources

3.1. Cement and mineral production

88. Data, methodology description, consistency and transparency seem to be covered with regard to cement production, lime manufacture, limestone and dolomite use and soda ash manufacture and consumption.

3.2. Ammonia production

89. The IPCC Guidelines state that the most accurate method of estimating CO_2 from ammonia production is to multiply the consumption of natural gas (or other fossil fuel feed stocks) by its carbon content. The United States has calculated the emissions by multiplying annual production data by a default emission factor included in the IPCC Guidelines. This emission factor does not take into account differences with regard to feedstocks, and hence the chosen methodology increases the uncertainty in the United States estimates for this specific sector. However the total amount of GHG emissions from the United States would not be affected, since these emissions are included in the Energy Sector, based on overall fossil fuel consumption data.

90. Further, the reported production data for ammonia is approximately 20 per cent higher than data from United Nations statistics. From the NIR it is difficult to detect an explanation for this difference. In its respons, the United States has explained that the United States will investigate the difference in its ammonia production statistics taken from the United States Census Bureau and those in UN statistics.

3.3. Petrochemical production

91. Often petrochemical production will result in minor emissions of volatile organic compounds (VOCs), due to for example leakage of hydrocarbons. According to the IPCC Guidelines these emissions should be accounted for as CO_2 in addition to VOCs. In the CRF in table 2(I) the United States has reported 336 Gg VOC emissions (1998) from chemical and allied product manufacturing (sector 2B-5). It not clear whether these emissions are also included in the CO_2 emissions and how any double counting is avoided. The United States explained that indirect emissions due to the oxidation of fossil fuel derived VOC emissions are implicitly accounted for under the oxidized portion of fossil fuel feedstocks. Therefore these emissions are accounted for, but reported under the Energy sector.

3.4. Silicon carbide and calcium carbide production

92. Emission of CH_4 from silicon carbide production has been estimated by multiplying production data by a default emission factor. The production data in CRF table 2(I) A-G is probably 1,000 times too high, and for 1998 for example should be 69.8 ktonnes instead of 69,800.00 ktonnes.

93. CO_2 emissions from silicon and calcium carbide production are not reported under the Industrial Process Chapter, but are implicitly included in the emission estimates within the Energy chapter as they derive from fossil fuel feedstock consumption.

3.5. Adipic acid and nitric acid production

94. The N_2O emissions from nitric acid production have been estimated using a tier 1 approach by multiplying production data by a country specific emission factor. Since nitric acid production may be a key source (0.4 per cent of total GHG emissions in 1998), a tier 2 approach based on plant-specific emission data could be considered. However, the United States is now investigating the use of more plant-specific data for the estimation of emissions from nitric acid.

3.6. Pulp and paper and food and drink processes

95. The United States has not estimated emissions from pulp and paper and food and drink processes. This is reported in CRF table 9. In the chapter on CO_2 consumption on page 78, however, these sectors are mentioned as if they are included. In its response, the United States explain that in cases where CO_2 produces an emission from a fossil derived source, they are accounted for under fossil fuel feedstocks or Carbon Dioxide Consumption.

3.7. Magnesium production

96. The IPCC Guidelines recommend an estimation based on the assumption that SF_6 emissions from magnesium production are equal to the consumption of SF_6 chemicals in magnesium foundries and smelters. The IPCC Good Practice Guidance define this approach as good practice if consumption data are available at the level of individual smelters. If these data are not available and the magnesium production is not a key source, aggregated consumption data or emission factors relating to production could be used. In the NIR it is reported that the emissions of SF_6 from magnesium production have been estimated from gas usage information supplied by primary magnesium producers. However, no data on consumption have been reported in the CRF, only magnesium production data. Hence it is unclear which methodology has been followed. Further, the same emission data have been reported for all years from 1995 to 1998, although magnesium production has decreased by 17 per cent from 1995 to 1998. The reason for this situation was, according to the United States response, that although primary magnesium production did decline between 1995 and 1998, casting, which has higher SF_6 usage per mass of metal than primary production, grew significantly over the same period.

97. Further, the United States has not reported CO_2 emissions from the production of magnesium either in the NIR or in the CRF. Normally, the production of magnesium results in emissions of CO_2 due to the use of carbonate as feedstock. The United States explained that these emissions are minor, around 0.005% of total GHG emissions in the United States. However the United States will investigate the inclusion of these emissions in future inventories.

3.8. Aluminium production

98. PFC emissions from aluminium production seem to be estimated according to good practice. However, the IEFs for CO_2 from aluminium production are similar for all years from 1990 to 1998. Normally this would indicate that there has been no energy/feedstock efficiency or technology development in the United States aluminium production, which seems unlikely. A

tier 2 approach based on the consumption of reduction agents or plant-specific emission data may be considered. However the total amount of CO_2 emissions from the United States would not be affected, since the CO_2 emissions from aluminium production are included in the Energy Sector, based on overall fossil fuel consumption data.

99. In the CRF it is reported that SF_6 emissions from aluminium foundries do not occur (NO). However, in the NIR it is stated that "SF_6 may also be used as cover gas for casting of molten aluminium with a high magnesium content, however, it is uncertain to what extent this practice actually occurs". Hence the review team believes these cells in the CRF should be labelled "not estimated" (NE).

D. AGRICULTURE

1. General overview

100. The United States has to a large extent fulfilled the reporting requirements outlined in the UNFCCC reporting guidelines. This Party has, where possible, used the IPCC Guidelines. Recalculations tables were not provided in the CRF, though such information was provided in the NIR. The NIR contained information on methodologies, activity data, emission factors, differences compared to previous submissions and uncertainty estimates (qualitative and quantitative) for source categories in the agriculture sector. Furthermore, the Party provided the following:

(a) Disaggregated estimates of CH_4 and N_2O, largely using methods that are consistent with the IPCC Guidelines (tier I) with CS emission factors in some cases. However, emissions from rice were estimated through the 1995 IPCC Guidelines since the 1996 IPCC Guidelines would result in an overestimation of emissions;

(b) Complete and consistent time series for sub-sources and all years (1990-98), except for the recalculations tables;

(c) Transparent descriptions of all methodologies for determining agriculture-related emissions including assumptions and references;

(d) References for sources of information-related emission factors, activity as well as rationale for selection;

(e) Either qualitative or quantitative uncertainty estimates for all source categories;

(f) Detailed estimates of all direct greenhouse gases.

2. Key sources

2.1. Enteric fermentation (CH_4): Key source - 4A

101. The Party conformed to the UNFCCC reporting guidelines. A detailed model (CS) describing the quantity of methane produced by individual ruminant animals (especially cattle) was used to estimate emissions. A mechanistic model of rumen digestion was used to derive average regional emission factors for each of the nine cattle types. Emissions from other animal types were based on average emission factors representative of entire populations for each animal type.

Methodologies

102. Locally derived models were used in determining emission estimates and emission factors for cattle. For dairy and non-dairy cows, regional emission factors were taken into account, thus taking care of the geographic coverage. Emissions from other animal types (sheep, goats, horses, pigs) were based on average emission factors representative of entire populations of each animal type.

Recalculations

103. Recalculations were not provided in the CRF although such information is provided in the NIR.

Implied emission factors (IEF)

104. IEF for dairy cattle (156.9 kg/head/year) seemed very high when compared with other Parties and IPCC default values. The Party provided a revised value of 94.7 kg/head/year, which is now closer to IPCC default values and values from other Parties.

Activity data

105. Livestock population data in the CRF were taken from the United States Department of Agricultural Statistics and compares favourably with FAO (difference 2 per cent). The data come from surveys.

Uncertainty

106. Diets analysed using the rumen digestion model include broad representations of types of feed within each region – thus compromising the representation of the full diversity of feeding strategies employed in the United States. Consequently, the resultant emission factors may be biased. Animal population numbers are also uncertain. Overall uncertainty in the emission estimates is 20 per cent (EPA, 1993).

2.2. Manure management (CH_4): Key source - 4B

107. The Party conformed to the UNFCCC reporting guidelines. A CS model EPA (1993) forms the basis of methane emissions for each animal type. Estimates of methane emissions in 1998 were 3,990 Gg, 53 per cent higher than in 1990. The major part of the increase in methane emissions was from pig and dairy cow manure and is attributed to shifts by industries towards larger facilities.

Methodologies

108. A CS model EPA (1993) forms the basis of methane emissions for each animal type. For pigs and dairy cows, the two greatest emitters of methane, estimates were developed on the basis of state level animal population data and average weighted methane conversion factors. For the other animals, 1990 state level estimates from the EPA (1993) were scaled according to changes in the state population.

Recalculations

109. Recalculations were not provided in the CRF although such information was provided in the NIR.

Emission factors

110. The CH_4 IEF for dairy cattle (101.46 kg/head/year) and pigs (39.89 kg/head/year) were high compared with other Parties and IPCC default values. The Party responded that the methodology had been improved; the IEF for dairy cows is now 45.53 kg/head/year and that for pigs is now 12.07 kg/head/year, which is closer to other Parties and IPCC default values.

Activity data

111. The activity data compare favourably with FAO data sets. Sources of data (cattle, sheep and pigs) were as follows:

(a) USDA: animal livestock population data;

(b) FAO: horse population;

(c) United States Department of Commerce: data on farm size distribution (cows and pigs).

Uncertainty

112. For primary factors contributing to uncertainty in emission estimates, information is lacking on the use of various manure management systems in each state and the exact methane gathering characteristics of each type of management system.

2.3. Direct emissions from agricultural soils (N_2O): Key source - 4.D.1

113. The Party conformed to the UNFCCC reporting guidelines.

Methodology

114. Determination of the direct emissions from (i) managed soils due to nitrogen application and cultivation of histosols, and (ii) managed soils due to grazing animals, follow the methodologies in the IPCC Guidelines.

Recalculations

115. Recalculations are not provided in the CRF although such information was provided in the NIR.

Emission factors

116. The IPCC default emission factor (0.0125 kg N_2O-N/kg N applied) was used to estimate annual N_2O emissions from nitrogen applied to soils as crop residue.

117. To estimate annual N_2O emissions from histosol cultivation, land areas were multiplied by the default emission factor (8 kg N_2O-N/ha) recommended in the IPCC Good Practice Guidance.

118. To estimate direct N_2O emissions from grazing animals, annual nitrogen excretion was summed over all animal types, and reduced by 20 per cent to account for the portion which volatizes to NH_3 and NO_X; the remaining nitrogen was multiplied by the IPCC default emission factor (0.02 kg N_2O-N/kg N) to estimate N_2O emissions.

Activity data

119. Activity data was derived from USDA and is comparable to FAO data sets.

Uncertainty (qualitative)

120. A number of conditions affect nitrification and denitrification rates in soils. These conditions vary by soil type, climate, cropping system and soil management. Their combined effect on the processes leading to N_2O emissions are not fully understood. It is not yet possible, therefore, to develop statistically valid estimates of emission factors for all possible combinations of soil, climate and management conditions.

121. Emission factors used were midpoint estimates based on measurements described in scientific literature and, as such, are representative of current scientific understanding. Estimated ranges around each midpoint estimate are wide. Uncertainties also exist in the activity data used to derive emission estimates.

3. Non-key sources

3.1. Manure management (N_2O)- 4B

122. The N_2O IEF for anaerobic lagoons (0.785 kg N_2O-N/kg N) seemed higher by a factor of 100 compared to other Parties and IPCC default values; the Party has improved the method and the new value is 0.006 kg N_2O-N/kg N.

123. Similarly, the N excretion rates for dairy cattle dropped from 420.5 kg N/head/year to 84.1 kgN/year and for pigs from 112.8 kg N/head/year to 7.1 kg N/head/year. These new values are closer to IPCC default values and other Parties' values.

3.2. Rice production - 4C

124. Trends in activity data (harvested area) indicate a decrease of 10 per cent in 1993 and an increase of 17 per cent in 1994. This could be explained by the fact that crop production increased in 1994 when compared to the 1993 flooding conditions of the North Central region (presumably a rice-growing region).

3.3. Field burning of agriculture residues - 4F

125. Maize production fluctuations of between -33 per cent and 59 per cent between 1990 and 1996 need explanation from the Party. According to the United States response, the maize production fluctuations in the United States are explained by annual changes in subsidy programs, commodity prices, and weather. More transparent explanations will be provided in future inventory submissions.

4. Other remarks

126. Other agricultural soil management practices, such as irrigation, drainage, tillage practices and following of land affect fluxes of N_2O to and from the soil. However, because there are significant uncertainties associated with these fluxes, they were not estimated.

E. LAND USE CHANGE AND FORESTRY

1. General overview

1.1. Introduction

127. Land-use change and forestry (LUCF) constitutes a net sink which, in absolute terms, is equivalent to 11.5 per cent of total GHG emissions of the United States. Changes in forest and other woody biomass stocks, CO_2 emissions and removals from soil, and yard trimmings and wood products in landfills (reported as "other GHG sources and sink categories") are 48.8 per cent, 40.9 per cent and 10.3 per cent, respectively, of total CO_2 removals.

1.2. National self-verification and QA/QC

128. The NIR provides extensive discussion of uncertainty for each category source of the LUCF sector. The GHG inventory in the LUCF sector is a part of the NIR and common reporting format (CRF) prepared by the United States Environmental Protection Agency (EPA) with the assistance of the United States Forest Service. Many research, government and consultancy organizations and specialists provided technical and editorial contributions during the preparation of the inventory. The NIR passed a public review and comment process in accordance with EPA policy.

1.3. Completeness

129. The United States reports on changes in land use and other woody biomass stocks (category 5A), CO_2 emissions and removals from soils (category 5D), and other GHG sources and sink categories (category 5E): For category 5D, only removals for forest soils are reported. Forest and grassland conversion (category 5B) and abandonment of managed lands (category 5C) are not reported in the NIR and CRF, because the data on these categories are not available or their contribution to total net carbon fluxes is minor (in the case of boreal forests). Table 9 of the CRF provides detailed explanation of source/sink categories which were included or not included in the accounting for the LUCF sector.

130. Since net fluxes from organic and mineral soils taken together are expected to negate emissions from liming, the accounting for CO_2 emissions from liming is documented in the NIR but not included in overall estimates for the LUCF sector.

131. The estimates of GHG emissions and removals are calculated for all periods from 1990 to 1998. CRF sectoral table 5 provides an overall report on the LUCF sector. Tables 5A to 5D were not completed due to the use of a CS methodology which does not exactly fit these tables. The use of national methods is documented in CRF summary table 3.

1.4. Transparency and use of indicators

132. The United States used CS methods to account for GHG emissions and removals from LUCF. These are described in the NIR and documentation boxes to tables 5A - 5D of the CRF. The indicators were used appropriately in the CRF.

1.5. Recalculations

133. The data in the CRF were submitted for the first time, and no recalculations were made.

1.6. Uncertainties

134. The NIR provides a thorough description of uncertainty for activity data and calculation methods for all GHG sources and sink categories accounted for in the national GHG inventory.

2. Consistency with the guidelines for estimating (IPCC) and reporting (UNFCCC)

135. In line with the Revised 1996 IPCC Guidelines, the United States used carbon stock estimates derived from periodic inventories and measurements of net changes in forest stock over time to account for changes in forest and other woody biomass stocks. The method for estimation of CO_2 emissions and removals from soil follows the IPCC Guidelines with a modification in order to better address country national conditions and apply available data sources. Other GHG sources and sink categories (yard trimmings and wood products in landfills) are calculated based on national methodology. The NIR provides a complete description of the methodology used to account for GHG emissions and sinks in the LUCF sector.

136. The GHG inventory reporting of the United States in the CRF and NIR is consistent with the UNFCCC reporting guidelines.

3. Specific sources

3.1. Changes in forests and other woody biomass

137. Changes in forests and other woody biomass (specified as "changes in forest carbon stocks" in the NIR) is equivalent, in absolute terms, to 5.6 per cent of the total equivalent GHG emissions of the United States. The estimates cover the following carbon pools: trees, understorey, forest floor, and harvested wood products (reported in this category under the section "Others").

138. From 1990 to 1993, the overall CO_2 removals changed insignificantly. In 1993, they decreased by 25 per cent. From 1993 to 1998 their value remained stable. The NIR explains the shift from 1992 to 1993 and subsequent stability in values as a result of calculating average annual fluxes on the basis of periodic activity data and model estimates and projections rather than annual stock estimates.

Methodology

139. The United States used a carbon stock approach to account for CO_2 emissions and removals due to changes in forests and other woody biomass. The method is consistent with the IPCC Guidelines and combines the data from periodic surveys of national forest stock and mathematical model assessments and projections of changes in carbon biomass and harvested wood product stocks. The method is described in the NIR, and appropriate references to it are also provided.

140. As reported in the CRF, CO_2 emissions from wood harvesting are included in general estimates of CO_2 removal for this source category. It is not clear, however, what part of harvested wood is left to decay or burnt on cut areas (and therefore, accounted for as CO_2 emissions), and

what is sequestered in harvested wood products. The NIR also provides information on CO_2 emissions from burning of woody biomass within industrial and residential/commercial sectors, but it is not clear where these emissions are accounted for. The NIR does not provide information on emissions of non-CO_2 gases associated to the burning of woody biomass.

Activity data

141. The main source of activity data is the United States Forest Service. It provides information on timber volume data by tree species, size class and other categories, together with historical harvest data. These data form the background for subsequent calculations and projections.

Conversion and emission factors

142. The United States used CS conversion factors to estimate amounts of carbon in aboveground and belowground biomass. The NIR includes appropriate references to studies. However, it is not clear from the NIR what emission and conversion factors were used to account for CO_2 sequestration in forest floor, understorey vegetation, and harvested wood products.

Response to previous reviews

143. The draft synthesis and assessment report identified a net decrease in CO_2 removals of 25 per cent in 1993. The NIR provides a clear explanation of the shift (see section 3.1 above Changes in forests and other woody biomass).

3.2. CO_2 emissions and removals from soil

144. The CO_2 removals from soil, in absolute terms, is equivalent to 4.7 per cent of total equivalent GHG emissions of the United States. The NIR includes estimates of CO_2 sequestration in forest soils for the period from 1990 to 1998 and in organic and mineral soils for 1990 to 1992. CO_2 removals in organic and mineral soils for other years were not calculated due to the lack of data. The NIR also includes CO_2 emissions from liming for 1990 to 1998. However, CO_2 removals in organic and mineral soils and CO_2 emissions from liming are not included in the CRF in overall estimates for the LUCF sector.

145. From 1990 to 1993, the overall CO_2 removals changed insignificantly. In 1993, they decreased by 44 per cent. From 1993 to 1998 their value remained stable. The NIR provides a clear explanation of the shift (see section 3.1 above Changes in forests and other woody biomass).

Methodology

146. The NIR does not provide a clear description of the methodology for estimating CO_2 sequestration in forest soils. The methodology for accounting for CO_2 removals in organic and mineral soils follows the 1996 Revised IPCC Guidelines with a modification in order to address country national conditions and apply available data sources better. It is described in the NIR.

147. Additional assumptions were made when difficulties occurred in obtaining specific data on total amounts of crushed limestone and dolomite input to soils. If the exact figures were not available for specific years, interpolation and extrapolation methods were used to obtain amounts of lime applied. These methods for data collection are consistent with the IPCC Good Practice

Guidance elaborated for other sectors.

Activity data

148. The United States' databases on climate, soil types, land use and management prctices provide activity data for estimates of carbon stock in organic and mineral soils. These databases will be reconsidered once the 1997 National Resources Inventory is finalized. Annual applications of limestone and dolomite were taken from the United States Geological Survey's Mineral Resources Program, Crushed Stone Reports and Mineral Industry Surveys.

Conversion and emission factors

149. IPCC default carbon stock and adjustment factors were used in the calculations.

3.3. Other greenhouse gas source and sink categories

150. This category in the CRF corresponds to changes in non-forest carbon stocks in landfills in the NIR. Non-forest carbon stocks in landfills, in absolute terms, is equivalent to 1.2 per cent of total equivalent United States' GHG emissions. These cover CO_2 sequestration in yard trimmings and wood products in landfills. From 1990 to 1998, the overall CO_2 removals in this sink category decreased by 10.7 per cent.

Methodology

151. The United States used CS methods to account for CO_2 removals in yard trimmings. The NIR provides a detailed description. But it is not clear from the NIR what method was used to account for CO_2 removals from wood products in landfills.

Activity data

152. The main source of activity data on yard trimmings is the EPA report Characterization of Municipal Solid Waste in the United States: 1998 Update. The data source for wood products in landfills is not clarified in the NIR.

Conversion and emission factors

153. The United States used CS carbon storage factors which were derived by the EPA. The NIR includes references to the appropriate EPA publications.

4. <u>Areas for further improvement</u>

4.1. Ongoing work by Party

154. The NIR identifies non-forest organic and mineral soils as currently lacking a category of CO_2 emissions and removals to be reported under the LUCF sector. The United States Forest Service has developed a model for estimating CO_2 emissions from forest soils. A similar model is currently being developed for non-forest soils. A new methodology has been implemented in order to estimate CO_2 fluxes from non-forest soils in the 1990 to 1992 period, but more recent data from the 1997 National Resources Inventory would enable accounting for CO_2 emissions and removals from non-forest soils in 1993 to 1998.

4.2. Issue identified by the desk review team

155. The United States is encouraged to include in the NIR a description of the methodology used for estimating CO_2 sequestration in forest soils and wood products in landfills. This will allow more complete reporting on GHG emissions and removals in the LUCF sector.

156. The United States is encouraged to provide more explanation in relation to emission factors used to account for CO_2 removals in the forest floor, understorey vegetation, and harvested wood products. This will allow for more complete and transparent reporting on GHG emissions and removals in the LUCF sector. The United States is now developing more transparent documentation on the methodologies for estimating CO_2 fluxes from forest soils and wood products in landfills

157. It is recommended that the United States include accounting for GHG emissions and removals from abandonment of managed lands, and non-forest organic and mineral soils. This will allow for more accurate and complete estimates of overall GHG emissions and removals in the LUCF sector.

F. WASTE

1. General overview

158. The NIR, including the CRF tables, is very comprehensive and informative, and largely fulfils the UNFCCC reporting requirements.

159. The emissions from solid waste disposal on land are calculated with a CS model, which does not correspond directly to either the default method or the first order decay method given in the IPCC Guidelines. The guidelines do, however, encourage Parties to use more sophisticated methods which incorporate CS data, if available. The method used by the United States clearly fulfils this criterion. Documentation of the model and parameters used should, however, have been provided in more detail. The emissions from wastewater treatment and human sewage are estimated using IPCC default methods (slightly modified) and the emissions from waste incineration by a CS method compatible with the IPCC Guidelines.

160. Estimates for industrial CH_4 emissions from wastewater treatment were not provided due to insufficient data available. However, the United States has now developed an estimate for CH_4 emissions from industrial wastewater consistent with IPCC Good Practice Guidance, and this estimate has been reported in subsequent inventory submissions. N_2O emissions from wastewater treatment were also not provided for the same reason, but it should be noted that the IPCC Guidelines do not provide a method for this. The failure to provide estimates for the sources and the reasons for it are described in both the NIR and the CRF tables (table 9 on completeness). The United States explained in its response, that the human sewage component of N_2O emissions from wastewater treatment was reported and is believed to be one of the most significant sources of N_2O from wastewater.

161. The United States inventory also included estimates of carbon stored in landfills due to disposal of yard trimming waste. These estimates are reported in the land-use change and forestry sector. The consideration of carbon stored in landfills is a deviation from the IPCC method, although it is justified by research results documented in scientific literature. The methodology and parameters used in the calculation should, however, be provided. The reason for the inclusion of the carbon sink caused by solid waste disposal of yard trimming waste in the United States inventory is "to comport with IPCC inventory reporting guidance regarding the tracking of carbon flows". The significance of these estimates is very small (less than 0.5 per cent of total emissions in the United States). The inclusion in the inventory of the carbon sink caused by yard trimming waste raises the question as to whether carbon storage in landfills should also include other types of waste of biogenic origin.

162. The in-depth review of the second national communication of the United States had no specific comments on the emission estimates of the waste sector.

2. Key sources

163. According to the key level assessment carried out by the secretariat, one key source in the waste sector in the United States inventory, namely methane emissions from solid waste disposal on land (SWDS), was identified.

2.1. CH_4 emissions from SWDS

Trend in emissions

164. CH_4 emissions from SWDS in the United States have been estimated as having been fairly constant during 1990 to 1998. The reported emissions were 10,171 Gg CH_4 in 1990, increased somewhat during 1991 to 1995 (10,151 Gg – 10,566 Gg), and decreased during 1996 to 1998 (10,267 Gg CH_4 in 1998). Although the total emissions were somewhat (less than 1 per cent) higher in 1998 than in 1990, the per capita emissions have decreased by approximately 6 per cent during the same period.

165. The emissions per capita are fairly high compared to those of other Parties (the second highest per capita emissions of all reporting Annex I parties). This can probably be attributed to a high waste generation rate and to the fact that a relatively large fraction (61 per cent in 1998) of the generated waste is disposed of at solid waste disposal sites (SWDS). The amount of municipal solid waste (MSW) generated in the United States was, according to the NIR, more than
4 times higher in 1998 than in 1990. The percentage of the MSW taken to the SWDS has, however, decreased from 77 per cent in 1990 to 61 per cent in 1998. Landfill gas recovery has increased from 2,159 Gg CH_4 in 1990 (approximately 20 per cent of the CH_4 emissions) to 4,632 Gg CH_4 in 1998 (approximately 30 per cent of the CH_4 emissions).

Activity data

166. The activity data on landfills is based on the EPA's national survey on landfills (municipal) and BioCycle 1999 (Glenn (1999) in the reference list of the NIR). Industrial landfills are included in the inventory and the CH_4 emissions have been estimated to be 7 per cent of the total CH_4 emitted from MSW landfills. The reasoning behind this figure is not explained, although a reference is provided (EPA 1993). As the reference is not a part of the inventory submission, a short explanation as to how this figure was derived would increase the transparency. In its response the United States explained that the United States will provide more transparent documentation of its emission estimates from industrial landfills, closed landfills, and overall landfill model calculations.

167. Landfill gas recovery is based on information provided by vendors for 235 flares. This is believed to underestimate the amount of recovery as, according to the EPA, approximately 700 flares may be closer to the real value.

168. The comparison with the data in the CRF for the year 1998 and the NIR showed some disparities. The amount of annual MSW at the SWDS in the CRF was erroneously given in Tg when requested in Gg (noted in the S&A by the secretariat and confirmed by the United States). The amount given in the CRF corresponded to the MSW generation figure, not the MSW landfilled figure. The activity data from industrial landfills cannot be traced from the figures in either the CRF or the NIR.

Method and emission factors

169. The CH_4 emissions from SWDS in the United States have been estimated based on a CS model. The principles of the model are described in some detail in the inventory report, but no calculation sheets, disaggregated emission factors or other equivalent information are provided.

The transparency of the model description should be improved. The model is based on a characterization of SWDS and measured data on emissions for the different types. The measurements (such as the methods used, the numbers or measurements and their reliability) are not described, neither are the emission factors for the different types of landfills given. It is also unclear whether or not emissions from closed/unused landfills are included in the inventory.

170. In the CRF tables, the United States had reported the activity data in Tg instead of Gg. In addition, the amount in the CRF corresponds to MSW generated not landfilled. These mistakes caused an error in the implied emission factor in the table (30.19 t/t when the correct value would be around 0.05 t/t). The corrected value is in good agreement with the range of emission factors reported by other Parties. The comparison of the emission factors may, however, be misleading as the choice of method used (IPCC default, FOD or other) has a great influence on the implied emission factors.

171. The value used for methane oxidation is given as 10 per cent of the value of methane generated minus the amount of landfill gas recovered. In appendix J, table J-2 of the NIR, the given values for avoided emission by oxidation correspond approximately to 9.2 – 9.4 per cent of the values given for methane generated minus landfill gas used for energy or flared.

Ways of improving the inventory

172. A change from the current CS method to the FOD method given in the IPCC Guidelines could be considered. The activity data needed for the model could be estimated in a way similar to that in which the amount of carbon in landfills has been estimated in the current model. The change would increase the transparency and comparability of the reporting. If the national method is preferred, the documentation and justification for its use should be improved (for details, see above). However, the United States believes, in its response, indicates that its country-specific method for estimating CH_4 emissions from landfills provides more accurate results than the first-order decay method, given the difficulty and uncertainty in developing accurate rate constants.

3. Other sources

3.1. Waste-water treatment

173. The CH_4 emissions from domestic waste-water treatment have increased by almost 9 per cent during the period 1990 to 1998 (150 Gg to 163 Gg). The emissions from this source category are estimated using the IPCC default method. The parameters used in the estimation are provided and referenced. The part of waste-water which is digested anaerobically is estimated to be 15 per cent. In the CRF tables this is erroneously reported in additional information as the percentage for treated wastewater. In its response, the United States explained that the percent treated anaerobically was placed in the incorrect location in the CRF submission

174. The “missing” estimates (CH_4 and N_2O from industrial wastewater) are discussed above in the general section.

3.2. N_2O emissions from sewage

175. The N_2O emissions from human sewage showed an increase from 23 Gg N_2O in 1990 to 25 Gg N_2O in 1998 (almost 9 per cent). The emissions from this source category are estimated using the IPCC default method, but in a slightly modified way. In the amount of nitrogen

discharged to waterways, the amount of nitrogen in sewage sludge applied to soils is taken into account. The N_2O emissions from the nitrogen in sewage sludge applied to agricultural are also estimated and reported in the agriculture sector. This modified method corresponds better to the real situation and is more accurate than the IPCC default method.

3.3. Waste incineration

176. Estimates on CO_2 and N_2O emissions from waste incineration are provided. The CO_2 emission factors for fossil CO_2 emissions from waste incineration are based on the amount of plastics in the United States waste stream. The activity data and emission factors are provided clearly and the carbon content in the different types of plastics could also be used by other Parties for improving their emissions estimates.

177. The secretariat noted in its S&A report a significant increase (9 per cent) in the CO_2 emissions and that the corresponding implied emission factor was also much higher. A similar difference was also noted for the implied N_2O emission factor. The United States explained this very clearly in the comments to S&A report. Inclusion of these explanations in future inventory reports could be of use to other Parties also.

178. The N_2O emission factor used in the United States inventory is 30 g N_2O/t waste. This is within the range given in the IPCC Guidelines and the IPCC Good Practice Guidance, although at the lower end. The estimates could be improved by surveying the technologies used in combustion and using corresponding emission factors, based on the literature or on actual measurements in United States plants. The survey would also improve the CO_2 emission estimates, if information on combustion efficiencies were supplied at the same time.

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