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NORWAY

REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY SUBMITTED IN THE YEAR 2004[1]

I. OVERVIEW

A. Introduction

1. This report covers the centralized review of the 2004 greenhouse gas (GHG) inventory submission of Norway, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8 of the Conference of the Parties. The review took place from 18 to 22 October 2004 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalists – Mr. William Irving (United States) and Mr. Matthew Dudley (Australia), Energy – Mr. Pavel Fott (Czech Republic), Mr. Hongwei Yang (China) and Mr Takeshi Enoki (Japan), Industrial Processes – Mr. Jos Olivier (Netherlands) and Ms. Virginia Sena (Uruguay), Agriculture – Mr. Damdin Dagvadorj (Mongolia) and Ms. Anna Romanovskaya (Russian Federation), Land-use Change and Forestry (LUCF) – Mr. Rizaldi Boer (Indonesia) and Mr. Xiaoquan Zhang (China), Waste – Mr. Yunus Arikan (Turkey) and Ms. Elisabeth Scheehle (United States). Mr. William Irving was the lead reviewer. Due to unforeseen circumstances, Mr. Rizaldi Boer, who was invited as the second lead reviewer, was not able to attend the review in Bonn, but contributed from Indonesia. The review was coordinated by Ms. Astrid Olsson (UNFCCC secretariat).

2. In accordance with the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Annex I Parties", a draft version of this report was communicated to the Government of Norway, 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 2004 submission, Norway has submitted a set of common reporting format (CRF) tables for the years 1990 and 1998–2002 and a national inventory report (NIR). In addition Norway has provided CRF table Summary 2 for the years 1990–2002. Where needed the expert review team (ERT) also used 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 annex 1 to this report.

C. Emission profiles and trends

4. In the year 2002, the most important GHG in Norway was carbon dioxide (CO_2), contributing 74.0 per cent to total[2] national GHG emissions expressed in CO_2 equivalent, followed by methane (CH_4) – 12.4 per cent – and nitrous oxide (N_2O) – 10.5 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) taken together contributed 3.1 per cent of the overall GHG

[1] In the symbol for this document, 2004 refers to the year in which the inventory was submitted, and not to the year of publication.
[2] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 equivalent excluding LUCF, unless otherwise specified.

emissions in the country. The Energy sector accounted for 66.0 per cent of total GHG emissions, followed by Industrial Processes (17.5 per cent), Agriculture (8.8 per cent) and Waste (7.3 per cent). Total GHG emissions (without LUCF) amounted to 55,343 Gg CO_2 equivalent and increased by 6.1 per cent from 1990 to 2002. The main increase in emissions of CO_2 was in energy industries and transport. There was a notable decrease in emissions between 2001 and 2002, which is attributed to the decrease in SF_6 emissions (by 93.4 per cent) in the source category SF_6 used in the Aluminium and Magnesium Foundries and reduced flaring from the source category Oil and Natural Gas extraction (CO_2 and CH_4 emissions).

D. Key sources

5. Norway reports a tier 2 key source analysis (level and trend assessment). It is consistent with the *1996 Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and is described in the NIR. Norway's key source analysis and the secretariat's[3] key source analysis produced different results because they used different approaches. Norway's analysis yielded 19 key sources, while the secretariat identified 23. The ERT noted that a number of the uncertainty parameters were normalized for this analysis. Norway is encouraged to arrange (tabulate) the key sources by their relative contributions, and not by IPCC hierarchy.

6. Norway generally uses recommended IPCC methods for key sources. The ERT did, however, identify specific areas where the transparency of the methods used could be improved and where a higher-tier method should be used. Norway is encouraged to provide more information and detail on the emission factors (EFs) used, for example, for N_2O emissions from Road Transportation and plant-specific factors used in the Industrial Processes sector. The ERT recommends that Norway consider using a higher-tier method for enteric fermentation from cattle. Norway is also encouraged to provide a summary of information on the tier of the IPCC method that was used and how this relates to each key source, and where planned improvements have been identified, as recommended by the ERT during the 2003 review process.

E. Main findings

7. The Norwegian inventory is largely complete. The ERT identified areas for improvement in relation to the completeness and the transparency of the inventory. The most important are a complete time series of CRF tables (including recalculation tables), the use of notation keys, and the provision of greater transparency on country-specific methods and EFs in the NIR.

8. The NIR is largely consistent with the UNFCCC reporting guidelines, and Norway is commended for its efforts to include improvements identified by the review of the 2002 submission in the inventory.

9. The ERT recommends that Norway formalize its quality assurance/quality control (QA/QC) plan as this will assist in identifying and resolving inconsistencies between the NIR and the CRF tables.

F. Cross-cutting topics

Completeness

10. Norway's 2004 submission includes CRF inventory data for the years 1990 and 1998–2002, and CRF table Summary 2 for 1990–2002. The ERT recommends that Norway submit a complete time series of CRF tables for its 2005 submission. The NIR does provide a complete time series of emissions data and an assessment of the general completeness of the inventory at a source category level.

[3] The secretariat had identified, for each individual Party, those source categories which are key sources in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance. Key sources according to the tier 1 trend assessment were also identified for those Parties providing a full CRF for the year 1990. Where the Party has performed a key source analysis, the key sources presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key source assessment conducted by the secretariat.

11. The NIR is largely complete with respect to the UNFCCC reporting guidelines. The organization of the main chapters of the NIR is consistent with the annotated table of contents in these guidelines, with some minor exceptions. For example, the NIR should follow the common annex structure and include discussions on time-series consistency in each sector chapter.

12. The submission covers most source categories, but Norway has identified and explained some gaps in sectoral coverage, such as emissions of N_2O from aerosol propellant and ferroalloys production. The reasons for their exclusion are described as being lack of data and/or the fact that they are not on the list of priorities for improvement of the inventory. Norway intends to include N_2O from aerosol propellant in its 2005 inventory.

13. Norway does not use the notation keys in a consistent way, and does not always use them when they are required. The ERT recommends that Norway use CRF table 9 to make its use of the "not estimated" ("NE") and "included elsewhere' ("IE") notation keys more transparent. Norway noted during the review that it intends to improve its use of notation keys in its 2005 inventory.

Transparency

14. The NIR and CRF tables are generally transparent. The ERT recommends that Norway provide more methodological information in the NIR, particularly for the country-specific methods used. The ERT found reviewing the methods used in the Energy and Industrial Processes sectors difficult as the detailed documentation (SN 2000) is referenced in the NIR through a website link, but not provided itself within the NIR. The ERT noted specific source categories for which additional description of the methodology used is needed, for example, the method of allocating fuel to the Fuel Combustion source categories, and the country-specific methods used in the Industrial Processes sector.

Recalculations and time-series consistency

15. Norway reports a number of recalculations of estimates provided in the 2003 submission. The rationale for most of these recalculations is provided in the NIR, but Norway has not submitted a complete time series of CRF recalculation tables. The major recalculations involve the data for energy industries, 1.B.2 Oil and Natural Gas, and aluminium production. The effect of the recalculations for the base year was a 0.24 per cent increase in the estimates of CO_2 equivalent emissions excluding LUCF and a 0.83 per cent increase including LUCF.

16. A cross-check between the NIR and CRF tables 8(a) and 8(b) identified an inconsistency in the recalculation of the Waste Incineration source category for 2001. CRF table 8(a) provides the recalculation data, but the rationale for the recalculation is not provided either in CRF table 8(b) or the NIR.

Uncertainties

17. Norway has estimated uncertainties for each source category (except for the LUCF sector) using the IPCC tier 2 Monte Carlo approach. These values were estimated in 1999 and 2000 (SFT/SN 1999a and SN 2000) and are deemed still to be valid. The overall uncertainty of the inventory is estimated to be 21 per cent for 1990, and the uncertainty in trend is 4 per cent for the period 1990–2000. Norway has also undertaken a tier 1 uncertainty assessment (SFT/SN 1999a) in which the uncertainty in national emissions is estimated to be 11–17 per cent for 1996.

18. The uncertainty analysis could be significantly improved by including a discussion of the factors influencing the high uncertainties of a number of parameters. In addition, Norway should include information on the normalization of data inputs with very large uncertainties, and comments on the consistency of this procedure with the IPCC good practice guidance.

Verification and quality assurance/quality control approaches

19. The NIR provides information on the current QA/QC and verification procedures used at a general or source-specific level. Norway has also identified a need to apply the external peer review and audit components of the IPCC good practice guidance.

Country-specific source categories

20. The ERT recommends that Norway improve the transparency of the information it gives on CO_2 capture and storage to clarify the amount of CO_2 that is injected per year, and on whether fugitive emissions from CO_2 injection are included in the CRF tables.

Follow-up to previous reviews

21. Norway has addressed a number of recommended improvements from previous reviews:

(a) The descriptions of sectors have been improved, especially for Agriculture and LUCF;

(b) The use of notation keys is now more extensive than before;

(c) Table 4.B(b) has now been completed with data on N_2O emissions from manure management;

(d) CO_2 emissions from liming of agricultural soils are reported under 5.D;

(e) The reporting of emissions and removals from soils is now consistent with the IPCC good practice guidance.

G. Areas for further improvement

Identified by the Party

22. The NIR identifies several areas for improvement at both a general and a source-category level in response to the recommendations of the 2003 review report. These include:

(a) The submission of a complete time series of CRF tables;

(b) Implementation of a tier 2 methodology for enteric fermentation;

(c) Use of the IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry (LULUCF) (hereinafter referred to as LULUCF good practice guidance).

Identified by the ERT

23. The ERT identifies the following additional cross-cutting issues for improvement. The Party should:

(a) Make greater and more consistent use of notation keys;

(b) Continue to improve the consistency of the NIR with the structure outlined in the UNFCCC reporting guidelines, particularly with respect to a discussion of the time-series consistency of recalculations performed and their impact on emission trends;

(c) Ensure that the information in the NIR and that in the CRF tables are consistent;

(d) Formalize a QA/QC plan.

II. ENERGY

A. Sector overview

24. In 2002, the Energy sector accounted for 66.0 per cent of total GHG emissions in Norway, excluding LUCF. Total GHG emissions from this sector increased by 24.7 per cent between 1990 and 2002, and decreased by 1.0 per cent from 2001 to 2002. Fuel combustion is the main source, accounting for 90.9 per cent of GHG emissions from the sector. Road traffic and offshore gas turbines (electricity generation and pumping of natural gas in pipelines) are the sector's largest single contributors. Other important sources are coastal navigation, energy use in the production of raw materials, and oil and gas operations which give rise to significant amounts of fugitive emissions in Norway. Public electricity and heat production is a minor source, as Norway produces electricity mainly from hydro-power.

25. The NIR and the CRF contain emissions estimates for all direct and indirect GHGs and all sources from the Energy sector.

26. Norway mostly uses country-specific EFs and higher-tier methods for the energy inventory. The description of the methodologies used and the activity data (AD) and EFs in the NIR have continued to improve over the last few submissions. However, Norway is encouraged to further improve the transparency of the NIR. For example, Norway should include a discussion on the deviation of apparent consumption and International Energy Agency (IEA) data, and of the implied emission factors (IEFs) that have been identified as outliers by the secretariat.

27. The Norwegian emissions inventory has been recalculated for the years 1990–2001 for all components in the 2004 submission. Most of the recalculations have been performed for 2001 because the energy accounts for 2001 which were the basis for the 2003 submission were "preliminary". The NIR provides explanations of the recalculations by source category in addition to the recalculation chapter in the NIR.

B. Reference and sectoral approaches

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

28. In 2002, the difference between the reference and the sectoral approaches was +20.4 per cent for energy consumption and –8.5 per cent for CO_2 emissions. Norway explains in the NIR that, due to its particular national conditions (characterized by a large non-energy use of coal, coke, natural gas and liquefied petroleum gas (LPG), extensive oil and gas production and exports, and relatively large statistical errors), the reference approach is inappropriate. The end-use energy statistics used for the sectoral approach are considered to be more accurate. However, there are differences between the results obtained using the reference approach and those obtained using the sectoral approach which cannot be explained by systematic differences between the approaches. For example, in 1999, 2000 and 2001 in the reference approach, CO_2 emissions were approximately 8 per cent higher than in the sectoral approach, but in 1990 and 2002 they were about 4 per cent and 8 per cent lower, respectively. The ERT encourages Norway to consider and explain this contrariwise deviation. It also encourages Norway to explain how the large positive difference in energy consumption, between the reference and sectoral approaches, resulted in a large negative difference in CO_2 emissions in 2002.

29. The ERT noted that there are differences between the Norwegian national energy balance data for 2002 and the IEA data. Norway provides explanations in the NIR: it treats the statistical error, carbon stored for non-energy use, and the definitions of domestic and international fuel use, in a different way from the IEA, as mentioned in paragraph 30 below.

International bunker fuels

30. Norway reports in the NIR that a new methodology has been applied to separate domestic from international fuel use for aviation. Figures on total aviation fuel consumption are derived from sales data collected by Statistics Norway (SN) from the Norwegian petroleum company. Data on domestic fuel

purchase and consumption are collected by SN from all airline companies operating domestic traffic in Norway.

Feedstocks and non-energy use of fuels

31. Norway uses relatively large amounts of gas, coal and coke as feedstock for industrial processes. In 2002, feedstock use of these fuels amounted to about one-third of total national fuel consumption (excluding biomass). As in its previous submissions, Norway has entered the non-energy use directly into table 1.A(d) using a carbon storage factor of 1. The respective default IPCC values are generally much lower. Norway mentions in the NIR that fuels oxidized during industrial processes are assumed to be "stored" in the Energy sector. This helps to explain the use of a high carbon storage factor for the sake of achieving comparability between the two approaches, as these emissions are to be reported under the Industrial Processes sector. The ERT encourages Norway to set up a QA/QC procedure to ensure consistency between the Energy and Industrial Processes sectors for those industrial processes that use fuels as feedstock.

Country-specific issues

32. In the NIR Norway reports the amount of CO_2 vented from CO_2 capture and storage at the Sleipner West oil and gas production field and explains why these emissions are included in the GHG inventory. The ERT suggests that Norway provide additional information on the amount of CO_2 injected per year and provide a clear description of where fugitive emissions from injection are reported in the CRF. The NIR should include more documentation on the monitoring of reservoir leakage, for example, a summary of any monitoring plans, emission licences and so on. It should be clearly indicated where the fugitive emissions or carbon storage have been included in the CRF.

C. Key sources

Stationary combustion: solid, liquid and gaseous fuels – CO_2

33. CO_2 emissions from stationary combustion (solid, liquid and gaseous fuels) represented 34.5 per cent of all reported emissions in 2002 in Norway. Specifically, CO_2 emissions from stationary combustion of gas, oil and coal contributed 17.1 per cent, 11.7 per cent and 4.7 per cent, respectively, of total reported emissions in 2002.

34. CO_2 emissions from combustion of natural gas in category 1.A.1.c Manufacturing of Solid Fuels and Other Energy Industries are the most important sources of emissions in Norway. Emissions in this key source originate predominantly from the combustion of natural gas in oil and gas extraction operations offshore. Emissions from the combustion of gaseous fuels in such operations increased by 72 per cent over the period 1990–2002 as a result of the increasing production of oil and gas. According to the NIR, Norway will use field-specific CO_2 emission factors to substitute the standard EF for natural gas burned in gas turbines offshore for its next submission.

35. The ERT noted that CO_2 emissions from coal combustion are identified as a key source in both the level and the trend analysis by the secretariat, but they are not a key source in Norway's key source analysis. The reason for this is that in Norway's CRF, emissions from liquid fuels in Agriculture/ Forestry/Fishing are reported as solid fuels. Norway uses a tier 2 method for the key source analysis, by which CO_2 emissions from coal combustion are correctly not identified as a key source.

Mobile combustion: liquid fuels – CO_2 and N_2O

36. CO_2 and N_2O emissions from mobile combustion represented 25.2 per cent of total reported GHG emissions in 2002. Among them, road vehicle use is the most important category of mobile combustion, followed by waterborne navigation and aircraft.

37. Norway uses a national transportation model to estimate CO_2 and N_2O emissions from road vehicles. The IEF of N_2O from gasoline in road transportation was identified by the 2004 previous review stages as the highest value among reporting countries. The ERT suggests that Norway include in

its NIR more detailed information on the N_2O EFs used for these estimates. Norway indicated during the review that it plans to update the methodology for N_2O emissions from road vehicles in its next NIR.

Fugitive emissions from coal mining – CH_4

38. Fugitive emissions from coal mining are estimated using a tier 2 methodology and a country-specific emission factor. Noting that the EF appears to be well developed, the ERT encourages Norway to assess the feasibility of applying a measurement-based tier 3 approach to this key source.

Fugitive emissions from oil and gas – CH_4

39. Fugitive emissions from this sector are estimated using an in-depth methodology which incorporates field-specific EFs and reported emissions data. The level of detail provided on the methodology and in the description of trends has improved. The method and EFs appear to be in line with the IPCC good practice guidance.

D. Non-key sources

Stationary fuel combustion: biomass – CO_2

40. The 1990 and 1998–2002 values of the CO_2 IEFs for fuel combustion of biomass are the highest of reporting Parties and higher than the IPCC default values. Norway explained in its response to the 2004 previous review stages that this is due to the inclusion of wood waste and black liquor in the biomass fuel category.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

41. In 2002, the Industrial Processes sector accounted for 17.5 per cent of total national GHG emissions (without LUCF). CO_2 represented 62 per cent of the sector's emissions in 2002 (mostly from ferroalloys and aluminium production). N_2O emissions from nitric acid production accounted for 20 per cent of emissions from the sector and actual emissions of fluorinated gases (F-gases) for 18 per cent. From 1990 to 2002, emissions from the sector fell by 29 per cent, mainly due to decreases of 66 per cent in PFC emissions from aluminium production and 93 per cent in SF_6 from magnesium production (each about 2 Mton CO_2 equivalent). Both actual and potential emissions for individual F-gases are reported. The (minor) indirect CO_2 emissions from solvent and other product use decreased by 12 per cent from 1990 to 2002.

42. For industrial processes, in contrast with the nine key sources identified by the secretariat, the Party, using the tier 2 key source analysis, identified four key sources. The following, which the secretariat identified as key sources, were *not* identified as key sources by the Party: N_2O from nitric acid production, CO_2 from cement production, CO_2 from ammonia production and CO_2 from carbide production (their 2002 levels accounting for 3 per cent, 2 per cent, 1 per cent and 1 per cent of total national emissions, respectively).

43. Recalculations have been made mainly for PFC and CH_4 emissions for the complete time series, the only significant recalculation being that for PFC emissions in 1990 (–8 per cent), the reasons for which are explained in the NIR.

44. The ERT found that major improvements have been made in the documentation in the NIR of the methodology for calculating PFC emissions from aluminium production, the largest key source by level in this sector. However, the transparency and comparability of the reporting of this technological sector could still be greatly improved, and the ERT recommends that Norway provide more detailed information on the rationale for the country-specific or plant-specific EFs used and the QA/QC activities undertaken to verify the quality of the emissions data reported by companies. This will also improve confidence in the part of the inventory that is based on plant-specific data reported by individual companies.

45. Norway could make its reporting of this sector easier to compare with that of other Parties by providing information on which IPCC tier the (mostly) country-specific methods used correspond to and on departures from the recommended methods and data, if any. In cases where IEFs have changed significantly over time, the ERT strongly recommends that Norway provide summary information in the NIR about any underlying changes in actual emission factors, or other parameters used to prepare estimates.

46. Norway reports in the CRF that it will include in its next submission the minor N_2O emissions from metal production and from product use. Rather than adding almost negligible sources, however, the ERT recommends that Norway give priority to providing CRF data for all years.

B. Key sources

Ferroalloys production – CO_2

47. The ERT observed that the IEF shown in the CRF is lower than the EFs listed in the NIR and that there has been a decrease of the IEF (i.e., consumption of reducing agent per ton of ferroalloy produced) of 14 per cent since 1990. Norway explained during the review that the IEF is lower due to the subtraction of carbon contained in the carbon monoxide (CO) produced that was used or sold for energy purposes (these emissions are reported in the Energy sector under 1.A). The ERT recommends Norway to include this information in its next NIR. Norway explained that section 4.4.1 of the NIR erroneously reports a decrease of 5.3 per cent – between 1990 and 2002 while the CRF reports the correct decrease of 9.5 per cent over the same period.

Aluminium production – PFCs

48. The NIR mentions changes in technology mixes over time but does not provide details of these transitions in the period 1990–2002. Further detail is needed to explain most of the emissions and emission factor trends. Since this is a key source, the ERT recommends that Norway describe in a table in the NIR for all years the type of processes (VSS, SWPB, CWPB, PFPB), their fraction in the national total aluminium production and the (implied) tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6) emission factors by type, as well as explaining the large inter-annual variations of the IEFs. Moreover, in view of the recalculations that the Party reports, the ERT recommends that Norway provide more detailed information on the extent and the quality of plant-specific QA/QC activities undertaken to check the quality of the emissions data reported by companies.

49. The ERT also encourages Norway to provide more detailed information on the country-specific method used for determining the C_2F_6 EFs and the rationale for using that method and the data that are used. The country-specific method results in a ratio of the C_2F_6 EF to the CF_4 factor of about 1:25. The Party could instead use the IPCC default ratio of 10 to select the C_2F_6 EFs or use new measurement data to determine another ratio value.

SF_6 used in magnesium foundries

50. The ERT recommends that Norway provide a more detailed explanation in the NIR of the causes of the large inter-annual changes in SF_6 emissions (e.g., +25 per cent between 1998 and 1999, and –17 per cent between 2000 and 2001), as was explained during the review. The emission factors are presented in (SN 2000). Norway plans to include a more comprehensive description of the methodology in the NIR 2005 and to revise the methodology in NIR 2006.

Consumption of halocarbons and SF_6 – F-gases

51. The NIR does not provide any information on the emission factors (e.g., leakage rates) and delay factors used in the emission calculation model; according to the information provided in the CRF, all are country-specific. Since this is a key source, the ERT recommends that Norway include this information in the methodology description of the NIR.

C. Non-key sources

Cement production – CO_2

52. Norway should describe clearly in the NIR the method used and the corresponding tier of the IPCC good practice guidance method, as was explained during the review.

Nitric acid production – N_2O

53. Because nitric acid production data are confidential, the ERT recommends that Norway describe in the NIR the QA/QC activities that have been performed to verify the quality of emissions data measured and reported by the two companies.

Ammonia production – CO_2

54. When the IEF (1.42 t/t) for 2002 is calculated without the CO_2 captured, it is well within the range reported by other countries. To make comparison with other countries' inventories easier, the ERT recommends that in its future submissions Norway report the uncaptured emissions under the heading "ammonia production" and report the CO_2 captured in an additional line as negative emissions.

Carbide production – CO_2

55. During the review Norway explained to the ERT that there are four carbide plants: three carbon carbide plants and one calcium carbide plant. The calcium carbide plant was closed in 2003, not in 2002 as stated in the NIR. The ERT recommends Norway to correct this information in its next NIR.

Aluminium production – CO_2

56. The NIR notes that the method for calculating emissions has been changed for all years but does not clarify the nature of these changes or explain how this improves accuracy. During the review Norway explained this, and the ERT recommends that Norway include this information in its next NIR.

IV. AGRICULTURE

A. Sector overview

57. In 2002, the Agriculture sector accounted for 8.8 per cent of total national GHG emissions in 2002, reaching 4,860 Gg CO_2 equivalent. Over the period 1990–2002 the emissions from the sector were relatively stable and decreased by 3.7 per cent. The contributions of CH_4 and N_2O emissions to total sectoral GHG emissions were 41 and 59 per cent, respectively. In the tier 2 key source analysis performed by the Party, 4.A Enteric Fermentation (cattle) and agricultural soils (in categories 4.D.1, 4.D.2, 4.D.3) were identified as key sources. That agrees with the secretariat's key source analysis.

58. Categories 4.D Agricultural Soils and 4.A Enteric Fermentation contributed 56.5 and 34.7 per cent, respectively, to emissions from the Agriculture sector. From 1990 to 2002, those emissions decreased by 5.2 per cent and 1.4 per cent, respectively. However, the explanations given in the NIR for the reduction in the amount of nitrogen (N) in agricultural products and the reasons for the decrease of GHG emissions from on-field burning (by 62.4 per cent over the period 1990–2002) are not clear. Norway explained during the review that from 1990 to 2002 there has been a decrease in the number of non-dairy and dairy cattle, which are the main contributors to the amount of nitrogen. In addition, a decreasing fraction of the agricultural residues are being burned. The ERT encourages Norway to provide more explanatory information on the drivers for the GHG emission trends during the period 1990–2002.

59. Recalculations have been made for the whole time series due to revision of the statistics of animal populations and changes in the ammonia model. The ERT encourages Norway to submit CRF tables for the years 1991–1997. Recalculations of GHG emissions from on-field burning have been made for 1999, 2000 and 2001 due to improvements to the activity data. No significant impact on the GHG trends is observed.

60. Norway reports complete estimates of all gases and sources from the Agriculture sector with transparent descriptions, as recommended by the *IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Guidelines). In its 2004 submission Norway has started to report emissions from the application of industrial and urban wastes as fertilizer. Norway also reports additional subcategories of animals (deer, reindeer, ostrich, fur-bearing animals) which are not included in the IPCC Guidelines.

B. Key sources

Enteric fermentation – CH_4

61. Norway has used the IPCC tier 1 method for estimating CH_4 emissions from enteric fermentation from cattle. This is not in line with the IPCC good practice guidance, which recommends the use of a higher-tier method. The level of milk productivity and body weight for dairy cows are not reported in the NIR or the CRF. According to the comments provided to the ERT by Norway during the review, in 2002 average milk yield was about 4,672 l/head/yr (4,860 kg/head/yr), which is higher than the default value (4,200 kg/head/yr), and the use of the default EF could therefore lead to emissions being underestimated. The ERT encourages Norway in its intention to update the methodology to tier 2 as a planned improvement in the future and to implement it at least for the base and the last year of submission in order to compare possible deviations.

Agricultural soils – N_2O

62. The N excretion rates reported by Norway (NIR, p. 107) are lower than the IPCC default values. The reference source for these data is not provided and the explanation given by Norway (NIR, p. 111) is not sufficient. Different sets of N excretion factors have been used for subcategories of 4.B(b) Manure Management and 4.D Agricultural Soils. During the review, Norway explained that the N excretion factors were developed in 1988 by Sundstøl and Mroz and that they were updated in this submission by national experts. The same N excretion factors are used in the N_2O and the NH_3-calculations.

63. The amount of N in crop residues is assumed to be equal to the total amount of N in the harvest. However, no justification for this assumption, which differs from the assumption in the default method, is provided in the NIR. The ERT encourages Norway to provide clear explanations for the method used for crop residues in the NIR and to consider the possibility of recalculating the emissions using the default methodology.

64. The estimates of N_2O emissions from grazing animals include a correction for N lost from pastures through ammonia (NH_3) volatilization. However, the default EF for N_2O has been derived for total N excretion and should be applied to that value. The ERT recommends that Norway investigate this question.

C. Non-key sources

Manure management – CH_4

65. The CH_4 IEFs for sheep, goats and horses, which were derived in accordance with the tier 2 method, are significantly higher than the default values. The ERT recommends that Norway provide possible explanations in the NIR on the national characteristics of the management of these animals that could lead to higher EFs.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

66. In its 2004 submission, Norway provides estimates of CO_2 removals and emissions from 5.A Changes in Forest and Other Woody Biomass Stocks and CO_2 emissions from liming of agricultural soils (in category 5.D CO_2 Emissions and Removals from Soils). Total CO_2 emissions from commercial harvest decreased sharply from 19,727 Gg in 1990 to 15,899 Gg in 1998, and then remained relatively

constant between 1999 and 2002. Removals increased steadily at an average annual rate of 1.6 per cent. As a result, the net CO_2 removals from changes in forest and other woody biomass stocks increased at an overall rate of 5 per cent per year. Furthermore, CO_2 emissions from liming of agricultural soils also decreased steadily at a rate of 5 per cent per year. Thus net CO_2 removals from LUCF also increased steadily at an average rate of 4.7 per cent per year. The net removals of 19,920 Gg in 2002 offset 36 per cent of total national GHG emissions in that year.

67. In the CRF for the year 1990, data on total biomass removed in commercial harvest, traditional fuelwood consumed, and total other wood use are not provided but estimates of carbon emissions have been calculated.

68. Norway states in the NIR that it is difficult to separate the contributions from category 5.A, 5.B and 5.C. In principle all forest and grassland conversion (category 5.B) are included in the inventory, while abandonment of managed lands (category 5.C) are only partially included. There could be some grassland conversion in e.g. mountain areas that are not included. However, deforestation (5.B) is included. Both 5.B and 5.C are included under 5.A. Norway explained during the review that, because deforestation is regulated, uncontrolled deforestation would not take place, and the forests would regenerate through replanting or natural regrowth. As a consequence, categories 5.B Forest and Grassland Conversion and 5.C Abandonment of Managed Lands are likely to have a relatively small impact on the Norwegian LUCF inventory.

69. In the NIR Norway has provided sufficient information on the methodologies used in developing the inventory, as well as sources of AD and EFs, and a list of references. The methodologies used are country-specific, except for commercial wood harvest, which follows the method in the IPCC Guidelines. Most of the EFs are also country-specific.

70. Norway provides qualitative uncertainty estimates in CRF table 7. For 5.A the quality of estimates is judged to be low (L) and high (H) for 5.D and 5.E.

71. The NIR states that the Norwegian Institute of Inventory is responsible for checking data quality and ensuring that the methodology in the forest inventory survey is consistent, and Statistics Norway examines the consistency of the various statistical data over time.

B. Sink and source categories

Changes in forest and other woody biomass stocks

72. The conversion of wood volume to carbon stock was performed using biomass expansion factors (BEFs), wood dry density (WD) and carbon content of biomass (CC). The IPCC expansion factor was not applied uniformly. Total felling (biomass which is removed physically from the forest) was not expanded to total biomass. Instead, the expansion of fellings was added to the item "logging residues" to obtain an estimate of "total logging residues". A BEF was also applied to natural losses. Logging residues and natural losses were both calculated as fixed percentages of total fellings and gross increment, respectively, and both were 6 per cent for spruce and pine and 10 per cent for deciduous trees (Schøning 1992). However, no justification is provided in the NIR for the use of the same percentage values for both logging residues and natural losses. Also no definition of natural losses is provided.

73. The ERT recommends the development of country-specific BEFs for spruce, pine and deciduous trees. As the estimates of total carbon depletion are dependent on the value of the BEF and the percentage values used for logging residues and natural losses, the selection of these values is crucial.

74. To increase the transparency of its reporting, Norway should provide a more detailed explanation of how mean annual biomass increment values were derived. The CRF shows that the carbon accumulation occurred in boreal forest (and this should cover spruce, pine and deciduous trees). The total area of forest (about 9,780 kha) did not change from 1990 to 2002. As the implied carbon uptake factor indicates, the mean annual biomass increment of this forest increased linearly at a rate of 0.03 t dm/ha/yr.

CO_2 emissions and removals from soils

75. Norway provides estimates of CO_2 emissions from liming of agricultural soils, but those from cultivation of mineral and organic soils are not estimated ("NE" is reported). In the NIR Norway indicates that uptake of CO_2 in forest and agriculture soil (in category 5.D) and non-CO_2 gas emissions and removals from forest soils and residues might occur, but they are not estimated.

CO_2 emissions and removals from lakes

76. The NIR states that lakes in the southern parts of Norway have been limed for several years. Data on lime application are collected by the Directorate for Nature Management. The EF is the same as that for liming of agriculture soils, that is, 0.44 t CO_2/per t calcium carbonate applied (SFT, 1990). Although these emissions are reported in the NIR, it could be made more clear – e.g. by a footnote – that in the CRF, category 5.E covers CO_2 emissions and removals from lakes.

C. Areas for further improvement

77. Norway intends to use the LULUCF good practice guidance and the updated UNFCCC reporting guidelines in order to improve both the completeness of its inventory and the methodology.

78. Norway should further elaborate the derivation of the growth increment for the boreal forest, the QA/QC process in place, and the justification for using the same percentage values for logging residues and natural losses.

79. To increase the certainty of the CO_2 removal estimates, Norway is encouraged to develop country-specific data on the BEF for spruce, pine and deciduous forest.

VI. WASTE

A. Sector overview

80. In 2002, the Waste sector accounted for 7.3 per cent of total GHG emissions of Norway in 2002. Emissions from the sector had increased by 2.5 per cent since 1990. The sector is dominated by methane emissions from solid waste disposal sites (SWDS), which accounted for 96 per cent of emissions from this sector in 2002.

81. All emission sources are covered in the NIR, but the CRF lacks information on key activity data and the notation keys are not used. The reasons for recalculations which have been performed are not explained in detail and are not included in the CRF.

82. The transparency of the inventory is a general issue for this sector. The methods appear to be consistent with the IPCC Guidelines and the good practice guidance, but all are country-specific and little detail is provided on the methodology or the development of the emission factors used. Activity data are generally not provided or are provided for only one year.

B. Key sources

Solid waste disposal sites – CH_4

83. Norway uses a modified IPCC tier 2 method. The method appears to be in accordance with the IPCC good practice guidance, but the development of the EFs and various parameters is not described in detail. Further description, analysis, and justification of the effects of various parameters would provide explanations for the unusually high IEF and emissions per capita.

84. The CH_4 recovery data are mentioned but details are not provided, and the reason for including them in the model needs further clarification. In addition, the revision of the recovery data should be better documented. The ERT recommends that Norway provide further detail on the number and type of recovery systems, the reduction calculations, and the rationale for including CH_4 recovery data in the model.

85. The CRF entries for SWDS are incomplete and the notation keys are not used.

86. There is a large decrease in the quantities of waste going to landfills from 1998 to 1999 but the NIR does not include an explanation. In response to a question during the review, Norway stated that the decrease is due to the introduction of a landfill tax on organic waste. The ERT recommends that Norway include this information in its next NIR. Norway indicated that it has now revised the calculation method for methane from landfills. The new methodology will be documented in the 2005 submission to UNFCCC.

C. Non-key sources

Solid waste disposal on land – CO_2

87. Norway reports emissions of CO_2 from landfills. The NIR states that the CO_2 emissions result from both direct oxidation (in the landfill) and indirect oxidation of methane (in the atmosphere), based on the assumption that 7.5 per cent of waste deposited in landfills is of fossil origin. The ERT recommends that Norway provide further explanation of this assumption in the NIR to enable the next ERT to assess the method, particularly the type and associated decay rates of the 7.5 per cent of fossil waste.

Waste-water handling – CH_4, N_2O

88. Activity data are only provided for one year. The ERT recommends that Norway provide the information for the entire time series in the NIR and the CRF.

Waste-water handling – CH_4

89. The NIR should state clearly that commercial waste water includes breweries, dairies and slaughterhouses but industrial waste water from industries with their own waste-water treatment is not included. It is not clear from the NIR how the commercial emissions are calculated since the default method and biochemical oxygen demand (BOD) levels are not provided. The ERT recommends that a more detailed description be provided for methane from commercial waste water.

Waste-water handling – N_2O

90. The methodology is not described in detail in the NIR. Norway provided an improved explanation in response to a question from the ERT. The ERT recommends that Norway provide this more detailed methodology, along with the time series of AD and a justification of the applicability of the EFs used, in its next submission.

91. The ERT recommends that the reason for the recalculations be explained (perhaps a correction to data, the availability of new data, or a change of methodology).

Waste incineration – CO_2, CH_4, N_2O

92. Activity data are only provided for the years 1990, 1998–2002. The ERT recommends that Norway provide the information for the entire time series in the NIR and the CRF.

93. The source of the gas flared is unclear. The ERT recommends clarification in the NIR.

94. There is no documentation of the CO_2, CH_4 and N_2O emission factors. The ERT suggests that the Party include a description of the way in which the EFs have been developed in its NIR.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

2003 and 2004 Inventory submissions of Norway. 2004 submission including a set of CRF tables for 1990 and 1998–2002, and an NIR.

UNFCCC secretariat (2004). "Report of the individual review of the greenhouse gas inventory of Norway submitted in the year 2003 (Desk review)". FCCC/WEB/IRI(1)/2003/ (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/pdf/nordeskrev03.pdf>).

UNFCCC secretariat. "2004 Status report for Norway" (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/nor04.pdf>).

UNFCCC secretariat. "Synthesis and assessment report of the greenhouse gas inventories submitted in 2004. Part I": FCCC/WEB/SAI/2004 (available on the secretariat web site <http://unfccc.int/resource/webdocs/sai/2004.pdf>) and Part II – the section on *Norway* (unpublished).

UNFCCC secretariat. Review findings for Norway (unpublished).

Norway's comments on the draft "Synthesis and assessment report of the greenhouse gas inventories submitted in 2004" (unpublished).

UNFCCC secretariat. "Handbook for review of national GHG inventories". Draft 2004 (unpublished).

UNFCCC secretariat. "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories", "Part II: UNFCCC reporting guidelines on national communications" and "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/1999/7 (available on the secretariat web site <http://www.unfccc.int/resource/docs/cop5/07.pdf>).

UNFCCC secretariat. "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC Reporting guidelines on annual inventories" and "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/2002/8 (available on the secretariat web site <http://unfccc.int/resource/docs/cop8/08.pdf>).

UNFCCC secretariat. Database search tool – *Locator* (unpublished).

IPCC. *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000* (available on the following web site: <http://www.ipcc-nggip.iges.or.jp/public/gp/gpgaum.htm>).

IPCC/OECD/IEA. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, volumes 1–3, 1997* (available on the following web site: <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>).

B. Additional materials

Responses to questions during the review were received from Mr. Eilev Gjerald (The Norwegian Pollution Control Authority (SFT)), including additional material on the methodology and assumptions used.

Lunnan et al. (1991). Skog og skogproduksjon i Norge som virkemiddel mot CO_2-opphoping i atmosfæren. Skogforsk 6.

NIJOS (2000). Skog 2000: statistikk over skogforhold og -ressurser i Norge (Statistics of forest conditions and resources in Norway). Ås: National Institute of Land Inventory.

Schøning, P. (1992). Ressursregnskap for skog 1987–1991 : dokumentasjon av metode og resultater (Resource accounts for forestry 1987–1991: Documentation of method and results). Internal notes 92/15, Oslo: Statistics Norway.

SFT (1990). Klimagassregnskap for Norge. Beskrivelse av utslippsmengder, drivhusstyrke og utslippsfaktorer. Bidrag til den interdepartementale klimautredningen. (Greenhouse gas inventory for Norway. Emissions figures, global warming potentials and emission factors. Contribution to the interministerial climate report). SFT report.

SFT/SN (2000). *The Norwegian Emission Inventory*. Documentation of methodology and data for estimating emissions of greenhouse gases and long-range transboundary air pollutants. Ketil Flugsrud, Eilev Gjerald, Gisle Haakonsen, Sigurd Holtskog, Henning Høie, Kristin Rypdal, Bente Tornsjø and Fredrik Weidemann. Statistics Norway/ Norwegian Pollution Control Authority. SN report 2000:1.

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