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Report of the individual review of the greenhouse gas inventory of Norway submitted in 2005*

* In the symbol for this document, 2005 refers to the year in which the inventory was submitted, and not to the year of publication.

CONTENTS

I. Overview

A. Introduction

1. This report covers the centralized review of the 2005 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. The review took place from 3 to 8 October 2005 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalist – Ms. Ruta Bubniene (Lithuania) and Ms. Anke Herold (European Community); Energy – Mr. Leif Hockstad (USA), Mr. Steven Oliver (Australia) and Mr. Michael Strogies (Germany); Industrial Processes – Ms. Ionela Draghici (Romania), Ms. Sonia Petrie (New Zealand), and Mr. Kiyoto Tanabe (Japan); Agriculture – Mr. Erda Lin (China) and Mr. Marcelo Rocha (Brazil); Land Use, Land-use Change and Forestry (LULUCF) – Mr. Jozef Mindas (Slovakia) and Mr. Justin Ford-Robertson (New Zealand); Waste – Mr. Ayite-Lo Ajavon (Togo) and Ms. Anke Herold. Mr. Ayite-Lo Ajavon and Ms. Anke Herold were the lead reviewers. The review was coordinated by Ms. Rocio Lichte (UNFCCC secretariat).

2. In accordance with the "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention", a draft version of this report was communicated to the Government of 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 2005 submission, Norway has submitted a complete set of common reporting format (CRF) tables for the years 1990–2003 and a national inventory report (NIR). The full list of materials used during the review is provided in the annex to this report.

C. Emission profiles and trends

4. In 2003, the most important GHG in Norway was carbon dioxide (CO_2), contributing 78.9 per cent of total[1] national GHG emissions expressed in CO_2 equivalent, followed by nitrous oxide (N_2O), 9.8 per cent, and methane (CH_4), 9.3 per cent. The fluorinated gases (F-gases) taken together contributed 2.1 per cent of the overall GHG emissions in the country. The Energy sector accounted for 71.5 per cent of total GHG emissions, followed by Industrial Processes (15.9 per cent), Agriculture (8.2) per cent and Waste (4.0 per cent). Total GHG emissions in 2003 amounted to 54,779 Gg CO_2 equivalent and increased by 9.3 per cent from 1990 to 2003.

D. Key categories

5. Norway reports a key category analysis mostly using tier 2 analysis, including LULUCF, both level and trend assessment, as part of its 2005 submission. The key category analysis performed by the Party and the secretariat[2] used different aggregation levels and produced slightly different results. The

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

[2] The secretariat identified, for each Party, those source categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the Intergovernmental Panel on Climate Change *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Key categories according to the tier 1 trend assessment were also identified for those Parties that provided a full set of CRF tables for the year 1990. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key-category assessment conducted by the secretariat.

Party identified 24 key categories, whereas the secretariat identified a total of 26 (taking into account both the level and the trend assessment). The categories Manure Management and Other Transportation were only identified as key by the UNFCCC secretariat. Using qualitative criteria, Norway identified fugitive emissions from coal mining and handling as key since the emission factors (EFs) used are lower than the default EF, and CO_2 capture and storage was identified as key as no methodology is available yet.

E. Main findings

6. In general, both the NIR and the CRF are largely complete and transparent. The inventory includes information on key categories, methods, data sources, EFs used, uncertainty estimates and quality assurance/quality control (QA/QC) procedures, and contains most of the relevant information needed for replication of the inventory. The methodologies for estimating GHG emissions are largely consistent with the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) and the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance). The transparency of the reporting has improved compared with previous inventory submissions; however, a number of areas remain where further information should be provided, as indicated in the sectoral sections below. Some important issues, such as improved estimation for CH_4 from enteric fermentation from cattle, remain unresolved after a number of reviews. In its response to the review, Norway indicated that the 2006 inventory submission would contain an estimation of CH_4 from enteric fermentation according to a tier 2 method.

F. Cross-cutting topics

1. Completeness

7. Norway has provided largely complete GHG emissions inventory data for the years 1990–2003. It has reported estimates of emissions and removals from LULUCF for the whole time series using the CRF tables for LULUCF, as required by decision 13/CP.9. The geographical coverage is complete; minor gaps in sectoral coverage are noted by the Party and explained in the NIR. The use of notation keys has been improved, although there are cases where the notation keys are not explained either in the documentation box or in CRF table 9.

2. Transparency

8. The NIR provides extensive explanations on the methodology of the GHG inventory. The NIR and the CRF are largely transparent, with some specific areas for improvement as identified in the sectoral sections.

3. Recalculations and time-series consistency

9. The expert review team (ERT) noted that recalculations reported by the Party of the time series 1990–2002 had been undertaken to take into account improved methods, revised EFs, updated activity data (AD) or new emission sources. The major changes include the following improvements: the inclusion of plant-specific data in the Energy and Industrial Processes sectors, the increased coverage of some sources, the inclusion of new sources (emissions of SF_6 from production of medium voltage switches and N_2O from propellant gas, drag racing and research), the improvement of an estimation model for N_2O in the Agriculture sector, new sources of AD, and a revision of the model used for estimating CH_4 from solid waste disposal. The recalculations are mostly transparently reported and justified, except for those that are discussed separately in the sectoral sections below. The recalculations resulted in a decrease in the estimates of total base year (1990) emissions (without LULUCF) by 3.8 per cent, and the estimates of total national emissions for 2002 decreased by 3.3 per cent.

4. Uncertainties

10. The Party has performed a tier 1 and a tier 2 uncertainty assessment; however, the uncertainty assessment has not been updated for three years. The Party is planning an update for its next inventory submission. Norway included the LULUCF sector in the uncertainty estimation. The NIR discusses planned improvements and uncertainty analysis within each category, indicating that the results of the uncertainty analysis are being considered in prioritizing improvements to the inventory. In its response to the review, Norway indicated that it would include an updated uncertainty assessment in its 2006 inventory submission.

5. Verification and quality assurance/quality control approaches

11. The country follows QA/QC procedures, including general and source-specific QC procedures, in preparing the GHG inventory. Norway intends to formalize its QA/QC system and to establish an inventory improvement plan in 2005. The ERT encourages this and suggests that Norway include this plan in its next inventory submission. In a number of source categories, Norway uses plant-specific emissions data reported directly to the authorities. Further information should be provided about how this plant-specific information is quality-checked. In its response to the review, Norway indicated that it would include the requested information and documentation on the national system in its 2006 inventory submission.

6. Follow-up to previous reviews

12. Norway has made many improvements to cross-cutting areas previously suggested by reviews, such as the reporting of a complete time series of CRF tables, including recalculation tables, improved use of the notation keys, more extended descriptions of methodologies, implementation of the *IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry* (hereinafter referred to as IPCC good practice guidance for LULUCF), and an improved description of the emissions and removals from CO_2 capture and storage. The formalization of a QA/QC plan has been started and the plan will be described in Norway's 2006 submission. The previously recommended upgrade to a tier 2 method for enteric fermentation has not yet been implemented.

G. Areas for further improvement

1. Identified by the Party

13. The NIR identifies several areas for improvement:

(a) The elaboration of an inventory improvement plan;

(b) The formalization of the QA/QC system;

(c) Examination of the differences between the reference approach and the sectoral approach in the Energy sector;

(d) The updating of the N_2O EF for road transport;

(e) The updating of calculations of emissions from consumption of halocarbons and SF_6;

(f) Improvements of the national forest inventory and the establishment of permanent sampling plots;

(g) The elimination of double counting of N_2O emissions reported both under Agriculture (fertilizer sold in Norway) and under LULUCF, as part of the fertilizer sold is used on forest land.

2. Identified by the ERT

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

(a) Improve the transparency of the description of the differences between the reference and the sectoral approach including with regard to the linkage to the national energy balance, and on some source categories in the Industrial Processes sector (e.g. 2.F Consumption of Halocarbons and SF_6);

(b) Increase the transparency of its reporting of CO_2 capture and storage by integrating more detail from key reports into the NIR in a separate annex;

(c) Reconsider the reference approach estimation of feedstocks and non-energy use of fuels based on the recommendations provided in the Energy sector;

(d) Describe the QA/QC activities performed to verify the quality of emissions data reported by companies;

(e) Use a higher-tier method for the key category CH_4 from enteric fermentation from cattle as has been indicated in several reviews;

(f) Provide more information on the sources of uncertainty estimates provided in the NIR.

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

II. Energy

A. Sector overview

16. The Energy sector is the largest source of GHG emissions in Norway, accounting for 71.5 per cent of total national emissions in 2003, when they amounted to 39,173 Gg CO_2 equivalent. The sector shows an increase of 9,888 Gg CO_2 equivalent, or 34 per cent, from the base year (1990) to 2003. Within the Energy sector, the largest contributions in 2003 arose from transport (37 per cent) and the energy industries (33 per cent). Major source categories include road transportation and offshore gas turbines, as well as coastal navigation. Fugitive emissions are also accounted for in this sector, and include substantial emissions arising from the production and extraction of oil and natural gas (9 per cent of total Energy sector emissions), as well as coal, to a lesser extent.

17. The reporting of the Energy sector is generally complete, consistent and comparable. Norway mostly uses country-specific EFs. For some fuels, EFs for the complete time series have been provided, while for others only one value is provided in the NIR. The references for many of the EF tables do not cite a specific reference (e.g., stating "Source: SFT " when 13 different SFT (Norwegian Pollution Control Authority) documents are listed in the references chapter). However, Norway has continued to improve its description of the methodologies used and the sources of AD compared with previous submissions. The ERT continues to encourage Norway to further improve the transparency of the NIR by providing time-series data for all country-specific EFs, as well as providing the detailed reference for each country-specific EF.

18. The ERT noted that recalculations made by Norway in the 2005 submission have resulted in an increase of the estimates for the Energy sector for the year 1990 and a decrease for the latest recalculated inventory year (i.e. 2002) compared with previous submissions. This is primarily due to recalculations in 1.A.2.a Manufacturing Industries and Construction – Iron and Steel and 1.A.2.c Chemicals. In response to questions raised during the review Norway stated that some of the plant-specific emissions have been

recalculated, based on the results of uncertainty analyses carried out by the plants concerned. While the ERT acknowledges Norway's apparent improvement to these emission estimates, it also encourages Norway to provide more details in future submissions justifying and explaining its recalculations and their effect on the time-series trend.

B. Reference and sectoral approaches

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

19. Norway has calculated CO_2 emissions from fossil fuel combustion using the reference approach for 1990 and 1998–2003 only. For the year 2003, there are differences of 11 per cent in the CO_2 emission estimates and of 6 per cent in the fuel consumption estimates between the reference approach and the sectoral approach. In response to questions from the ERT, Norway stated that the reference approach gives inaccurate emission estimates for Norway compared to the sectoral approach. Norway further stated that the deviation between the two approaches is mainly due to the large production and exports of oil and gas in Norway compared to the national consumption of oil and gas. Even small errors in e.g. the AD and the CO_2 EFs related to production and export of crude oil and natural gas can amount to large discrepancies in the national total emissions when the reference approach is used. The ERT continues to encourage Norway to explain the reasons for the differences between the two approaches in greater detail.

20. Norway provides energy balance tables in the annexes to the NIR. In response to questions from the ERT on differences between the energy balance sheets and CRF tables, Norway explained that the inclusion of the energy balance in the NIR is meant to supplement the CRF tables. The ERT encourages Norway to clarify this issue further, as mentioned above, in the context of its discussion of the more accurate calculation methods used in the sectoral approach.

2. International bunker fuels

21. Norway provides a description of its calculation of bunker fuels in the NIR (chapter 3.18). The explanation is a short but sufficient description of the calculation of aviation bunker fuels. The transparency of the NIR should be improved by the addition of a similar description for the calculation of marine bunker fuels.

3. Feedstocks and non-energy use of fuels

22. Norway enters feedstock and non-energy use of fuels data in CRF table 1.A.(d), but does not provide comparable information in the energy balances presented in the NIR. The ERT had difficulty reconciling the data in the CRF tables with the data in the NIR, especially for liquid fossil fuels (the totals in the CRF tables are much higher than the non-energy-use numbers provided for petroleum products in the energy balances). The ERT encourages Norway to further explain the reference approach calculation, as well as these differences in liquid fuels.

23. For the reference approach, Norway applies a storage factor of 100 per cent for feedstocks and non-energy uses of fuels. However, not all feedstocks and non-energy uses will exhibit total storage of carbon, so it appears, upon further examination of the NIR text, that this approach was taken by Norway as a "correction factor" (the terminology used in the NIR) to reduce the differences in CO_2 emissions between the reference approach and the sectoral approach. The ERT recommends that Norway examine this issue further and use the Revised 1996 IPCC Guidelines values for carbon stored, as well as accounting consistently for the carbon in feedstocks used in the Industrial Processes sector. This is especially relevant given the large effect of the non-energy use of fuels (namely production and exports) on Norway's inventory. In its response to the review, Norway indicated that it would use the same storage factors for the reference approach as for the sectoral approach in its 2006 submission.

4. Country-specific issues

24. Norway indicates in its NIR that the N_2O EFs for road transportation in the national emissions inventory are too high when compared to those of other European countries, and that a project has been scheduled aiming to update these EFs. The NIR states that the project will be completed in time for the 2006 submission.

25. Additionally, Norway intends to examine more closely the energy balance figures reported to the International Energy Agency (IEA) and those estimated by Statistics Norway.

C. Key categories

1. Manufacturing industries and construction

26. The transparency of the NIR, especially the section describing 1.A.2 Manufacturing Industries and Construction, could be greatly improved. The NIR indicates that from 1998 onwards surveys of the manufacturing industries provide detailed data for these sources. The ERT recommends that the pre-1998 methodology and data sources should be described in more detail to enable assessment of time series consistency.

27. In addition, the Recalculations section of the NIR for this source category could be improved. Examples include describing how, in 1.A.2.a Manufacturing Industries and Construction – Iron and Steel, emissions for the two plants have been recalculated, and explaining that CO_2 from "CO-gas" is now reported under non-combustion emissions, and describing how, in 1.A.2.c Manufacturing Industries and Construction – Chemicals, CO_2 emissions data for all the years reported (1990–2003) have replaced previous emissions calculations based on EFs and AD. Norway provided further explanations and details to the ERT regarding these examples, but the ERT recommends that such information should generally be provided in greater detail in the NIR. In its response to the review, Norway indicated that it aims to increase transparency in this area for the 2006 inventory submission.

2. Road Transportation: liquid – CO_2, N_2O

28. Norway verified the allocation of fuels to the different source categories from road transport in the years 1993 and 1999 using both a top–down and a bottom–up approach. The results for gasoline appear acceptable (a <5 per cent difference between the two approaches), but the results for diesel do not appear to be in agreement. The top–down consumption is 40 per cent higher than the modeled bottom–up approach, which may indicate a potential for improvement of the diesel allocation in the top–down approach to subcategories such as road traffic or off-road (e.g. based on mileage). However, the model assumption does not affect the total estimates for CO_2 from road transport, but could have a small effect on N_2O emissions. The ERT recommends that Norway consider an improvement of the top–down approach based on the results of the comparison between the top-down with the bottom–up approach.

29. The EFs used for road transportation are derived from several studies to ensure the use of the most accurate values for the modelled and detailed estimates. However, the studies referenced were mainly published in the mid-1990s. To provide greater transparency it should be explained in more detail how legislation during the last 10 years for road transport has been taken into account in developing the EFs for N_2O, as well as those for CH_4. The ERT recommends that Norway provide more information on the actual modification of the EFs. In its response to the review, Norway indicated that the calculation of N_2O and CH_4 from road vehicles has been updated for the 2006 submission.

3. Fugitive emissions from coal mining – CH_4

30. Fugitive emissions from coal mining are estimated using a tier 2 methodology and a country-specific EF.

31. Coal mining AD are reported as saleable production rather than raw coal production. In responding to the review Norway explained that raw coal production data were not available, but that efforts would be made to find data sources for raw coal production. The ERT encourages Norway to approach producers to supply data on raw coal production activity which would be expected to correlate more closely with emissions.

4. Fugitive emissions from oil – CH_4

32. Fugitive emissions from this sector are estimated using field-specific EFs and reported emissions data. For Oil Refining/Storage, 0.1 Gg CH_4 is reported for all years. Norway has indicated that it will consider including new facility measurement data in its next NIR. The ERT encourages Norway to pursue this approach.

5. Fugitive emissions from venting and flaring – CO_2, CH_4

33. Fugitive emissions from this sector are estimated using field/equipment-specific EFs and reported emissions data. Generally good descriptions of AD QA/QC and verification are given.

34. EFs for flaring are provided; however, incomplete referencing makes it difficult to identify the relevant documents in the reference list. In its response to the review, Norway explained that emissions from venting offshore are based on reported emissions from each field and emissions from most oil and gas fields are mostly based upon field-specific EFs. The NIR however largely details the default EFs which are only used when field specific factors are not available. The ERT encourages Norway to improve the transparency of the description in the NIR.

35. For CO_2 capture and storage, the ERT welcomes the increased level of detail and discussion provided in the NIR, and encourages Norway to continue improving this aspect. However, descriptions are provided in general terms only, and more detail would assist transparency. Specific areas where a more detailed discussion would be beneficial are: the nature and characteristics of the storage site/reservoir (including discussion of any potential sources of leakage); the leakage monitoring system (it is noted that Norway expects more information in the next year); and injected CO_2 behaviour in the reservoir (a description is provided, referring to images and data from reports in general terms). Overall, increased transparency for CO_2 capture and storage could be achieved by integrating greater detail from key reports into the NIR, perhaps by providing a separate annex to the NIR. In its response to the review, Norway indicated that the 2006 submission will include more details on the Utsira reservoir.

D. Non-key categories

1. Civil aviation

36. For civil aviation emissions, Norway has based its estimates on surveys for the years 1989, 1995 and 2001. In a response to a question from the ERT about the interpolation of these data, Norway stated that EFs have usually not been interpolated, whereas AD have been interpolated. As the surveys are the source for EFs, Norway has kept the factors unchanged in the period between the surveys. It stated that this practice should be reconsidered, which the ERT encourages Norway to do. In its response to the review, Norway indicated that in its 2006 submission EFs will be interpolated between 1989, 1995 and 2001.

37. Additionally, in the Civil Aviation section, the NIR refers to studies which indicate that the value for the IPCC default EF for CH_4 from cruise traffic is too high and that a different value was used. Norway provided the reference for these studies to the ERT in response to questioning, and the ERT recommends that Norway provide this reference in its next NIR.

2. Fugitive emissions from natural gas

38. It is unclear where emissions from the transmission/distribution of natural gas are reported. The notation key "included elsewhere" ("IE") is used, but the relevant details are not provided in CRF table 9. In its response to the review, Norway indicated that it will improve transparency in the 2006 inventory submission.

III. Industrial Processes and Solvent and Other Product Use

A. Sector overview

39. In 2003 the Industrial Processes and Solvent and Other Product Use sectors taken together accounted for 16.2 per cent of Norway's total GHG emissions. CO_2 represented 67 per cent of the sector's emissions (predominantly from ferroalloy and aluminium production). N_2O from nitric acid production contributed 20 per cent and actual emissions from F-gases 13 per cent. From 1990 to 2003 emissions from this sector decreased by 35 per cent, mainly because of decreases in PFC emissions from aluminium production (by 79 per cent) and SF_6 from magnesium production (by 92 per cent). Both actual and potential F-gas estimates are reported.

40. The ERT noted an inconsistency within the NIR: in chapter 1 Norway mentions that ammonia production was not identified as a key category, whereas in chapter 4 (in Table 47) it is listed as one. The ERT recommends that Norway correct this inconsistency.

41. Estimates are provided for most categories and all years of the time series, using notation keys where required. However, for the category Consumption of Halocarbons and SF_6 in the year 2003, no AD and related information or detailed emissions data have been provided in CRF table 2(II)F (except for SF_6 from electrical equipment) to support the estimates reported for this category. The ERT encourages Norway to provide the necessary underlying data or use notation keys, including explanatory information, in the documentation boxes, as appropriate.

B. Key categories

1. Cement production – CO_2

42. The ERT welcomes the improvements made to the description of methodology for this source in the NIR. Norway is encouraged to further improve the transparency of the NIR by including descriptions of the types of cement produced in Norway, the percentage of lime present in the clinker and the cement kiln dust correction factor used in the calculations. The ERT welcomes Norway's intention to recalculate the complete time series in its next submission using emissions data supplied directly by plants.

2. Nitric acid production – N_2O

43. In the previous (2004) review report the ERT recommended Norway to describe the QA/QC activities performed to verify the quality of the emissions data reported by the companies. Source-specific QC procedures undertaken are explained in general terms in section 1.6.4 of the NIR, but detailed information on this particular source category is not provided. In its response to the review, Norway indicated that it would give a more complete description of the source-specific QA/QC procedures in its 2006 submission.

3. Ferroalloys production – CO_2

44. The implied emission factor (IEF) shown in the CRF is lower than the EFs listed in the NIR. In its response to the review this year, Norway explained that this was due to the subtraction of carbon (C) contained in the carbon monoxide (CO) produced that was sold to other industries or district heating

plants for energy purposes. (Those carbon emissions were reported in the Energy sector under 1.A. Fuel Consumption) The ERT recommends that Norway include this explanation for the lower IEF and to explain adequately in its next submission where in the Energy sector the carbon from the CO is reported.

45. CO_2 emissions from this source have decreased by 14 per cent since 1990. Norway explains in the NIR that this is due to reduced activity in the sector and that plants have been closed. In the same period, the IEF decreased by 20 per cent. However, the NIR does not contain information that would explain this decrease. During the review, Norway explained that this is caused by an increase in the relative share of bio-carbon used as a reducing agent in this period. The ERT found this explanation satisfactory and recommends that Norway include it in its next NIR.

4. Aluminium production – PFCs

46. Since 1990, there has been a very large decrease in both PFC emissions from Aluminium Production (by 79 per cent) and the corresponding IEFs. The NIR explains that the decrease is caused by changes in technology that have resulted in large reductions in emissions and improvements in production efficiency. The ERT welcomes Norway's intention, as expressed during the review, to include in its next NIR a further explanation for this decrease, including the underlying data.

47. As mentioned in the previous review report, the country-specific ratio of tetrafluoromethane (CF_4) to hexafluoroethane (C_2F_6) is higher than the IPCC default and the highest of reporting Parties. This could result in the emission estimates for C_2F_6 being too low. The country-specific method used to determine this ratio is described in the NIR, but the ERT considered that it was not yet transparent enough to justify the use of this ratio. During the review Norway provided further details on the results from measurements undertaken at Norwegian plants and indicated that it would reconsider this ratio. Norway also indicated that the method for calculating PFCs from aluminium production is under revision and that its results would be reported in its 2006 inventory submission. The ERT encourages Norway to implement these improvements and to provide in the next NIR more detailed information on the results from measurements, including clear references to the underlying reports.

48. The ERT noted that the recommendation made in the previous review report, that Norway should include in the NIR a table describing the various technologies employed in aluminium production over the period 1990–2003, has not been addressed. The ERT encourages Norway to include such a table in its next submission.

5. Consumption of halocarbons and SF_6 – HFCs

49. There is a large decrease in HFC emissions from 2002 to 2003. Norway explained that this was the result of the introduction of new legislation on F-gases which brought in a tax on imports.

50. As noted in the previous review, the method used to quantify these emissions and the country-specific parameters are not described transparently in the NIR. Norway is encouraged to document the method and the input data for the model used to estimate HFCs, by both source category and individual gas. In its response to the review, Norway indicated that an improved method would be used and documented in the 2006 inventory submission.

C. Non-key categories

Ammonia production – CO_2

51. Norway accounts for capture of CO_2 which is then used in the food and beverage industry (the emissions are reported under 2.D.2 Food and Drink). Some of this captured CO_2 is, however, exported to other countries, and the emissions from these exports are excluded from Norway's inventory. Norway mentions that it is the responsibility of the importing countries to account for these emissions. However,

the Revised 1996 IPCC Guidelines state that "the CO_2 from Ammonia Production may be used for producing urea or dry ice. This carbon will only be stored for a short time. Therefore, no account should consequently be taken for intermediate binding of CO_2 in downstream manufacturing processes and products". CO_2 use in the food and drink industry seems to be a similar form of short-term storage in products, and thus comparable to dry ice or urea production. In addition, there is no obligation to report CO_2 emissions from food and drink (see table 2-1 of the Revised 1996 IPCC Guidelines) for importers. The ERT therefore urges Norway to include also the exported CO_2 which was captured from this source in its national total. The ERT considers that CO_2 emissions captured from ammonia production should preferably be reported in their entirety under this source category. However, if Norway chooses to report them under category 2.D.2 Food and Drink, this should be clearly explained in the documentation box in the respective tables of the CRF as well as in the NIR in Norway's next submission.

IV. Agriculture

A. Sector overview

52. In 2003 the Agriculture sector emitted 4,496 Gg CO_2 equivalent, accounting for 8.2 per cent of total national emissions. Emissions from the sector have been relatively stable since 1990, with a small decrease of 2 per cent (a decrease of 2.1 per cent of CH_4 emissions and a decrease of 2.2 per cent of N_2O emissions). The trend from 2002 to 2003 shows an increase of 2 per cent. Agricultural soils account for 53 per cent of the emissions of the sector, followed by enteric fermentation with 37 per cent and manure management with 10 per cent.

53. There are significant differences between the AD used for sheep and swine between the Norwegian inventory and the Food and Agriculture Organization of the United Nations (FAO) values. These differences are explained and justified in the NIR. Recalculations have been done due to a correction regarding transformation of N_2O to volatile ammonia (NH_3) and to corrections of the percentage distribution between different storage systems for manure and grazing to better reflect Norwegian conditions.

B. Key categories

1. Enteric fermentation – CH_4

54. Norway uses a tier 1 method for this key category. It recognizes the need to apply tier 2 for dairy and non-dairy cattle, as recommended by previous reviews, but has not provided any detailed information about the plans to move to tier 2. The average milk yield is still not reported in the NIR. If 4,860 kg/head/yr is still used for this parameter, emissions could still be underestimated. Regarding the uncertainties of this source (±5–10 for the AD and ±25 for the EF), no specific information is provided in the NIR. As already recommended in previous reviews, Norway should move to a higher-tier method and give more information in the NIR regarding the estimation parameters and the uncertainty estimation. In its response to the review, Norway indicated that the 2006 inventory submission will contain an estimation of CH_4 from enteric fermentation from dairy and non-dairy cattle as well as sheep using a tier 2 method.

2. Agricultural soils – N_2O

55. The previous review recommended that the assumption that the amount of nitrogen (N) in crop residues is equal to the total amount of N in harvest should be reconsidered using the default method. This has not yet been done and the ERT still recommends that Norway improve the method and parameters used in the estimation of N_2O emissions from crop residues. In its response to the review, Norway indicated that improvements to the methodology for estimating N_2O emissions from crop residues are under preparation and will be reported in the 2006 inventory submission.

56. For N_2O from cultivation of organic soils, the ERT recommends that Norway provide more detailed information as to how loss of C is treated in the model, as the input data for total organic soils area seem to be rough estimates. The NIR should also indicate whether this part of the estimation is verified using field measurements.

57. The country-specific value for nitrogen lost due to leaching and surface run-off ($Frac_{LEACH}$) is 18 per cent, and thus much lower than the IPCC default value of 30 per cent. In its response to the review, Norway explained that this value (18 per cent) is calculated from an estimated average of N-leaching for the country on 33 kg N/hectare. It is estimated based on measures of N-leaching in 12 small watershed areas, and expresses the discharge to nearest surface water recipient. The areas are chosen in such a way that together they make a representative selection of Norwegian farming with regard to farming practices, geographical localization and climate and soil conditions. These parameters are monitored closely in these 12 watershed areas.

58. Part of the amount of fertilizer used is applied on forest land and is also reported under LULUCF. During the review Norway indicated that it would remove this double counting in its 2006 inventory submission.

C. Non-key categories

Manure management – CH_4, N_2O

59. Norway reports in the NIR that emissions from manure management decreased by 5 per cent over the period 1990–2003, due in particular to a decrease in emissions from animal waste management systems (AWMS), but the data in the CRF emissions show an increase of 4.2 per cent over that period. According to a response given by Norway during the review, the statement in the NIR is incorrect. The ERT recommends that the NIR be corrected.

60. A tier 2 method with country-specific EFs is applied. More information could be given in order to improve transparency and to explain differences between country-specific parameters and the IPCC default parameters, especially regarding the NH_3 model. According to the response given by Norway during the review, it intends to provide more information in the next NIR.

V. Land Use, Land-use Change and Forestry

A. Sector overview

61. Norway has submitted data for LULUCF using the CRF tables for LULUCF as required by decision 13/CP.9 and has followed the IPCC good practice guidance for LULUCF. Norway notes that the data are considered preliminary since this is the first time it has used the new methods and categories, and it anticipates improvements in the methodologies.

62. In 2003 total net removals by the LULUCF sector amounted to 20,941 Gg CO_2 equivalent (corresponding to 38 per cent of total national GHG emissions (54,779 Gg CO_2 equivalent)) for that year. Living biomass in forests dominates this sector and is considered to have a relatively high accuracy.

63. Net CO_2 removals increased by 56 per cent from 1990 (13,427 Gg CO_2 equivalent) to 2003. This included a 53.6 per cent increase from 1996 to 1997 which resulted from incorporating the results of an updated national forest inventory. Average annual net removals in the sector increased from approximately 13,500 Gg CO_2 for the period 1990–1996 to around 21,000 Gg for 1997–2003. The ERT noted that Norway plans to interpolate between the different forest inventory data sets in order to smooth out the abrupt change in biomass stocks.

64. Mandatory CO_2 categories that appear not to be reported include: 5.A.2 Lands Converted to Forest Land, 5.D.2 Lands Converted to Wetlands and 5.F.2 Lands Converted to Other Land. In some cases this may be due to inappropriate use of the notation keys or lack of explanation. The ERT encourages Norway to review the use of the notation keys and to complete CRF table 9 for the LULUCF sector. More extensive use of the documentation boxes (in English) could also improve clarity. In its response to the review, Norway indicated that the use of notation keys and related information will be improved in its 2006 submission.

65. The whole time series has been recalculated as a result of the new IPCC good practice guidance for LULUCF. In its previous (2004) submission, Norway reported net removals of 9,538 Gg CO_2 equivalent for 1990 (71 per cent of the value in the current submission) and 19,920 for 2002 (95 per cent of the value in the current submission). It is unclear whether these changes in net removals compared to the previous submission are attributable to only the results of the application of the IPCC good practice guidance for LULUCF or also to improvements in national data and methods. In its response to the review, Norway explained that the increase in emission levels compared to last years' submission is due to development of calculation methods and updating of calculation parameters and AD. The ERT encourages Norway to provide information on the impacts of their recalculation in the NIR.

66. The key categories vary slightly between the tier 1 and tier 2 analyses (level and trend) but in each case the three components of Forest Land Remaining Forest Land (biomass, dead organic matter and soils) are among the top categories. Soils under Grassland Remaining Grassland also feature in both analyses. The ERT encourages Norway to include information on the LULUCF sector in the CRF table on key categories.

67. Norway applies tier 3 methods for the pools biomass, dead organic matter and soils under the category Forest Land Remaining Forest Land. The ERT encourages Norway to provide this information in the corresponding table of the CRF. In its response to the review, Norway explained that its estimation of carbon stock changes in soil organic matter, litter and deadwood is based on a model for forest soils and provided references to that model. Norway further indicated that additional documentation would be included in its 2006 inventory submission.

68. No formal uncertainty analysis has been done, but uncertainty estimates are provided and a brief explanation how they have been estimated was given to the ERT during the review. The ERT encourages Norway to clarify in the NIR how these estimates have been derived.

69. Norway has noted that it is working on the development of QA/QC procedures for LULUCF.

70. The ERT considered the figures provided to be very helpful, including pie charts of land use (figure 23), graphs showing changes over time series (figure 30), and graphs of emissions/removals in all LULUCF categories (figure 29).

71. Norway has reported a large area under Other Land (60 per cent of total land area) but no corresponding emissions or removals estimates are provided. The ERT recognises that emissions/removals estimates do not have to be reported for the category Other Land remaining Other Land, but given the significant area involved, the ERT encourages Norway to confirm the extent of this land category, and other non-forest land-use categories. In response to the review, Norway informed the ERT that a project to confirm land use classifications of the borders of this area is under consideration.

B. Sink and source categories

1. Forest land – CO_2 and N_2O

72. Norway does not provide separate estimates for C stock increases and decreases, but explains that the increase in net emissions is a result of a continued increase in standing volume and gross increment,

while the amount of CO_2 emissions due to harvesting and natural losses has been quite stable. The ERT suggests that this information could be used to separate emissions from removals (increases and decreases in stocks) in CRF table 5.A. In its response to the review, Norway indicated that separate calculations of emissions and removals (increases and decreases in carbon stocks) will be considered for the 2006 inventory submission.

73. Norway is aware that N_2O emissions from the use of synthetic fertilizer on forest land have been included twice in the inventory (i.e. they are already accounted for in the Agriculture sector) and notes that this will be corrected in the next NIR.

2. Agriculture lime application – CO_2

74. Norway reports CO_2 from lime application to lakes and rivers (under category 5.G Other), using the same EF as that applied to cropland, as all lime is assumed to emit CO_2 according to information provided by Norway during the review. The ERT recommends that Norway provide additional information in the NIR to support the use of the agriculture EF for the application of lime to water.

VI. Waste

A. Sector overview

75. In 2003 the Waste sector contributed approximately 4.0 per cent of total national GHG emissions in Norway. CH_4 from landfills was the most important GHG emitted in the sector, contributing 92.5 per cent to the total sectoral emissions. From 1990 to 2003 emissions in the sector decreased by 14 per cent. The NIR does not explain this declining trend, but states that emissions are relatively stable. The ERT recommends that Norway reconsider the information provided on the emissions trend for the Waste sector. In its response to the review, Norway explained that the decreasing trend is mostly due to a decrease in emissions from solid waste disposals as a result of increased methane recovery and reduced amounts of waste disposed at landfills.

76. Source-specific QA/QC procedures are only performed for 6.A Solid Waste Disposal on Land, not for 6.B Wastewater Handling. No information is provided as to how uncertainty estimates for the Waste categories were derived. In particular, for the revised model for solid waste disposal, more information should be added on how the uncertainty estimation was performed.

B. Key categories

Managed waste disposal on land – CH_4

77. Norway has reviewed and updated the model for calculating CH_4 emissions from landfills, and this has resulted in major recalculations for this source category and a reduction in the estimates of CH_4 emissions by 35.4 per cent for 1990 and 45.7 per cent for 2002.

78. The description of the methodological approach and the data and parameters used have improved considerably and the NIR contains detailed information on the approach and justification for most parameters used in the model. The quantitative impacts of all changes applied are described in detail.

79. Norway uses three different values for the life-times which describe the time taken for degradable organic carbon (DOC) to decay to half its initial mass: 2.8 years for food waste, 8.4 years for paper and 10.5 years for wood and textiles. The Revised 1996 IPCC Guidelines provide a default half-life of 23 years for wood and paper in dry site conditions and the average default half-life for municipal solid waste (MSW) suggested is 14 years. As Norway has assumed a more rapid decay than the default for all fractions, further justifications for the faster decay rates and sources of this information should be

provided. In its response to the review, Norway indicated that it will report results from revised calculations for landfill emissions in its 2006 inventory submission.

80. Norway reports that annual surveys provide data on the amounts of different waste materials. The transparency of the reporting would be enhanced if time series of these AD could be included in the NIR. It is not entirely clear whether these surveys refer to waste landfilled or to total waste generation. The coverage of the AD should be further explained, for example, whether commercial and industrial wastes, sludge, and construction and demolition waste are included in the AD. The description of the recalculation of historical data should be improved and information should be provided as to how the historical data were extrapolated.

81. The NIR describes that in the revised model plastics are no longer considered as degradable, but the documentation box of CRF tables 6.A and 6.C presents a DOC value of 0.57 for plastics. This discrepancy should be further explained or corrected. In its response to the review, Norway explained that the DOC value of 0.57 is only used for calculations of the carbon in plastics accumulated in Norwegian landfills, whereas the DOC_f (the dissimilating part of DOC) is set at zero.

82. In CRF table 6.A for 1990 and 2002 the AD for annual MSW at solid waste disposal sites (SWDS) are three orders of magnitude too high. These values should be corrected in future submissions.

C. Non-key categories

1. Waste-water handling – CH_4, N_2O

83. CH_4 and N_2O emissions from industrial waste water are reported as "not estimated" ("NE") and CH_4 emissions are reported as "not occurring" ("NO") for sludge. In its response to previous stages of the review, the Party explained that CH_4 emissions from domestic sludge are calculated together with waste-water emissions, and the NIR explains that emissions from breweries, dairies and slaughterhouses are included. The ERT recommends that Norway correct the notation keys used in the CRF tables. In its response to the review, Norway indicated that it will use the notation key "NE"/"IE" for domestic sludge and industrial waste water in its 2006 submission, since parts of the emissions are included elsewhere.

2. Waste incineration – CO_2

84. Norway reports CO_2 emissions from flaring of landfill gas. These emissions are usually considered as being of biogenic origin and therefore do not have to be included in national inventory totals. From the information provided in the CRF and the NIR it is not clear whether these estimated emissions are included in the inventory totals. This should be clarified in Norway's next inventory submission. In its response to the review, Norway indicated that it would exclude CO_2 emissions from flaring of landfill gas in the next inventory submission, which in the current inventory were included by mistake.

85. Flaring of CH_4 during methanol production is also reported under 6.C Waste Incineration. The documentation box for CRF tables 6.A and 6.C should clarify whether this source is included in the emissions reported in this table. Such emissions should be reported under emissions from petrochemical production in the Industrial Processes sector.

86. The amount of hospital waste has been kept constant since 1999 because such data are no longer collected. Norway should check whether the incineration of hospital waste still occurs without energy recovery as in the past and whether the assumption of constant amounts is still valid. Because of concerns about hygiene, in other countries hospital wastes are no longer burnt directly in hospitals, but as part of hazardous wastes in special incineration plants, and this trend may also be taking place in Norway.

Annex

Documents and information used during the review

A. Reference documents

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

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B. Additional information provided by the Party

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

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