UNITED NATIONS
NATIONS UNIES

FRAMEWORK CONVENTION ON CLIMATE CHANGE - Secretariat
CONVENTION - CADRE SUR LES CHANGEMENTS CLIMATIQUES - Secrétariat

FCCC/WEB/IRI/2004/SWE 4 April 2005

SWEDEN

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 Sweden, 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 11 to 15 October 2004 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalists – Ms. Riitta Pipatti (Finland) and Mr. Pavel Shermanau (Belarus), Energy – Ms. Branca Americano (Brazil), Mr. Mamadou Diarra (Niger) and Mr. Dario Gomez (Argentina), Industrial Processes – Mr. Menouer Boughedaoui (Algeria) and Mr. Alexander Nakhutin (Russian Federation), Agriculture – Mr. Viktor Novikov (Tajikistan) and Mr. Haruo Tsuruta (Japan), Land-use Change and Forestry (LUCF) – Mr. Nagmeldin Goubti Elhassan (Sudan) and Mr. Risto Sievänen (Finland), Waste – Ms. Tatiana Tugui (Republic of Moldova) and Mr. Gao Qingxian (China). Mr. Dario Gomez and Ms. Riitta Pipatti were the lead reviewers. 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 Sweden, 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, Sweden has submitted a complete set of common reporting format (CRF) tables for the years 1990–2002 and a national inventory report (NIR). Where needed, the expert review team (ERT) also used previous years' submissions, 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 2004, the most important GHG in Sweden was carbon dioxide (CO_2), contributing 78.7 per cent to total[2] national GHG emissions expressed in CO_2 equivalent, followed by nitrous oxide (N_2O) – 12.0 per cent – and methane (CH_4) – 8.2 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) taken together contributed 1.1 per cent to the overall GHG emissions in the country. The Energy sector accounted for 76.4 per cent of the total GHG emissions, followed by Agriculture (12.6 per cent), Industrial Processes (7.7 per cent), Waste (2.8 per cent), and Solvent and Other Product Use (0.4 per cent). Total GHG emissions amounted to 69,601 Gg CO_2

[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.

equivalent and decreased by 3.5 per cent from 1990 to 2002. Total GHG emissions with LUCF included amounted to 43,060 Gg CO_2 equivalent and decreased by 16.9 per cent during the same period. Sweden gives policies and measures, such as CO_2 taxes, as the reasons for the downward trend in emissions. Warmer weather is also said to have contributed to the downward trend.

D. Key sources

5. Sweden has reported a key source tier 1 analysis, both level and trend assessment. The key source analysis performed by Sweden and the secretariat[3] produced similar results, although the analyses are difficult to compare as Sweden has done the analysis at a more disaggregated level. Sweden identified 59 key sources, and the secretariat 32. In the NIR Sweden states that it will perform a more aggregated key source analysis in its next submission.

E. Main findings

6. Sweden's inventory submission generally adheres to the UNFCCC reporting guidelines. A full set of CRF tables for the years 1990–2002 is provided and the NIR largely follows the structure set out in the guidelines. The user-friendliness of the NIR could be improved by reducing the number of cross-references between the different sections and annexes of the report.

7. The methodologies used are consistent with the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 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). IPCC tier 2 or country-specific methods are used frequently.

8. Sweden has provided quantitative uncertainty estimates for the inventory for the first time in its 2004 inventory submission. The ERT welcomes this improvement.

9. The ERT also noted that Sweden provided timely and thorough responses to questions raised during the review. It was evident from these responses that Sweden plans to address many of the questions raised by the ERT, mostly as part of work already underway, and also as a result of the inventory review.

F. Cross-cutting topics

Completeness

10. All years 1990–2002, all gases, all sectors and practically all source/sink categories are covered in the 2002 inventory. Sweden reports additional categories, such as nitrogen (N) fixation in hayfields, in the CRF to account for its use of country-specific methods. The ERT recommends that Sweden integrate these in the CRF categories, report the country-specific features in the relevant documentation boxes in the CRF and provide more details of the methods used in the NIR.

Transparency

11. The contents of the NIR are generally informative: sources of activity data (AD) and emission factors (EFs) as well as external references are given. Country-specific methods, models and factors influencing the emissions are described, but the descriptions do not always make it possible to assess the key assumptions used or how the results produced are better than those obtained by using the IPCC methodologies.

[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.

12. Information on the factors influencing trends in AD and EFs are given only at a very general level.

13. The NIR includes much cross-referencing between different parts of the report, and in some cases a reference to more detailed information does not make it easier to understand the issue addressed. For instance, on page 71 explanations and justification for recalculations in the Energy chapter are addressed. All emissions for natural gas are reported to have been adjusted based on updated thermal values and a reference to section 3.3.2 is given. Section 3.3.2, however, gives information on data sources for the thermal values but does not explain the changes made by the recalculations. The ERT encourages Sweden to reduce the amount of cross-referencing in the NIR and check that all relevant information is in fact included when cross-references are made.

Recalculations and time-series consistency

14. The ERT noted that recalculations of the time series 1990–2002 have been undertaken for all sectors except Waste. The many recalculations take into account new AD and EFs as well as correcting mistakes identified previously. Methods have also changed, for example, for CO_2 emissions from cement production. The estimate for CO_2 emissions from cultivation of organic soils for 2001 was missing from the previous (2003) submission and is now included. Many of the changes have resulted in changes in the order of several per cent (even tens to thousands of per cent for some sources), even if the changes in the total emissions are much smaller. Estimated total national emissions (without LUCF) for the base year (1990) decreased by 0.85 per cent, and estimated emissions for 2001 decreased by 3.15 per cent.

15. Sweden provides good information on the recalculations and their impact on the emissions estimates but only very general information on the rationale behind the changes. The ERT recommends that in its next submission Sweden provide information as to how the new data are better than those previously used.

Uncertainties

16. Sweden has provided quantitative uncertainty estimates for all sources for the first time in the 2004 submission, using the tier 1 method based on expert judgement or IPCC defaults. Some uncertainty estimates are much lower than the IPCC defaults. The ERT recommends that Sweden provide the rationale for the values, including the zero values, in future submissions.

Verification and quality assurance/quality control approaches

17. Sweden is developing its quality assurance/quality control (QA/QC) system. Information on procedures already undertaken has been provided, but verification activities are not described. In its response to the 2004 previous review stages Sweden stated that reviewers from the Swedish Environmental Protection Agency (EPA) have validated the emissions data, methodology used, AD and EFs.

Follow-up to previous reviews

18. Sweden has made many improvements to its inventory: quantitative uncertainty estimates have been provided for the first time, the consistency of the NIR with the UNFCCC reporting guidelines has been improved, mistakes have been corrected and gaps have been reduced.

G. Areas for further improvement

Identified by the Party

19. The NIR identifies areas for improvement in the chapters of the Energy, Industrial Processes and Land-Use Change and Forestry sectors. For the remaining sectors no improvements are planned. In its response to the 2004 previous review stages, Sweden indicated that it is developing QA/QC procedures, which will be fully implemented in the 2006 submission.

Identified by the ERT

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

(a) Improve the quantified uncertainty estimates and explain the rationale behind those that differ much from the IPCC default and those that have been assigned a zero value;

(b) Consider implementing a tier 2 key source analysis (linked with (a) above);

(c) Provide more precise descriptions of country-specific methodologies;

(d) Improve the transparency of the NIR by reducing the number of cross-references in the report;

(e) Continue the development of the QA/QC management system.

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

II. ENERGY

A. Sector overview

22. The Energy sector is the largest contributor of GHG emissions in Sweden. The bulk of these emissions are from fuel combustion activities: transport (30.1 per cent of total national emissions), energy industries (18.4 per cent), manufacturing industries and construction (15.8 per cent) and other categories (10.6 per cent). Fugitive emissions amount to 1.5 per cent of total national GHG emissions.

23. The NIR and the CRF contain emissions estimates for direct and indirect GHGs. Sweden indicates in the NIR that estimates of fugitive emissions from venting and flaring of liquids and gaseous fuels are most probably incomplete. The NIR provides information on sources of AD and the EFs and associated parameters used for estimating emissions. Plans for improvements include the revision of EFs for Stationary Combustion and Waterborne Navigation categories. For off-road vehicles and other machinery both the AD and the EFs are to be reviewed and updated.

B. Reference and sectoral approaches

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

24. In 2002, the difference in CO_2 emissions from total fuel combustion estimated using the reference and using the sectoral approaches was 5.9 per cent. By type of fuel, the differences were 44.9 per cent for solid fuels, 2.4 per cent for liquid fuels and 0.02 per cent for gaseous fuels. For all years there are large differences in the reported fuel consumptions, particularly those of solid fuels. These differences were explained on the basis of the relatively large amount of fuel used in categories 1.B and 2.C, which cannot be taken into account in the comparative assessment because of the structure of the CRF. To address this issue, Sweden has developed a country-specific analysis that adds the amount of fuel used in these two subsectors to the fuel consumption reported in the sectoral approach. However, some differences remain unexplained. These were attributed to the national energy statistics. For the period 1990–2002 the differences between the reference and the sectoral approach which remain unexplained were between 0.43 and 5.65 per cent, and the differences for total fuel consumption and for CO_2 emissions were between 0.17 and 3.75 per cent. Sweden states in the NIR that the large difference for solid fuels is due to transformation losses (energy losses) in the iron and steel industry that are not yet specified in the sectoral approach. In the 2005 submission, these losses will be estimated and the energy amount will be reported for each year. The ERT commends Sweden on its effort to clarify this issue.

International bunker fuels

25. Emissions reported as international bunker emissions for maritime transport are estimated on the basis of the amount of fuel that is bought in Sweden and used abroad. Sweden states in the NIR that the AD

and EFs for navigation will be further investigated. The ERT encourages this undertaking and recommends that the Party check whether the assignment of AD to international bunkers is in accordance with the criteria for defining international maritime transport suggested by the IPCC good practice guidance.

26. Emissions from international bunkers for aviation are based on the amount of fuel delivered and the apportionment between domestic and international flights provided by the Swedish Civil Aviation Administration (SCAA). Total fuel consumption calculated by the SCAA differs by between 3 per cent and 15 per cent from the figures provided by the official Swedish statistics (Statistics Sweden) over the period 1995–2000. It is recommended that Sweden explain this discrepancy in distinguishing between domestic and international aviation. Sweden indicated that these differences arise because fuel consumption at private airports is not included in the SCAA statistics.

Feedstocks and non-energy use of fuels

27. The non-energy use of bitumen, coke, gas petrol, liquefied petroleum gas (LPG), lubricants and other liquid fuels is taken into account in the reference approach using the quarterly fuel statistics collected by Statistics Sweden and a value of 1 for the fraction of carbon stored for all fuels. To improve transparency, it is recommended that Sweden include in its future submissions a brief description of the way in which the information on non-energy use of fuels is distinguished in the quarterly fuel statistics surveys.

C. Key sources

Stationary combustion: oil – CO_2

28. The trend of total fuel consumption for the iron and steel industry fluctuates and follows quite closely the trend of consumption of liquid fuels, which are the dominant fuels for this industry. However, the trend in total fuel consumption does not correlate closely with the trends in pig iron production or steel production. In its response to the 2004 previous review stages, Sweden stated that the iron and steel industry has been carefully overhauled in preparation for companies participating in emissions trading during 2004 and that possible errors will be corrected in the next submission. The ERT encourages this revision and also suggests cross-checking the fuel consumption data with the AD of the iron and steel industry reported in the Industrial Processes sector.

Stationary combustion: coal – CO_2

29. In the period 1990–2002, the CO_2 implied emission factor (IEF) values for solid fuels for public electricity and heat production are within the range 110.4–144.8 t/TJ and are among the highest, or are the highest, of reporting Parties. According to appendix 16 of the NIR, the CO_2 EFs used for solid fuels are as follows: blast furnace gas 299 kg/GJ, steel converter gas 187 kg/GJ, peat 107 kg/GJ, coke 103 kg/GJ, and coking coal and other bituminous coal 91 kg/GJ. The comparison between the EFs reported in the NIR and the IEFs reflects the fact that the use of blast furnace gas and steel converter gas may make a significant contribution to the emissions from this category. To improve transparency, the ERT recommends that Sweden include further information about the shares of the different fuels used in this category in its future submissions.

30. Sweden reports in the NIR that, for the period 1990–2002, emissions from the two integrated steel mills have been recalculated and redistributed to comply with the IPCC good practice guidance. However, the use of coke oven gas, blast furnace gas and oil in the energy plants within the steel mills are reported under category 1.A.1.a instead of category 1.A.2.a. The ERT commends Sweden for its effort to improve the estimation and to report the emissions of the iron and steel industry, and recommends allocating the emissions from autoproducers to the sector where they were generated.

31. Sweden reports in the NIR that CO_2 emissions arising from the combustion of blast furnace gas also include carbon from the use of limestone. However, the Industrial Processes chapter reports that emissions of CO_2 from the use of dolomite and limestone in iron pellet production are reported in category 2.A.3. The ERT recommends that Sweden clarify this issue and that all CO_2 emissions arising from the use of limestone be estimated and reported in the Industrial Processes sector.

Road vehicles: oil – CO_2, CH_4, N_2O

32. CO_2 emissions are estimated using a tier 1 approach while non-CO_2 emissions from road traffic are estimated using the EMV (emissions from road traffic) model. The AD used are the amounts of fuel delivered distributed into subcategories according to additional information on fuel consumption and emissions from transport collected from several governmental organizations. Although Sweden has included a discussion of the EMV model in the NIR, following earlier recommendations, further information is needed to improve transparency. The ERT recommends that Sweden describe the approach used to assess the balance between the fuel use calculated by the model and the statistics of fuel sales.

33. Sweden includes in appendix 16 of the NIR the series of EFs used for all fuels, vehicle types and driving conditions for the period 1900–2002. There is a noticeable decrease in the values of the CH_4 EFs between 1990 and 2002, particularly those of diesel passenger cars and small trucks under urban driving conditions. In its response to the 2004 previous review stages, Sweden stated that this decline for diesel follows the alteration in usage of diesel, from environmental class 3 in the early 1990s to environmental class 1 in 2002. To improve transparency, it is recommended that Sweden provide more information on this environmental class numbering in its future submissions.

Fugitive emissions: coal – CO_2

34. Flaring of coal-related gases in the iron and steel industry is reported as fugitive emissions in subcategory 1.B.1.c Other. Sweden is commended on its effort to deal with CO_2 emissions from the iron and steel industry in this disaggregated manner.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

35. In 2002, emissions from Industrial Processes sector accounted for 7.7 per cent of total CO_2 equivalent emissions. CO_2 represented 75.2 per cent of the sector's emissions in 2002, N_2O 10.1 per cent and fluorinated gases (F-gases) 14.6 per cent. In the period 1990–2002, CO_2 equivalent emissions from the Industrial Processes sector decreased by 1.0 per cent. CO_2 emissions increased by 0.5 per cent and N_2O decreased by 38.1 per cent, whereas the increase in F-gas emissions was 48.0 per cent.

36. CO_2 and N_2O emissions from the Solvent and Other Product Use sector decreased by 42.0 per cent and 40.9 per cent, respectively, between 1990 and 2002.

37. Sweden plans to review its methodology for estimating N_2O emissions from nitric acid production, to improve the comparison of the PFC emissions from aluminium production calculated by the country-specific methodology with those calculated using the methodology suggested in the IPCC good practice guidance, and to revise the method of calculating emissions from semiconductor production according to the IPCC good practice guidance. The ERT welcomes these plans for improvement.

B. Key sources

Cement production – CO_2

38. Sweden has used a tier 2 methodology to estimate CO_2 emissions based on clinker instead of cement production, which was used in its 2003 submission. The ERT welcomes this improvement. The EF is based on plant-specific data and takes into account the amount of cement kiln dust (CKD). The method is based on the GHG protocol of the World Resources Institute (WRI). The amount of dust released and the fraction recycled is not reported in the NIR, so that comparison of the inventory with other Parties' is not possible. The ERT encourages Sweden to provide these data in its next submission.

Lime production– CO_2

39. The IEF for lime production (0.52 t/t) has been identified as an outlier. The EF covers emissions from production of quicklime, dolomitic lime, lime produced in the sugar industry and make-up lime in

the pulp and paper industry. In some industries measures such as the recycling of gas are reported to lower the EF; for some the IPCC default factors are used. AD by type of production and by type of lime are not provided. The ERT requests Sweden to report the ratio of limestone to dolomite produced as well as the AD for each production type so that the calculation of the average EF can be evaluated. See also paragraph 31 in the section on Energy above. Sweden indicated that lime production is based mostly on limestone and provided to the ERT disaggregated lime production data for both, conventional production and production within the sugar and pulp industry for the period 1990–2003.

Nitric acid production – N_2O

40. Fluctuations in the IEF were identified between 1994 and 2002. In response to the 2004 previous review stages, Sweden explained that of originally three nitric acid plants only one was in operation in 2002. The ERT recommends more clarification in the next submission concerning the fluctuations in the IEF. Sweden indicated that this variability is mainly related to fluctuations in one facility that was shut down in 2000. It also indicated that both, activity data and reported emissions were provided by the facility through its environmental reports and as it is no longer in operation it is not possible for the inventory team to check these estimates.

Iron and steel production – CO_2

41. The CO_2 IEF value of 2.89 t/t for steel is among the highest of reporting Parties. In its response to the 2004 previous review stages, Sweden indicates that it uses "use of raw material", not "steel production", as AD. The IEF therefore cannot be compared with those of other countries as the AD are not the same. The ERT encourages Sweden to report the amount of steel produced as AD in its future submissions and to explain the methodology used to derive the estimates in the NIR.

42. Sweden does not use the IPCC methodology based on reducing agent mass used but, because of lack of data, as reported in the NIR, emissions are calculated from the blast furnace gas consumed. For transparency, the ERT recommends that Sweden provide, in the Industrial Processes chapter of the NIR, information on the source of activity data and how the country specific EF has been derived, avoiding cross-referencing with the Energy sector.

Aluminium production – PFCs

43. The IEFs for tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6) are among the highest of reporting Parties, at 0.34–0.71 kg/t and 0.04–0.08 kg/t, respectively. These are within the IPCC default values of 0.31–1.7 and 0.04–0.17 kg/t, respectively. The ERT recommends Sweden to give more details about how the EFs have been estimated.

Consumption of halocarbons and SF_6

44. Potential emissions are provided for the years 1995–2002. Potential emissions for the years 1990–1994 are reported as "not estimated" ("NE") or "not occurring" ("NO"). The NIR provides the information that data for bulk import and export are not available for these years. It further states that potential emissions for imports and exports in products are estimated. However, these do not seem to be reported in the CRF. The ERT recommends that Sweden clarify this issue. Sweden informed the ERT that it chose not to include the incomplete data on potential emissions 1990–1994 in the CRF-tables to avoid misleading results from the calculations of the ratio of potential to actual emissions in table 2(II)s2.

C. Non-key sources

Other (chemical industry) – CH_4

45. CH_4 emissions under this subcategory are reported only for 2001 and 2002. In the interests of completeness, Sweden is encouraged to provide estimates for the years 1990–2000 as well.

Other (chemical industry) – N_2O

46. The same value is reported for the years 1990–1997. In its response to the 2004 previous review stages, Sweden indicated that between 1998 and 2000 data were collected from only one company and in 2001 data were collected from two companies but the time series was not updated. The ERT recommends Sweden to report the emissions from all plants emitting N_2O and to update the time series for the sake of consistency.

Aluminium production – CO_2

47. The Party reports in the NIR that these emissions estimates are based on expert judgement for 1990, on the mandatory annual environmental reports presented by companies for 1995–2001, and on interpolation for 1991–1994, which could be the source of the fluctuations found in the IEF. The aluminium producer is revising the time series and recalculating emissions of all substances, and the results will be available in the next submission. The ERT recommends that the Party recalculate the emissions using the improved data.

Other (mineral products) – CO_2

48. The notation key "included elsewhere" ("IE") is used for CO_2 emissions from "mining, other activities" but it is not stated where these emissions are included.

Limestone and dolomite use – CO_2

49. Sweden has used a total standard value of 900 t CO_2/year for each smaller glass production plant. The ERT encourages Sweden to explain the methodology and provide the definition of a smaller plant.

Carbide production – CO_2

50. The NIR states that the new EF has been derived based on the reported emissions and carbide produced, and that the emissions have been recalculated in the 2004 submission. The ERT recommends Sweden to clarify how the emissions data are derived – through measurement or calculation. Sweden informed the ERT that the emissions were derived by calculations carried out by the plant.

IV. AGRICULTURE

A. Sector overview

51. In 2002, emissions from the Agriculture sector in Sweden amounted to 8,788 Gg CO_2 equivalent, or 12.6 per cent of total national GHG emissions. N_2O emissions from manure management and agricultural soils (direct, indirect, and from animal production) accounted for 65.4 per cent of the country's total N_2O emissions, and CH_4 emissions from enteric fermentation and manure management accounted for 58.1 per cent of its total CH_4 emissions. According to the CRF and the NIR, emissions from rice cultivation, prescribed burning of savannas, and field burning of agricultural residues do not occur in Sweden.

52. Total emissions from the Agriculture sector decreased by 8.3 per cent from the base year (1990) to 2002. The highest emissions occurred in 1994. The decrease in the emissions is mostly due to decreases in N_2O emissions from agricultural soils and in CH_4 emissions from enteric fermentation. CH_4 emissions from manure management increased by 22.6 per cent from 1990 to 2002.

53. Sweden identified four key sources based on level and/or trend assessment: CH_4 from enteric fermentation and manure management, and N_2O from manure management and agricultural soils (direct, indirect, and from animal production). All the four key sources in the Agriculture sector are included in the 10 largest sources contributing most to uncertainty in the 2002 national emissions.

54. Activity data are mainly taken from the official figures of Statistics Sweden. Other data sources have also been used. National EFs have been developed, especially for CH_4 emissions from cattle and direct N_2O emissions from fertilizers and manure used on agricultural fields. The AD for nitrogen (N) leaching and ammonia emissions originate from national sources.

55. Recalculations have been done in the Agriculture sector. The use of sewage sludge as fertilizer has been included in N_2O emissions from agricultural soils. The grazing period for dairy cows has been changed, and 45 per cent of the excretion during the grazing period is allocated to the manure management systems. The N content in manure production from grazing animals and the figures for production of manure from dairy cattle have been revised. The recalculations have resulted in a slight increase in the estimates of GHG emissions from the Agriculture sector (by 0.52 per cent in the base year, 1990, and 0.26 per cent in 2001) compared to the 2003 submission.

B. Key sources

Enteric fermentation – CH_4

56. Sweden uses a modified tier 2 method for calculating the EF for dairy cattle, which is 120.3 kg CH_4/head/yr, 126.4 kg CH_4/head/yr, and 127.7 kg CH_4/head/yr for 1990, 1995 and 2002, respectively, and much higher than the IPCC default EF (100 kg CH_4/head/yr for Western Europe). The CH_4 conversion rate decreased from 7.2 per cent in 1990 to 6.7 per cent in 2002, and average daily intake is the same value – 339.1 MJ/day – for all the inventory years, although the NIR states that the EF is related to milk production, which increased from 1990 to 2002. The ERT recommends Sweden to describe clearly the major reason for the increase in the EF. In addition, Sweden is encouraged to provide an equation for the relationship between the EF and milk production.

Manure management – CH_4

57. The tier 2 methodology is used for CH_4 emissions from cattle and swine, and tier 1 is used for other animals. However, the national CH_4 conversion factor for liquid manure is 10 per cent. This is equal to the default value in the IPCC Guidelines, but much lower than the updated default value of 39 per cent given in the IPCC good practice guidance. Sweden states in the NIR that the lower value is considered to be more appropriate for Swedish conditions, without any reference or source information. The ERT recommends Sweden to explain why the lower value is considered more appropriate to Swedish circumstances. Sweden informed the ERT that the low value was selected because of Sweden's cold climate and the fact that the slurry containers usually have a surface cover.

Agricultural soils – N_2O

58. The value of $Frac_{GASF}$ shown in table 6.1 in the NIR is about 0.01, which is derived from CORINAIR and is much lower than the IPCC default value of 0.1, but no explanation is provided. The ERT requests Sweden to describe how this value is derived and provide the rationale behind its use as the country-specific value. Sweden indicated that the reference by CORINAIR provides a value of 1 per cent for the amount of ammonia emitted by the use of N, NP and NPK-fertilizers. The combination of this factor with the sales statistics of fertilizers in Sweden results in a value of $Frac_{GASF}$ between 1 and 2 per cent of the nitrogen supplied by mineral fertilizers. An analysis of the difference between this interval and the suggested IPCC factor has not been done yet.

59. The value of $Frac_{GASM}$ shown in CRF table 4.D is 0.33, which is derived from Statistics Sweden and is much higher than the IPCC default value of 0.2, but no explanation is provided. The ERT requests Sweden to describe how this value is derived and provide for the rationale behind its use as the country-specific value. Sweden indicated that the fraction of nitrogen emitted as ammonia from manure management is calculated from the data submitted under the Convention on Long-Range Transboundary Air Pollution and that these ammonia emission factors are combined with different kinds of manure and manure management, distributed according to national statistics to estimate the value of $Frac_{GASM}$.

60. Sweden reports that N_2O emissions from sewage sludge used as fertilizer were calculated using the equation shown on page 116 in the NIR, while N_2O emissions from sewage sludge in CRF table 4.D include both direct and indirect N_2O emissions. Sweden is requested to provide values of direct and indirect N_2O emissions from sewage sludge separately in the category Other in table 4.D.

61. Sweden reports a new source, background N_2O emissions from mineral soils due to previous farming activities. The suggested EF is 0.5 kg N_2O–N/ha. It is not clear whether the country-specific value is derived from field measurements or expert judgement, although the data source (in Swedish) is listed. Sweden is requested to describe how this value is estimated. Sweden indicated that the EF is based on a set of data from different field observations.

62. The value of N excretion from sheep is 13 kg N/head/ year, which is much lower than the IPCC default value of 20 kg N/head/year. No explanation for the difference is provided. The ERT recommends Sweden to explain how the country-specific value is derived. Sweden indicated that the N excretion from sheep is being revised.

63. The value of $Frac_{LEACH}$ is estimated to be 0.22 by using a model called SOIL/SOILN. This is lower than the IPCC default value (0.3). The ERT recommends Sweden to show in what ways the country-specific value is more reasonable than the IPCC default for Swedish conditions. Sweden indicated that the SOIL/SOILN model uses a variety of regionally distributed national data such as use of fertilizers and manure, crop distribution and soils types. A systematic analysis of the difference between the country specific and the IPCC default values has not been done.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

64. In 2002, net CO_2 removals from the LUCF sector in Sweden amounted to 26,541 Gg, representing 38.1 per cent of total national emissions. No significant trend could be observed over the period 1990–2002. Fluctuations in the rate of harvesting were identified as a key factor determining the inter-annual changes of net removals.

65. The completeness of the NIR and the reporting in the CRF have been improved in this submission; the transparency of the reporting is also on a good level, for which the ERT wishes to congratulate the Swedish reporting team. The methods and references are now more thoroughly discussed in the NIR than before, more information is provided about recalculations, and AD are presented to aid the review of the calculations. AD are now reported in table 5.A and the notation keys have been used in all tables. Tables 5.A, 5.B, 5.C and 5.D are now reported in a more complete way.

66. In the recalculation the estimated net removals by sinks in 5.A have been changed to correct a calculation error. Consequently, net removals in year 2001 decreased by 8,272 Gg CO_2.

67. Category 5.B Forest and Grassland Conversion is assumed to be of little importance, and forest fires are not frequent in Sweden. This source category is therefore considered to be negligible and emissions/removals are not reported.

B. Sink and source categories

Changes in forest and other woody biomass stocks

68. The ERT identified two minor points which should be corrected in the next inventory:

(a) No documentation is given for non-forest trees in table 5.A (either type of tree or information in the documentation box). The NIR specifies (in table 7.1) that "A separate non-forest class, for example including biomass on rock surface, is denoted not available. See also CRF 5A", but this does not seem to correspond to what is reported in table 5.A.

(b) Removals of non-forest trees are reported in table 5.A as removals of harvested wood products in table 5.

Forest and grassland conversion

69. According to the NIR, the extent of forest and grassland conversion is negligible and reported as "0" in the CRF. However, the recommended way to report such cases is to mark "NE" and provide an

explanation similar to that now given in the NIR. A numerical estimate of the size of each negligible source/sink would also make the reporting clearer. The data provided in the NIR alone would probably warrant such a calculation.

Abandonment of managed lands

70. According to the NIR, abandoned land is converted automatically by law to forest land. To avoid double counting Sweden has reported "0" in table 5.C, while in table summary 3 the methods used to estimate CO_2 in the category Abandonment of Managed Lands are reported as tier 2 and country-specific. To avoid possible confusion it is recommended that Sweden use the notation key "IE" in table 5.C and provide information on where carbon flux from abandonment of managed land has been included.

VI. WASTE

A. Sector overview

71. The Waste sector contributed 2.8 per cent in 2002 and 3.8 per cent in 1990 to the total GHG emissions of Sweden. The largest source of GHG emissions and the only key source in the sector is CH_4 from solid waste disposal sites (SWDS). Emissions from the Waste sector have decreased constantly over the last 10 years – by 28.7 per cent in total, due to the decrease in the total amount of organic waste disposed to landfills and increasing CH_4 recovery from SWDS. At present only 20 per cent of waste generated is landfilled, 40 per cent is incinerated and 40 per cent is recycled.

72. CH_4 from SWDS contributed 2.6 per cent to total national emissions in 2002. CH_4 emissions from waste-water handling are not included; they are reported as "NO". N_2O from waste-water handling contributed 0.2 per cent to total national emissions in 2002. CO_2 emissions from waste incineration with energy recovery are reported in the Energy sector, in accordance with the IPCC Guidelines. In CRF table 6.C the notation key "IE" is used.

B. Key sources

Solid waste disposal sites – CH_4

73. The method used for calculating the emissions from SWDS is the IPCC tier 2 method using country-specific parameters. The NIR provides a detailed description of the methodology used. Comparisons between tier 1 and tier 2 methods are provided in the NIR.

74. The half-life of waste differed from the IPCC default values. It is assumed to be 7.5 years instead of 14.5 (the IPCC default). The rationale for this assumption is not given. The ERT recommends Sweden to provide it in its next submission.

75. The per capita waste generation rate is reported as 467 kg/day in table 6.A. This is a reporting mistake: the correct unit should be kg/year. The percentage figures on the composition of landfilled waste do not add up to 100 per cent. The ERT encourages Sweden to explain these issues in its next submission.

C. Non-key sources

Waste-water handling – CH_4 and N_2O

76. Waste-water handling includes only N_2O emissions from industrial, domestic and commercial waste water and from human sewage. Sweden has not estimated CH_4 emissions from industrial, domestic and commercial waste water treatment and the notation key "NO" is used. Sweden indicated in its response to ERT that since all sludge is treated on SWDS and reported in sector 6.A, it is assumed that no other CH_4 is emitted from the waste-water handling processes. The ERT encourages Sweden to explain more in detail the methodology used and the assumption that no additional CH_4 is released during the waste water treatment processes.

77. The notation key "NE" is used in the additional information box in table 6.B. However, some data on waste-water streams are indicated in the NIR. The ERT encourages Sweden to provide these data in the CRF as well for greater transparency. Sweden indicated that it is difficult to provide disaggregated data for the additional information box, mainly because of the fact that Swedish municipal waste water treatment plants handle significant amounts of industrial waste water and there is not enough information to estimate the division of incoming wastewater between industrial wastewater and domestic/commercial waste water.

Waste incineration – CO_2

78. Waste incineration in Sweden is used for energy recovery and is accounted under the Energy sector. The notation key "IE" is used appropriately.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

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

UNFCCC secretariat (2004). "Report of the individual review of the greenhouse gas inventory of Sweden submitted in the year 2003 (Centralized review)". FCCC/WEB/IRI(3)/2003/SWE (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/pdf/swecentrev03.pdf>).

UNFCCC secretariat. "2004 Status report for Sweden" (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/swe04.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 *Sweden* (unpublished).

UNFCCC secretariat. Review findings for Sweden (unpublished).

Sweden'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://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/english>).

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 Ms. Sandra Pettersson (Naturvårdsverket – the Swedish Environmental Protection Agency) including additional material on the methodologies and assumptions used.

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