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SWEDEN

REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY SUBMITTED IN THE YEAR 2003[1]

(Centralized review)

I. OVERVIEW

A. Introduction

1. In accordance with decision 19/CP.8 of the Conference of the Parties, the United Nations Framework Convention on Climate Change (UNFCCC) secretariat coordinated a centralized review of the 2003 greenhouse gas (GHG) inventory submission of Sweden. The review took place from 15 to 19 September 2003, in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalist – Mr. Joe Mangino (United States) and Ms. Inga Konstantinaviciute (Lithuania); Energy – Mr. Leif Hockstad (United States), Mr. Michael Strogies (Germany) and Mr. James Magezi-Akiiki (Uganda); Industrial Processes – Mr. Pierre Boileau (Canada) and Mr. Klaus Radunsky (Austria); Agriculture – Mr. Samuel Adejuwon (Nigeria) and Mr. Bhawan Singh (Trinidad and Tobago); Land-use Change and Forestry – Mr. Jozef Mindas (Slovakia) and Mr. Bubu Jallow (Gambia); Waste – Mr. Eduardo Calvo (Peru) and Ms. Angelina Madete (Tanzania). Mr. Radunsky and Mr. Adejuwon were the lead reviewers of this review. The review was coordinated by Ms. Rocio Lichte (UNFCCC secretariat).

2. In accordance with the UNFCCC "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 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 2003 submission, Sweden submitted common reporting format (CRF) tables for the years 1990–2001 together with a national inventory report (NIR) containing background information on methods, data sources and emission factors (EFs) used. The NIR also includes information on uncertainties, quality assurance/quality control (QA/QC), key source analysis and forthcoming improvements. 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 2001, the most important GHG in Sweden was carbon dioxide (CO_2), contributing 78.4 per cent to total[2] national GHG emissions expressed in CO_2 equivalent, followed by nitrous oxide (N_2O) – 12.2 per cent, and methane (CH_4) – 8.3 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons

[1] In the symbol for this document, 2003 refers to the year in which the inventory was submitted, and not to the year of publication. The number (3) indicates that this is a centralized review report.

[2] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 equivalent excluding Land-use Change and Forestry, unless otherwise specified.

(HFCs) and sulphur hexafluoride (SF_6), taken together, contributed 1.1 per cent of total GHG emissions in the country. The Energy sector accounted for 75.8 per cent of total GHG emissions, followed by Agriculture (12.6 per cent), Industrial Processes (8.3 per cent) and Waste (3.0 per cent). Total GHG emissions (excluding Land-use Change and Forestry (LUCF)) amounted to 70,485 Gg CO_2 equivalent and decreased by 3.1 per cent from 1990 to 2001. The emissions trend data do not indicate any notable or unexplained annual fluctuations in the national totals.

D. Key sources

5. Sweden has provided a key source analysis based on the *Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) tier 1 method for key source identification, using level and trend analysis. The UNFCCC secretariat performed an assessment of key sources using the same approach.[3] The small differences between these two analyses arise from the different subsectoral classifications used. The Swedish key sources analysis is very detailed and disaggregated.

E. Main findings

6. The NIR and CRF generally adhere to the UNFCCC reporting guidelines with only a few exceptions, where some transparency and documentation issues are noted. While most of the fundamental components of the UNFCCC reporting guidelines have been included in Sweden's NIR, additional introductory material and a description of emissions and trends would improve the inventory documentation and facilitate assessment of the data contained in it. In particular, discussions on the assessment of completeness should be included, as well as more extensive discussions on the use of key source analysis, uncertainty analysis, a summary of the impact of recalculations of the inventory and trends, and QA/QC procedures and responsibilities. In its response to the draft of this report, Sweden informed the expert review team (ERT) about further improvements of the NIR in its 2004 submission, which would focus on description of methodologies, trends, recalculation and uncertainty analysis.

7. The methodologies used for preparing the GHG inventory are generally consistent with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Guidelines) and the IPCC good practice guidance. Country-specific approaches and/or tier 2 IPCC methodologies are used for most key source categories identified. Exceptions are some less significant sub-source categories (such as some animal species in enteric fermentation) where tier 1 is used.

F. Cross-cutting topics

Completeness

8. Sweden has provided a complete CRF for the period 1990–2001 with all required tables, which appear to have been completed in a comparable and complete manner. All major source/sink categories and direct and indirect GHGs are reported in the inventory. Mainly because of limited availability of data (CRF table 9), emissions from the following source/sink categories are not reported in the 2003 submission: CO_2 emissions from some categories in Industrial Processes (chemical industry, asphalt roofing, road paving with asphalt) and LUCF (abandonment of managed land, emissions and removals from soil, forest and grassland conversion); CH_4 emissions from some categories in Industrial Processes (metal production), LUCF (forest and grassland conversion) and Waste (solid waste disposal on land – other); N_2O emissions from some categories in Industrial Processes (metal production) and Solvent and

[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.

Other Product Use (N_2O from aerosol cans); and potential HFC, PFC and SF_6 emissions from Industrial Processes.

9. Information on methods and emissions factors for waste-water handling has not been included in CRF table Summary 3.

Transparency

10. The NIR includes descriptions of methodologies, underlying assumptions and EFs in a coherent manner for each sector. References to sources of data, however, are provided mostly in Swedish. The information provided in the CRF and the NIR is transparent with some exceptions as regards the methodologies used in the Energy and Industrial Processes sectors.

11. The ERT recognizes the continued improvement in the transparency and documentation of Sweden's NIR as compared to previous reviews. Continued attention should be given to documenting verification of country-specific values, particularly for key source categories (e.g., for industrial plant data). Inserting additional background information into the NIR source category sections would improve the transparency of the estimation methodologies, particularly where country-specific methods or factors are used.

12. The NIR states that a consortium, Swedish Environmental Emission Data (SMED), has developed an emissions database that stores emissions data and underlying data (see section B of the introduction to the NIR). It is not clear to what extent this database is being used currently or how it is used. It is stated that functionalities for QC are to be included in the system, but it is not evident which of the already mentioned measures are in place, if the database is in fact currently used. Additional documentation regarding the database would help to explain its use more transparently. As regards the use of the database, Sweden informed the ERT that a new system for air emissions is under development, which is expected to be rolled out in the second half of 2004. For the 2003 submission a temporary database has been used.

13. Because of the significant level of difference in the Energy sector emission estimates between the reference and sectoral approaches (the reference approach was up to 10.6 per cent higher than the sectoral approach), additional explanatory information should be provided in the NIR to provide a more transparent accounting of the differences. See the comments under the Energy sector for more detail on this topic. Sweden expressed its intention to analyse and minimize the differences between the two approaches, and referred to its 2004 submission, where information on this matter would be provided.

Recalculations and time-series consistency

14. Sweden has provided recalculations for the period 1990–2000 (table 8(a)), and justifications for the recalculations in CRF table 8(b). Recalculation resulted in an increase of 3.1 per cent in total emissions for 1990 (without LUCF) and a decrease of 0.6 per cent in total emissions for 2000. By gas, recalculations for the year 2000 result in a decrease in CO_2 emissions of 7.3 per cent (increase by 1.2 per cent for 1990), a decrease in CH_4 emissions of 0.2 per cent (2.6 per cent for 1990) and an increase in N_2O emissions of 22.2 per cent (27.1 per cent for 1990). For the 2000 inventory, the largest sectoral changes occurred in CO_2 emissions from the Solvent and Other Product Use sector (68.2 per cent increase), and in CH_4 and N_2O emissions from agriculture (33.4 per cent increase).

15. The recalculations reported in CRF table 8(a) generally follow the descriptions of recalculations in the NIR. The recalculation of the 2000 inventory, however, does not follow the same pattern as the recalculations for the other years: it results in a net decrease in emissions as opposed to increases seen from 1990–1999. The change in the year 2000 is related to CO_2 for energy industries, as explained in the NIR (section 1.1). Expanded documentation on this change as it relates to quantity changes in this subsector would help in the assessment of this recalculation. Sweden informed the ERT that detailed descriptions on recalculations would be provided in its 2004 submission.

Uncertainties

16. No rigorous assessment of uncertainty was performed for the 2003 submission. The qualitative estimation of uncertainty is provided in CRF table 7. The NIR states that the uncertainty is the largest for the inventories of CH_4 and N_2O (perhaps with an uncertainty factor of 2), and for non-methane volatile organic compounds (NMVOC) – possibly in the order of 50 per cent – while the uncertainty for the carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen oxide (NO_x) inventories is assumed to be less than 30–40 per cent and the uncertainty for CO_2 may be as low as 1–2 per cent. Sweden plans to provide quantified uncertainties for the emissions in the coming year.

Verification and quality assurance/quality control approaches

17. The NIR identifies that some partial independent peer review of the inventory was carried out during 2002, but there is no documentation of what was included in these independent reviews. The NIR states that the IPCC good practice guidance QA/QC procedures will be further implemented in 2003 and 2004. Sweden informed the ERT that QA was performed by comparing data with data from other Swedish agencies, and that a formal QA/QC procedure is under development for implementation in 2005. The ERT would welcome further information on these issues in the NIR.

Follow-up to previous reviews

18. Sweden has made significant progress in including some source categories that were noted as missing in previous inventory reviews, including CH_4 emissions from the Energy sector and Industrial Processes (mineral products), N_2O emissions from some Energy categories and waste-water handling, and the updating of methods to better reflect the IPCC good practice guidance.

G. Areas for further improvement

Identified by the Party

19. Sweden identified several areas for improvement, to be implemented at different times in the future. For its 2004 submission, Sweden mentions: the revision of data in the refinery sector, in particular through checking with the Energy Statistics agency to see whether all the different fuels used in refineries for combustion are reported for all years, and to enable the Party to exclude transformation losses for the whole time series; and the revision of the estimates for emissions from flaring. The following improvements are expected to be implemented for the 2005 submission: revision of EFs for combustion and for waste combustion; review of the whole time series for off-road vehicles in order to improve the quality of these data and to make the methodology consistent with that used for estimating CO_2 emissions; and improvements to the quality of the documentation on the separation made between national and international operations in navigation. In addition, Sweden plans to use a new method for calculating forest biomass for the year 2001, which it would also use to recalculate data on forest biomass from 1990 to 2000 for next year's submission.

Identified by the ERT

20. The ERT identifies the following major areas for improvement: a quantitative analysis of uncertainty is needed; descriptions of country-specific methodologies should be expanded; QA/QC activities should be expanded and documented; and an analysis and discussion of recalculations, trends and summaries should be included to improve the overall transparency of the inventory.

21. The key source analysis follows the following structure: data on detailed source categories are presented, and then separated according to individual GHGs. At this level, a partial separation for different fuels has been used in the Energy sector; the ERT believes that this is too disaggregated. This has consequences particularly for road traffic, where N_2O and CH_4 emissions from gasoline consumption are key sources, while the CO_2 emissions from diesel oil consumption are not identified as a key source. Sweden expressed its intention to provide a more aggregated key source analysis in its 2004 submission.

II. ENERGY

A. Sector overview

22. The NIR provides detailed charts showing the EFs and thermal values used in the calculations. It is unclear, however, which EFs are country-specific and which are IPCC defaults. Some CO_2, CH_4 and N_2O EFs are presented as an average EF value, as EFs are acknowledged to fluctuate across time. The provision of EFs for the complete time series would increase the transparency of the calculations (e.g., the NO_x and SO_2 EFs are provided year by year). Sweden indicated that a complete time series of EFs would be provided in its 2004 submission.

B. Reference and sectoral approaches

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

23. Sweden provides a detailed spreadsheet in its appendices showing a time-series comparison of the reference and sectoral approaches, which show differences across all years. Only limited details have been provided on the reasons for the differences (e.g., "The reason for these differences is that energy statistics in Sweden are not fully adapted to international reporting of environmental statistics"). The spreadsheet seems to detail that additional fuel consumption from feedstocks, fugitives and industrial processes eliminate the differences between the two approaches. Additionally, comparison of CRF tables 1.A(b) and 1.A(c) shows different fuel consumption and emission values for the reference approach. This appears to happen across the time series. It is unclear why these two tables do not match. In responding to the draft of this report, Sweden expressed its intention to further analyse and minimize the differences between the two approaches, as well as to provide information on this matter in its 2004 submission.[4]

24. There is inconsistency between the values reported for the differences between table 1.A(c) in the CRF and those shown in appendix 13 of the NIR regarding comparisons between the sectoral and reference approaches for fuel. The brief explanation in the documentation box of the CRF refers to the appendix, and states that the differences are less if fugitive emissions and industrial processes are considered. Because of the significance of the differences (up to 10.6 per cent) and because of the importance of this source category, more explanatory information should be provided to describe the differences and the comparison calculations done in appendix 13, and provide more transparent accounting of the differences. This should be combined with a more extensive quantitative accounting of the uncertainties associated with the sector-specific values for energy usage. See paragraph 23 and footnote 4 for Sweden's response on the issues addressed in this paragraph.

International bunker fuels

25. Regarding the data on fuels sold for inland navigation and international shipping, it is not completely clear if this disaggregation is based only on the Statistics Sweden EN31SM data collection procedure or if use has been made of additional statistics. The ERT recommends that the exact method of disaggregating the fuel sold for inland navigation and for international shipping should be described in more detail. Sweden explained that information on fuel purchases for national and international navigation is based on statistics on supply and delivery of petroleum products, and expressed its intention to provide further information regarding the data sources in its 2005 submission.

26. The disaggregation for the energy consumption figures used for national and international aviation seems to be very clear and is based on the results of detailed emission estimations by the Swedish Civil Aviation Administration (SCAA). However, there are differences of up to 15 per cent in the underlying fuel consumption figures between the SCAA results and the figures collected by Statistics Sweden about the fuel sold for these purposes, and the reasons for these should be explained in more

[4] Sweden further explained that it has developed a country-specific reference and sectoral approach, which also takes into account fuel consumption and CO_2 emissions from fuels used in categories 1.B, 2.C and 2.D, while in table 1.A(c) of the CRF the reference approach is compared to only the data of table 1.A(a) of the CRF.

detail. Sweden explained in its response to the draft of this report that domestic aviation emissions currently include emissions from aviation occurring within the agriculture and forestry sectors, while SCAA exclude these emissions, which causes differences in the estimates between SCAA and Statistics Sweden for both international and national aviation. The ERT encourages Sweden to provide additional explanation on this matter in the NIR.

Feedstocks and non-energy use of fuels

27. Statistics on the non-energy use of fuels are taken from energy statistics collected by Statistics Sweden. However, no methodology is given for determining a carbon storage factor for the fuels used as feedstocks. The ERT recommends that the methods and data sources from this source be shown in more detail in order to increase the transparency of the inventory. In responding to the draft of this report, Sweden explained that the statistics on non-energy use of fuels are based on the quarterly fuel statistics survey. The latter is obtained by sample surveys to companies within the energy and industry sectors. As for the carbon content of the fuels, Sweden explained that they are derived from the CO_2 EFs for stationary combustion. Sweden further expressed its intention to improve information on this matter in its 2004 submission.

Country-specific issues

28. Sweden has developed and described a correction method for fossil CO_2 emissions to take into account climatic conditions in Sweden so as to be able to compare actual emissions with a climatic "normal" year. This normal-year correction includes emissions from the heating of buildings and from electricity generation, and has been provided in the NIR in addition to the actual emission estimates without correction provided in the CRF.

C. Key sources

1.A.1.b Stationary combustion: energy industries, petroleum refineries

29. The NIR states that SO_2, NO_x and volatile organic compound (VOC) emissions for this subsector are too high due to the fact that the emissions reported are based on statistics from the use of energy. It further states that, since there is a lack of data from production of energy in the energy statistics, the emissions are overestimated. It is unclear from this statement how the emissions were calculated, nor whether this overestimation extends to GHG emissions. The ERT recommends that Sweden correct and clarify this issue. Sweden informed the ERT that emission estimates from refineries have been revised for the 1990–1999 period based on consumption of fuels; these improved estimates would be provided in its 2004 submission.

1.A.2.a Stationary combustion: manufacturing industries and construction, iron and steel

30. The NIR does not state clearly how Sweden apportions solid fuels combusted versus solid fuels consumed in the process. Sweden indicated that it would provide revised emission estimates for the iron and steel sector together with more detailed information in the NIR (in particular with regard to the allocation of fuels to different categories) in its 2004 submission.

31. The NIR states that the steel industry flares coke oven gas, blast furnace gas and steel converter gas and that these emissions should be reported separately under Fugitive Emissions (1.B.2.c). It is unclear if these emissions are included under this category. Sweden informed the ERT that only part of the flared gases were reported as fugitive, while the remainder part was covered under category 1.A.2.a. Sweden also indicated that all emissions from flaring of rest gases in the two primary iron and steelworks would be reported as fugitive emissions in its 2004 submission.

1.A.5.a Stationary combustion: other sectors – all fuels

32. The NIR states that the fuel consumption data from the residential subsector are good, but that calculation of emissions for the other subsectors requires the use of models and extrapolation from old

results. No references are given to the models and no methodology is given for the extrapolation from old results. Total fuel consumption is compared to fuel deliveries, so the NIR states that errors will only occur in the allocation to subsectors. However, while the mobile combustion sector has a section describing "delivered amounts of fuel", the stationary combustion sector does not. The ERT recommends that the Party provide more discussion of the models used in the NIR and provide further details on the allocation of fuels in the stationary combustion section. Sweden expressed its intention to provide improved information on this matter in its 2004 submission.

1.A.3.b Mobile combustion: road traffic – CO_2, CH_4, N_2O

33. A short description of the EMV (Emissions from Road Traffic) model is needed in the NIR. It is frequently mentioned, but it is not clear what the basic approach of the model is. The discrepancies in energy consumption between the traffic-oriented estimates and the amount of fuel delivered (sometimes up to 25 per cent) should be explained in more detail. Sweden explained that the observed differences are due to different demarcations for the two estimates, and expressed its intention to provide the requested information in its 2004 submission.

34. The implied emission factors (IEFs) for CH_4 are among the highest of the reporting Parties. The deviation from the arithmetic medium value of all countries which have reported is 138 per cent in the case of gasoline and 156 per cent for diesel. Though in its response to this report Sweden briefly summarized how the CH_4 emissions are estimated, the ERT encourages Sweden to provide some explanation in its 2004 submission.

35. To improve transparency regarding the estimation of emissions of N_2O, more information is needed about how the model deals with different types of catalyst.

1.A.3.d Mobile combustion: waterborne navigation

36. The estimates for small boats are based on an assumption from 1992. The energy consumption is derived from the gasoline sold (i.e., 1.5 per cent of all gasoline sold is assumed to be used by small boats). Because this source category is considered to be key source, this assumption should be checked after 10 years. Sweden informed the ERT that emissions from the navigation category are currently under review and that updates are planned.

1.A.3.a Mobile combustion: aircraft

37. The description in the NIR follows the CORINAIR definitions, but would be better summarized according to the IPCC classifications. The assumptions used for the modelled approach for the years 1990–1994 are given. Because this is considered to be a key source, more specific information (at least for the base year 1990) is needed. Sweden clarified that for aircrafts the IPCC classification has been followed, and expressed its intention to provide additional information in its 2004 submission.

Solid fuel transformation

38. CO_2 emissions from solid fuel transformation were reported as a key source. Both the methodology and the EFs used are country-specific but not enough detail is given to enable comparison with the IPCC methodology. The ERT recommends that Sweden provide appropriate details. The CO_2 emissions from solid fuel transformation exhibit large inter-annual fluctuations and there is a net increase in the emissions of 15.0 per cent from 1990 to 2001. No explanation is given for the large inter-annual fluctuations. The IEF for emissions from solid fuels is rather low (3.2 kg/t) compared to those reported by other countries. Sweden should look closely at these estimates again. Sweden indicated that the methodology for emissions from the iron and steel industry has been improved, and that additional information would be provided in its 2004 submission.

D. Non-key sources

1.A.3.c Mobile combustion: railways

39. CH_4 emissions are estimated primarily as a share of hydrocarbons. Separation follows the CORINAIR relation between NMVOC and CH_4. The IEF for liquid fuels (2.9 kg/TJ) is among the lowest of all reporting Parties (range 2.4 to 40 kg/TJ).

40. For N_2O emissions, the CORINAIR default EFs are used. The IEF for liquid fuels (28.6 kg/TJ) is among the highest of all reporting Parties (range 0.6 to 32.2 kg/TJ).

Fugitive emissions: oil and gas operations

41. Both the methodology and the EFs used are country-specific but not enough detail is given to enable comparison with the IPCC methodology. The ERT recommends that Sweden provide appropriate details. Sweden indicated that methodological descriptions would be provided in its 2004 submission.

42. Emissions from the transportation and handling of oil and natural gas, as well as venting and flaring, are reported as "included elsewhere" ("IE") but no explanation is given as to where they are included. Sweden should provide the appropriate explanation. Sweden indicated that some fugitive emissions have been revised and further disaggregated for its 2004 submission.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

43. Emissions from this sector decreased by 3.9 per cent between 2000 and 2001, and are now 2 per cent above 1990 levels. CO_2 emissions from industrial processes have increased by 4.5 per cent since 1990, while CH_4 emissions have increased by more than 39 per cent. N_2O emissions decreased by almost 34 per cent and HFC emissions increased 90-fold between 1990 and 2001. PFC emissions decreased by 39.3 per cent over the period, while SF_6 emissions increased by 20 per cent.

44. In 2001, individual GHGs from this sector contributed 8.2 per cent of total CO_2 emissions, 0.1 per cent of total CH_4 emissions, and 6.7 per cent of total N_2O emissions.

45. The Swedish inventory provides as comprehensive an accounting of GHGs and precursors as any inventory reviewed to date. The information on precursor gases is more complete than that in most of the inventories provided by other Parties.

46. Some of the issues noted by the ERT and addressed by the Party are related to the quality or method of reporting by industrial facilities. In many cases this type of reporting will improve the accuracy of estimates, but without proper institutional and legal arrangements to manage these data the quality of the overall inventory may be reduced. Sweden informed the ERT about the collection of information and data from operators (i.e. through environmental reports) and the QC performed (i.e. data comparisons and reasonableness checks), as well as about ongoing projects with the aim to improve and secure the quality and dataflow of reporting from industrial facilities. The ERT encourages Sweden to report on the outcome of those projects in its future submissions.

47. The Swedish methodology for estimating HFC, PFC and SF_6 emissions is only available in Swedish. The ERT would appreciate an English translation of this background document for this key source. Sweden indicated to prepare an overview of this document, including description of the models used.

B. Key sources

2.A.1 Cement production – CO_2

48. Emission estimates for this source are calculated using cement production statistics rather than clinker production. Sweden states that in 2004 these emissions would be estimated using clinker production.

2.C.3 Aluminium production – PFCs

49. The IEFs are calculated incorrectly in the CRF for the year 2001. There is a difference of a factor of 1000 compared to other years. This has been recognized by the Party and will be corrected.

50. Emission estimates for 1995–2001 were obtained from the individual facilities' environmental reports. Data for 1990 were estimated by the Swedish EPA using expert judgement. An interpolation was used to fill in the intervening years due to the lack of activity data (AD) for those years at the time of preparing the 2002 submission. Though the necessary AD were obtained meanwhile and provided in response to the draft of this report, Sweden explained that no recalculations using those data have been performed so far. The ERT would welcome a recalculation of the time series on the basis of those data, as proposed by Sweden.

2.C.4 Magnesium production – SF_6

51. The IEFs are calculated incorrectly in the CRF for the year 2001. There is a difference of a factor of 1000 compared to other years. This has been recognized by the Party and will be corrected.

2.F Consumption of halocarbons and SF_6

52. Recalculations of HFC and SF_6 emissions in 2000 are not reported in table 8(a), although the estimates have in fact changed from the 2002 submission to the 2003 submission. Sweden states that this is due to an error in the reported emissions of HFCs and SF_6 in recalculation table 8(a). The estimates for HFCs and SF_6 in the 2000 inventory have been revised upwards by 0.9 and 1.2 per cent, respectively. Sweden clarified that those recalculations concern HFC-134a from foam blowing, updated information on aerosols, and better data for leakage of SF_6 from equipment.

53. A model was used to estimate emissions of HFCs and PFCs. The AD for the consumption of PFCs have been updated for 1995–2000; however, no explanation of which sector is affected is given. In responding to the draft of this report Sweden explained that those updates concern semiconductor manufacture. The ERT would welcome that such explanations be provided in the 2004 submission.

C. Non-key sources

2.A.2 Lime production – CO_2

54. The ERT would appreciate a more detailed and clearer description of the method used including the basis of the AD and the EF used. Sweden indicated it will provide revised emission data as well as more detailed information in its 2004 inventory submission.

2.A.4 Soda ash production and use – CO_2

55. These emissions are reported as "not estimated" ("NE") but no explanation is given in the NIR or CRF table 9 as to why they are not estimated. Sweden indicated it will provide these missing emissions estimates in its 2004 submission.

2.B.1 Ammonia production – CO_2

56. Sweden reports approximately 5 kt of production of NH_3 in the NIR but states that it has not estimated emissions because of lack of data. Although Sweden indicated that discussions on these

emissions are in progress, the ERT would welcome an explanation of why a default estimate cannot be provided.

2.B.2 Nitric acid production – N_2O

57. Emission estimates were obtained from the industrial facilities except for 1991–1993, for which they have been estimated using a default EF. In its response to the draft of this report Sweden explained how the emission factors for those years were chosen. The ERT encourages Sweden to provide such explanation in its 2004 submission.

IV. AGRICULTURE

A. Sector overview

58. Emissions of CH_4 from enteric fermentation for cattle are calculated using recently updated EFs; hence a revision has been done for the whole time series. For reindeer the IPCC tier 2 methodology was applied, and for the less significant animal groups in Sweden the IPCC tier 1 methodology was applied.

59. Recalculations integrating new EFs for CH_4 from cattle and reindeer have also been done. Deep litter is included as a separate animal waste management system (AWMS). New EFs for indirect N_2O emissions from agricultural soils are also used.

60. The AD are mainly based on official Swedish statistics and are essentially the same as those provided in the 2002 submission, but with some minor improvements. Interpolation/extrapolation has been used for the years 1990–94 and for 1996, 1998 and 2000 for which no high-quality data on the periods during which animals are stabled, waste management systems and so on are available. The ERT would welcome additional explanation, in particular for the periods during which animals are kept in stables and waste management systems in the base year. In response to the draft of this report, Sweden provided additional information regarding its data collection on manure management systems.[5] The ERT encourages Sweden to include such information in its next submission.

61. In previous inventories, national EFs were used for N_2O from agricultural soils and for background emissions from organic soils. In the current submission the use of IPCC default EFs is indicated for these sources, which explains an increase of 38 per cent in the estimates compared to the earlier submissions.

B. Key sources

4.A Enteric fermentation – CH_4

62. The 2001 CH_4 IEF for dairy cattle (127.5 kg/head/yr) was the highest among reporting Parties. Sweden has responded to a previous query on high IEFs (118–125.6 for 1990–2000) by stating that the CH_4 IEFs for Swedish dairy cattle should be among the highest of all reporting Parties because of the high milk productivity of Swedish dairy cattle, which has increased from 1990 to 2001.

63. The ERT noted high values of the CH_4 IEFs for swine (1.5–1.78 kg/head/yr) for almost all years, compared to those of other reporting Parties, as well as large inter-annual variations (13 per cent) and the

[5] Sweden provided the following information on this matter: Statistics on manure management systems for cattle and swine are published by Statistics Sweden biannually since 1997, which Sweden considers adequate as input for GHG calculations. Similar data were also collected in 1988, which were used for extrapolating solid storage (including deep litter) and liquid systems to the year 1990. For separating deep litter from solid storage, the statistics for 1997 were however used. For some years between 1990 and 1997, statistics on used manure, tabled by manure type and animal category (cattle and swine), were used for interpolating the required data on manure management systems. Statistics on stable periods for cattle have also been published biannually since 1997. In the beginning of the nineties, standard values were developed from expert judgments, which have been used for the period 1990–1994. For other less important animal groups, standard values based on expert judgments on manure management systems as well as stable periods are used for the complete time series.

fact that the IEF increased by 14.6 per cent between 1990 and 2001. Sweden has responded to queries on this in the past by stating that inter-annual variations depend on the changing distribution of animals between different subgroups in this category (sows, slaughter swine, pigs etc.) over time. Furthermore, Sweden suggests that one way of eliminating this variation would be to use three-year averages of the animal population statistics. However, the ERT suggests that it is good practice for the emissions data to contain neither overestimates nor underestimates of the annual emissions, and therefore proposes that Sweden continue using annual data. The ERT would welcome some qualitative information on the high CH_4 IEFs for swine. In responding to the draft of this report, Sweden outlined the causes for the observed IEFs values[6] and indicated to consider simplifying and increasing the transparency of its inventory in this regard in its upcoming submission. CH_4 emissions from poultry are reported as "NE", although AD (17,850,000 heads) are provided. For purposes of completeness, Sweden is encouraged to estimate CH_4 emissions from poultry. Sweden expressed its intention to investigate the need of reporting CH_4 emissions from poultry.

4.B Manure management – CH_4

64. The ERT noted a high increase (13 per cent) in CH_4 emissions from manure management between 2000 and 2001. Sweden responded that this is due to the increased use of deep litter for handling manure from "other" cattle and that, because national statistics for AWMSs are produced biannually, the increase shown for 2000–2001 represents an increase over two years.

65. The CH_4 IEF for non-dairy cattle increased by 33 per cent between 2000 and 2001, which is an unusually high increase. For purposes of transparency the Party is encouraged to explain this very large increase. As also mentioned in paragraph 64 above, Sweden explained this increase by the fact that it represents an increase over two years (1999–2001) given that for 2000 the same data as for 1999 were used due to lack of data for 2000. Sweden expects that if another interpolation method were used, the annual change would be smaller. The ERT encourages Sweden to provide such explanations in its next submission.

C. Non-key sources

4.B. Manure management – N_2O

66. The N_2O IEF for "other" AWMS seems to be at the high end of the range of reporting Parties. Sweden responded to previous queries on this issue by stating that the value of the N_2O IEF (0.02 kg N_2O-N/kg N) refers to deep litter. Sweden is encouraged to provide further explanation on the choice of the EF for AWMS as the IPCC default factor is 0.005 kg N_2O-N/kg N. Sweden informed the ERT that no research on these emissions or on national emission factors has been carried out in Sweden, and indicated that the choice of the EF for this source will be taken into consideration.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

67. Net CO_2 removals from the LUCF sector ranged from 20,292 to 33,083 Gg during the period 1990–2001, representing 35.9–59.9 per cent of the total CO_2 emissions from Sweden. No significant fluctuations have been observed. Fluctuations in the rate of harvesting were identified as a key factor determining the annual fluctuations of the net removals.

68. Sweden provided emissions/removals data for categories 5.A Changes in Forest and Other Woody Biomass Stocks and 5.D CO_2 Emissions and Removals from Soil for 1990–2001. Categories 5.B

[6] Sweden explained that emissions have been calculated based on the number of sows (assuming an average number of piglets per sow and year) given that statistics on sows are considered to be more reliable than those on piglets. The IEFs are however calculated based on the total number of animals according to the statistics. As soon as the assumed average number of piglets per sow differs from the number of piglets according to the statistics, the IEF will also differ from the used IPCC default EF.

and 5.C are reported as "NE" or as "0". For category 5.A, CRF table 5 only includes one aggregate figure for CO_2 removals under boreal forests, while sectoral table 5.A provides data also for temperate forests and "Other", as well as separate data for emissions and removals. The data reported in table 5 should be harmonized with those reported in table 5.A.

69. QC was performed during the preparation of the inventory, but no details of the process are provided. QA was partly carried out during 2002 and will be further developed in the period 2003–2004. Details are not explained. Validation of the inventory results has been carried out and the standard error has been evaluated at the level of 10 per cent (95 per cent confidence interval).

70. The estimates for category 5.A were recalculated and some inconsistencies have been identified for the year 1999 between the 2002 and 2003 submissions. These differences are not explained.

71. Forest and grassland conversion (5.B) is assumed to be of little consequence, and forest fires are not frequent in Sweden. This source category is therefore considered to be negligible.

72. Category 5.C is not reported. On the basis of the information in the NIR, abandoned lands are directly converted to forest lands, and the CO_2 emissions/removals from this land use category are therefore included in category 5.A.

B. Sink and source categories

5.A Changes in forest and other woody biomass stocks – CO_2

73. Sweden has used a country-specific methodology for the calculation of the difference between gross annual increment (increment in growing stock plus increment of harvest trees) and annual removals from stock (felling plus natural losses). The basic principles of the methodology are described in the NIR. The AD are based on data from the Swedish National Forest Inventory and the National Board of Forestry. The new updated values for biomass expansion factors have been used for the calculations.

74. Carbon uptake (table 5.A) is calculated for the categories of boreal and temperate forests and also for non-forest trees. The value entered for annual growth rates for non-forest trees seems to be low and the source of this value is not properly cited in the NIR. Table 5.A also reports data on carbon release from the subcategory other changes in carbon stocks. This subcategory includes releases from decay of forest products and slash left during the harvest, but the calculation methods and AD are not mentioned in the NIR.

5.D Emissions and removal from soils – CO_2

75. Soil carbon changes are discussed extensively in the NIR. Sweden considers that, for the reporting requirement of the soil carbon pools under category 5.D in the CRF, the available soil inventory that could be used is too uncertain at present. Category 5.D includes estimates from only liming of agricultural soils. These emissions have been estimated according to the IPCC methodology.

VI. WASTE

A. Sector overview

76. The major emission source in this sector was CH_4 from solid waste disposal sites (SWDS) (93 per cent of total waste emissions). The cause of the decreasing trend of the Waste sector emissions is a decrease in CH_4 emissions from solid waste and N_2O from waste-water handling, which is explained mainly by improved waste management (waste minimization and resource recovery) practices in Sweden.

77. The inventory is mostly complete in terms of gases, sources and years covered. Plans to include emissions from compost are included.[7] Very transparent statistics are included that allow for reconstruction of the inventory. The NIR provides improved information on industrial waste, although the ERT recommends Sweden to present the basis for its gas potentials, disaggregating them according to the IPCC good practice guidance. Emissions from waste incineration are considered under Energy and are therefore not estimated here. As a result of the use of aerobic waste-water treatment plants, CH_4 emissions are considered insignificant, which is consistent with the IPCC good practice guidance. Sweden indicated that more detailed information on gas potentials would be provided in its 2005 submission.

78. References and documentation on methodologies and country-specific EFs, as well as additional information in CRF tables, are provided, enhancing the transparency of the inventory. According to the self-assessment reported in CRF table 7, estimates in the sector are of medium quality only for CH_4 from SWDS. Uncertainty analyses are not provided for each emission source. Recalculations in the sector are reported for N_2O emissions from waste water in the CRF, but are not addressed in the NIR. The recalculation results in increases of 195.4 Gg CO_2 equivalent for the base year and of 146 Gg CO_2 equivalent for 2001.

B. Key sources

6.A Solid waste disposal on land – CH_4

79. Explanations of the rationale for the choice of parameters used and references are provided in the NIR. CH_4 emissions are calculated as total CH_4 generated minus CH_4 oxidized and CH_4 recovered. Additional information and documentation boxes are provided with CRF table 6.A. The per capita waste generation rate in the CRF is very high and the percentages of composition of landfilled waste do not add up to 100. Comparisons between tier 1 and tier 2 estimates are provided and results seem to be consistent. The proportion of wood in the construction and demolition stream has not been considered for the calculation of DOC_f. Information on recovered CH_4 does not state the origin of the data (measurement or estimation). The ERT recommends that the explanation be expanded. Sweden expressed its intention to provide information on recovered CH_4 in its 2005 submission.

C. Non-key sources

6.B Waste-water handling – N_2O

80. Emissions are calculated based on nitrogen in discharged water. A correction factor to cover sources not accounted is applied.

81. CH_4 emissions from waste water are also considered to be zero because of the use of aerobic waste-water treatment plants. The ERT recommends Sweden to apply the notation key "IE" for CH_4 waste-water handling emissions from sludge. Sweden expressed its intention to follow this recommendation in its 2004 submission.

6.B Emissions from human sewage – N_2O

82. This category is not reported separately in the NIR, but is used for populations without waste-water treatment plants. The data for protein consumption are included in the CRF and are assumed to be the same for the whole period 1990–2001. The estimate used is derived from a national value. The figure (32.8 kg protein/person/yr) is correctly presented in the NIR, but not in the CRF. This results in a high IEF.

6.C Waste incineration

83. Estimations are provided elsewhere for this category owing to energy use of incineration even from toxic waste.

[7] In responding to the draft of this report, Sweden indicated that emissions from compost would be considered as "not occurring" in its 2004 submission.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

2002 and 2003 Inventory submissions of Sweden. 2003 submissions including CRF for years 1990–2001 and an NIR.

UNFCCC secretariat (2003). "Report of the individual review of the greenhouse gas inventory of Sweden submitted in the year 2002" (Desk review). FCCC/WEB/IRI(1)/2002/SWE (available at http://unfccc.int/program/mis/ghg/countrep/swedeskrev.pdf).

UNFCCC secretariat. "2003 Status report for Sweden" (available at http://unfccc.int/program/mis/ghg/statrep00/swe00.pdf).

UNFCCC secretariat. "Synthesis and assessment report of the greenhouse gas inventories submitted in 2003 Part I." FCCC/WEB/SAI/2003 (available at http://unfccc.int/program/mis/ghg/s_a2003.html); and Part II – the section on Sweden) (unpublished).

Sweden's comments on the draft "Synthesis and assessment report of the greenhouse gas inventories submitted in 2003" (unpublished).

UNFCCC secretariat. Review findings for Sweden (unpublished).

UNFCCC secretariat. "Handbook for review of national GHG inventories." Draft 2003 (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." FCCC/CP/1999/7 (available at http://www.unfccc.int/resource/docs/cop5/07.pdf).

UNFCCC secretariat. "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/2002/8 (available at 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 at http://www.ipcc-nggip.iges.or.jp/public/gp/gpgaum.htm).

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

B. Additional materials

Responses to questions during the review were received from Ms. Pettersson (Swedish Environmental Protection Agency) including additional material on the methodology and assumptions used.

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