UNITED NATIONS
NATIONS UNIES

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

FCCC/WEB/IRI(3)/2002/SWE 26 September 2003

REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY OF SWEDEN SUBMITTED IN THE YEAR 2002[1]

Centralized review

I. OVERVIEW

A. Introduction

1. The Conference of the Parties (COP), by its decisions 6/CP.5 and 34/CP.7, requested the secretariat to conduct individual reviews of greenhouse gas (GHG) inventories submitted by Parties included in Annex I to the Convention (Annex I Parties), according to the "UNFCCC guidelines for the technical review of GHG inventories from Annex I Parties", hereinafter referred to as the UNFCCC review guidelines.[2] The principal objectives[3] of the review of the GHG inventories are to ensure that the COP has adequate information on GHG inventories and GHG emission trends, and to examine the information submitted by Annex I Parties in accordance with the UNFCCC reporting guidelines[4] for consistency with those guidelines.

2. The centralized review of Sweden took place from 9 to 13 September 2002. It was carried out by a team of nominated experts from the roster of experts, working at the headquarters of the UNFCCC secretariat in Bonn). The assignments of the experts were as follows: generalists – Mr. Bernd Gugele (European Community) and Mr. Marius Taranu (Republic of Moldova); energy – Mr. Lambert Schneider (Germany) and Mr. Mohammad Soltanieh (Iran); industrial processes – Ms. Deborah Shafer (USA) and Mr. Mauro Meirelles de Oliveira Santos (Brazil); agriculture – Ms. Anna Romanovskaya (Russian Federation) and Mr. Tomoyuki Aizawa (Japan); land-use change and forestry – Mr. Aquiles Neuenschwander (Chile) and Mr. Daniel Martino (Uruguay); waste – Mr. Davor Vešligaj (Croatia) and Mr. Jens E. Frøiland Jensen (Norway). Mr. Jens E. Frøiland Jensen and Mr. Marius Taranu were the lead reviewers for this centralized review. The review was coordinated by Ms. Astrid Olsson and Ms. Sevdalina Todorova-Brankova (UNFCCC secretariat).

3. In accordance with the UNFCCC review guidelines, 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.

---

[1] In the symbol for this document, 2002 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] For the UNFCCC review guidelines and decision 6/CP.5 see document FCCC/CP/1999/7, pages 109 to 114 and 121 to 122, respectively.

[3] For the objectives of the review of GHG inventories see document FCCC/CP/1999/7, page 109, paragraph 2.

[4] The 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/P/1999/7), are referred to in this report as the UNFCCC reporting guidelines.

B. Inventory submission and other sources of information

4. In its 2002 submission, Sweden submitted common reporting format (CRF) tables for the years 1990–2000. Sweden submitted a national inventory report (NIR) in 2002 including for each sector a description of the methodologies used, activity data and emission factors. The submission was received in the secretariat on 11 April 2002.

5. The status report 2002 and the draft 2002 synthesis and assessment (S&A) report, together with the previous status reports and S&A reports and the reports of the desk and in-country review of Sweden's 2001 GHG inventory,[5] were made available to the review team. The Party provided additional information and clarification during the review upon request from experts. The Party's responses are taken into consideration in this report. The full list of materials used during the review is provided in annex I to this report.

C. Emission profile, trends and key sources

6. In the year 2000, the most important GHG in Sweden was carbon dioxide (CO_2), which accounted for 80.5 per cent of total[6] national GHG emissions expressed in CO_2 equivalent, followed by nitrous oxide (N_2O), 10.0 per cent, and methane (CH_4), 8.5 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) contributed 1 per cent of the overall GHG emissions in the country. By source, energy accounted for 77.5 per cent of total emissions, agriculture 10.8 per cent, industrial processes 8.7 per cent, waste 2.9 per cent and solvent and other product use 0.2 per cent.

7. Emissions of CO_2, excluding Land-use, change and forestry (LUCF), were in 2000 just below the 1990 level (by some 0.4 per cent). In the Energy sector, CO_2 emissions from IPCC category 1.A.4 (Other sectors) decreased by 28.5 per cent, whereas emissions from transport (+4.4 per cent), manufacturing industries (+6.6 per cent) and energy industries (+5.2 per cent) showed increases. N_2O emissions decreased by 3.6 per cent between 1990 and 2000, mainly due to reductions in emissions from agricultural soils (–5 per cent), chemical industry (–21.3 per cent) and manure management (–19.6 per cent). CH_4 emissions have decreased significantly, by some 13.8 per cent, driven mainly by the reduction of emissions from solid waste disposal on land (–20.3 per cent), fuel combustion (–28.9 per cent) and enteric fermentation (–7 per cent). Emissions of HFCs, PFCs and SF_6 are quite small (1 per cent) but grew rapidly during the period 1990–2000 (+36.1 per cent). Total GHG emissions (without CO_2 from LUCF) decreased by 1.7 per cent between 1990 and 2000.

8. Sweden has performed the key source analysis using the IPCC tier 1 level and trend assessment method to identify its key sources for all years reported as part of its 2002 submission. The analysis was presented in the NIR according to the *IPCC good practice guidance and Uncertainty Management in National Greenhouse Gas Inventories*, hereinafter referred to as the IPCC good practice guidance. It is noted that some differences were found, for both level and trend assessment, between the key source analysis provided by Sweden and the independent preliminary key source analysis of the secretariat.[7] The main reason for these differences may be the more detailed category and fuel split used by Sweden. The ERT encourages the Party to elaborate on its conclusions based on the key source analysis as regards future improvements of the inventory. In its response to the draft version of this report, Sweden explains

---

[5] See documents FCCC/WEB/IRI(1)/2001/SWE and FCCC/WEB/IRI(2)/2001/SWE.

[6] Total national GHG emissions refer to aggregate emissions of CO_2, CH_4, N_2O, PFCs, HFCs and SF_6, all expressed in terms of CO_2 equivalent, excluding CO_2 emissions/removals from LUCF.

[7] The UNFCCC 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. They may differ from the key sources identified by the Party itself.

that it is developing priorities for the implementation of the IPCC good practice guidance and the contribution to uncertainties. The latter is based on the key source analysis.

D. General assessment of inventory

9. The national inventory submitted by Sweden is generally in conformity with the UNFCCC reporting guidelines. The methodology used to estimate GHG emissions is 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. Areas for further improvement are identified in paragraphs 16 and 17 below and in sections II–VI for sector-specific aspects.

1. Completeness

10. Sweden submitted inventory data for the years 1990 to 2000 using the CRF including all gases requested (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6), as well as precursor gases nitrogen oxides (NO_x,) carbon monoxide (CO), non-methane volatile organic compound (NMVOC) and sulphur dioxide (SO_2)) and almost all tables requested (except tables 2(II).F, 3.A-D, 5.A to 5.D). The CRF was accompanied by an NIR. Notation keys were widely used in the CRF.

2. Transparency

11. The NIR for Sweden generally adheres to the UNFCCC reporting guidelines. The NIR includes annual information from the base year 1990 to the 2000 inventory year by providing the copies of the CRF tables as appendices. The NIR submitted describes activity data, methods and emission factors used to compile the inventory. The expert review team (ERT) notes that the NIR also includes information on uncertainties, quality assurance/quality control (QA/QC), differences from previous submissions, forthcoming improvements and a key source analysis. More detailed information on uncertainty estimates would increase the transparency of the Swedish submission. Sector specific recommendations for improving transparency are included in sections II-VI below.

3. Recalculations

12. The ERT notes that Sweden reported recalculations in table 8(a) for the period 1990–1999 (with a few gaps as concerns F-gases), and brief explanations were given in table 8(b) and the NIR. The recalculated 1990 total GHG emissions were 2.04 per cent (with LUCF) and 1.44 per cent (excluding LUCF) above the value of the previous submission. The corresponding values for 1999 are –6.83 per cent (with LUCF) and –0.23 per cent (without LUCF). The main sectors affected by the recalculations are Industrial processes (1990 and 1999) and LUCF (1999). The main reasons for recalculations are correction of errors (CO_2 from metal production, CH_4 and N_2O from industrial processes), the updating of scenario estimates with measured data (LUCF), and the updating of activity data (HFCs).

4. Uncertainties

13. The Swedish NIR provided overall estimates of quantified uncertainty for each GHG. The NIR refers to the general use of national statistics as part of its discussion on uncertainty, but no information is provided on how uncertainties were quantified, and no results were provided for uncertainty determinations at the source category level. According to Sweden's responses to the draft 2002 S&A report and the draft version of this report, information on how uncertainties were quantified will be included in the coming years, and uncertainty determination at the source category level will also be provided with future submissions (particularly, in 2004 inventory submission). Table 7 of the CRF reports qualitative estimates of the uncertainty for GHG source and sink categories.

5. Quality assurance/quality control (QA/QC)

14. The Swedish NIR indicates that some QC was performed in the preparation of the inventory, but it does not indicate what QC procedures were actually implemented. The NIR also states that, apart from UNFCCC reviews, QA with independent review of the inventories has not yet been carried out. According to the NIR, some of the IPCC good practice guidance for QC has been implemented, but not that for QA. Sweden does not currently conduct a third party review or a public review. Verification is done through inventory review conducted by UNFCCC. However, in its response to the draft version of this report, the Party states that during 2003 a project was conducted to develop a plan for how to implement QA/QC procedures in accordance with the IPCC good practice guidance. The implementation will begin during 2004 and the first results will appear in the 2005 inventory submission.

6. Issues related to previous reviews

15. Sweden addressed some of the issues and problems identified during previous reviews. The ERT notes that emissions were reported from the following source/sink categories which were lacking in the last submission: CO_2 emissions from LUCF (emissions and removals from soils); methane emissions from the Energy sector (international bunkers – marine); and N_2O emissions from the Energy sector (civil aviation, railways, and international bunkers – aviation). In addition, Sweden performed a key source analysis according to the IPCC good practice guidance.

7. Areas for further improvement

16. Sweden has noted the following areas for further improvement:

(a) Review the emission factors for combustion within energy sector. This will be done during 2003 and the emission factors will be ready for use in 2004, time series calculated from revised emission factors will be included in the 2005 inventory submission;

(b) Analyse the differences between the reference and the sectoral approaches. This is done every year as a QC procedure and measures are taken to decrease the differences;

(c) Report emissions from flaring in section 1.B and not in section 1.A as at present. This will be done in the 2004 inventory submission;

(d) Improve the time series for transport emissions of CH_4, N_2O, NO_X, CO, NMVOC, and SO_2 for the years 1990–1999 by performing recalculations to ensure a consistent time series in the 2003 inventory submission;

(e) Recalculate SO_2 emissions in the iron and steel industry. They are included in the 2003 inventory submission;

(f) Improve the emission calculations of biomass burning in the residential sector. Sweden is revising the emission factors for CH4 and NMVOC and they will be used in the inventory submission of 2004;

(g) Revise the methodology in the sector Solvent and other product use. The time series has been recalculated in the 2003 inventory submission;

(h) Revise methane emissions from enteric fermentation of cattle which has been implemented in the 2003 inventory submission;

(i) Elaborate further the implementation of formal QA/QC procedures in view of the full adoption of the IPCC good practice guidance which is being developed and will be implemented in the 2004 inventory submission.

17. In addition to the issues mentioned in paragraph 16 the ERT encourages Sweden to:

(a) Provide an uncertainty analysis according to the IPCC good practice guidance, which will be included in the 2004 inventory submission;

(b) Elaborate on the basis of the key source analysis conclusions as regards the future improvement of the inventory.

II. ENERGY

A. Sector overview

18. In 2000 the Energy sector contributed 77.5 per cent of total greenhouse gas emissions in Sweden (without LUCF). In 2000, GHG emissions in the energy sector were 1.0 per cent below the 1990 level. As Sweden does not produce coal, oil or natural gas, fugitive emissions are very low, contributing only 0.5 per cent to emissions in the energy sector. Large quantities of electricity in Sweden are produced in hydro and nuclear power plants. Therefore, GHG emissions from energy industries in 2000 were about 21 per cent less important than emissions from road transportation (35 per cent) and manufacturing industries and construction (25 per cent). Emissions from energy industries vary significantly from year to year depending on precipitation and temperature: CO_2 emissions from energy industries were lowest in 2000 (about 5 million tonnes) and highest in 1996 (about 12 million tonnes). Biomass is also an important fuel in Sweden, contributing in 2000 about 18 per cent to fuel combustion.

19. The CRF tables in the energy sector are complete and notation keys have mostly been used correctly. The NIR provides a general description of methodologies. However, the information provided is rather general and in some cases vague. Only the general approach is described, but methodologies are not explained in detail. Uncertainty is described in a qualitative manner. The ERT welcomes the fact that Sweden describes the deficiencies of the inventory and plans to revise its estimates. There are several cases where emissions have been allocated differently for a single year or some years, or different methodologies have been used for different time periods. This may cause time series inconsistencies. The ERT encourages Sweden to improve the description of methodologies in the NIR and, where possible, to use the same methodologies and the same allocation of emissions for the whole time series. In its response to the draft version of this report, Sweden states that in the 2004 inventory submission more information on methodologies used and relevant information on the Swedish inventory will be included. The use of notation keys will also be corrected in the 2004 submission.

20. Emission factors and thermal heating values are provided in a very transparent manner for the whole time series, except for mobile sources, where they are only provided for 2000 as emission factors were not available for mobile sources for the period 1990-1999. The illustration of emission factors could be further improved if a reference were provided for each emission factor, if the selection of emission factors were described in the NIR (country-specific, default, etc.) and if emission factors for mobile sources were also reported for other years than 2000. In its response to the draft version of this report, the Party states that the whole time series for mobile sources was recalculated in the 2003 submission and emission factors were provided in the NIR. References for emission factors and descriptions of how emission factors were selected will be considered in the NIR for the 2004 inventory submission.

21. According to the CRF table 8(a), greenhouse gas emissions in the Energy sector have been recalculated for the years 1990 and 1991 (fuel combustion and fugitive emissions), 1995 (fugitive CH_4 emissions) and 1996 (fuel combustion). These recalculations are not mentioned or explained in the NIR (the NIR mentions only other gases than CO_2, CH_4 and N_2O for the Energy sector). The CRF table 8(b) provides only a very general explanation, which addresses only a part of the recalculations. The ERT recommends that all documented and explained recalculations be in a transparent manner. In the response to the draft version of this report, the Party states that the documentation and explanations were improved in the 2003 submission and will be further improved in the 2004 submission.

B. Key sources

1. Stationary combustion

22. According to the NIR, activity data for fuel combustion in energy industries and manufacturing industries and construction are collected from different surveys. Data between 1997 and 1999 appear to be based on sample group survey and to be adjusted to energy statistics, while other years are based on data from all companies. The NIR does not provide much information on the methodologies applied or on the consequences with respect to accuracy and uncertainty. The NIR states that possible mistakes through the adjustment of data from the sample group survey for the period 1997–1999 are marginal. However, implied emission factors are partly unsteady, in particular between 1996 and 1997 and between 1999 and 2000, indicating that inconsistencies due to different data collection methods may not be negligible. Therefore, the ERT recommends analysing the cause of these time series inconsistencies and, where necessary, improving data collection methods, in particular regarding time series consistency. In its response to the draft version of this report, Sweden states that for all years except 1997–1999, data from the Swedish industrial statistics survey were used as activity data and the industrial statistics is the yearly total survey, except for 2001, when a sample survey was conducted. For 1997–1999 the industrial statistics could not be used, because the survey was conducted in a way not suitable for the emission inventory. To be able to identify the necessary information, the Party had to rely on quarterly statistics for the 1997–1999 years. Currently, it is not possible to improve the figures for 1997–1999 and the only way to adjust the time series is to interpolate over the years 1996–2000, however, this might not necessarily be an improvement since valuable information from the quarterly statistics would then be lost.

23. The CO_2 IEFs for solid fuels in the category 1.A.1.a Public electricity and heat production is considerably lower during the period 1990–1996 (about 95–96 t/TJ) than in the years thereafter (about 101 t/TJ). In the response to the draft version of this report, the Party states that there has been a transition from use of LD gas and peat, which dominated earlier years, to more use of blast furnace gas in this source category. As these fuel types have different emission factors, the result is a change in IEFs. The CO_2, CH_4 and N_2O IEFs for liquid fuels in the category 1.A.1.b Petroleum refining have constant values from 1990 to 1999 (76.2 t CO_2/TJ, 2 kg CH_4/TJ and 5.0 kg N_2O/TJ) and decrease in 2000 to 68.8 t CO_2/TJ, 1.52 kg CH_4/TJ and 3.6 kg N_2O/TJ, respectively. Also in manufacturing industries and combustion, several time series inconsistencies of IEFs indicate that the allocation of emissions and allocation of activity data do not correspond well. For example, the CO_2 IEFs for solid fuels in the subcategory 1.A.2.a Iron and steel is considerably higher in 2000 than in all other reported years, and in the subcategory 1.A.2.b Non-ferrous metals and 1.A.2.c Chemicals vary significantly. For instance, in category 1.A.2.b it amounts to about 89 t/TJ in 1990–1991, to about 80 t/TJ in 1992–1994, to 94 t/TJ in 1995–1996, to 103 t/TJ in 1997–1999 and to 91 t/TJ in 2000. Inconsistencies can also be found in the category 1.A.4 Other sectors: for example, CO_2 emissions in the commercial/institutional sector are reported to have exactly the same quantity in 1992 and 1993 (2.47 Gg), whereas in most other years no emissions or larger emissions (11 Gg in 1997) are reported. Several other examples could be mentioned. The ERT recommends that Sweden check these inconsistencies and improve the accuracy of emission and activity data estimates. In its response to the draft version of this report, Sweden states that the time series for 1.A.1.b, 1.A.2.a, 1.A.2.b and 1.A.2.c are under revision and revised data will be submitted in the 2004 submission. The fluctuations in 1.A.2.b are not due to old methods but to real fluctuations in what fuel types have been used. Also, the reporting of sector 1.A.4.a is correct according to the current guidelines, activity data are collected from a publication from Statistics Sweden, in which data are given with only one digit and rounding off errors may occur causing fluctuations in the time series.

24. According to Sweden's key source analysis, N_2O emissions are a key source for some fuel combustion activities. In the NIR, methodologies for the estimation of N_2O emissions from stationary combustion are not described. N_2O emission factors from stationary combustion appear to be relatively high compared with those reported by other Parties. The N_2O emission factors, which are listed in the

NIR, are differentiated according to fuels and sectors but not according to technology types, as is good practice for key sources. The ERT encourages Sweden to check its N_2O emission factors, to disaggregate activity data by technology type as well, allowing for technology-specific emission estimates, and to document the methodologies in the NIR. In the response to the draft version of this report, Sweden states that it is aware that the N_2O emission factors are too high and they are presently being reviewed in order to deliver revised emission data in the 2005 submission.

2. Mobile combustion

25. In the NIR it is stated that several emissions in the transport sector are allocated in 2000 differently from other years. Sweden reports in its NIR that corrections have been made to diesel consumption in road transportation in order to reflect the private storing of diesel as a result of expected price increases. It would be helpful to provide in the NIR quantitative information on these corrections. According to the NIR, for the estimation of non-CO_2 emissions Sweden uses two different models for 1990–1994 and 1995–2000, which makes emission estimates not directly comparable. Sweden notes in its NIR that from 1990 to 1994 CH_4 and N_2O emission estimates from road transportation are only available on an aggregated level. Sweden plans to revise these data in order to achieve consistent time series and consistency with the methodology for CO_2 emissions. In the response to the draft version of this report, Sweden explains that it has revised its emission estimates in the 2003 submission for a consistent time series, the minor exception being non-CO2 emissions from off road vehicles and other working machinery. These emissions will be recalculated in the 2004 submission. Sweden further states that the correction for private storing of diesel that was previously used was removed in the 2003 submission since it was found that it was not in accordance with the IPCC Guidelines.

26. In road transportation (category 1.A.3.b), the CO_2 IEF for diesel oil is lower in 1998 and 1999 than in all other years, where the IEF has a constant value of 75.3 t/TJ. In contrast, the CO_2 IEF for gasoline in road transportation as well as navigation (category 1.A.3.d) has a higher value in 1998 and 1999 than in all other years (constantly 72.6 t/TJ). This indicates that possibly emissions and/or activity data have not been separated correctly between diesel oil and gasoline in 1998 and 1999. The CO_2 IEF for diesel oil for road transportation is also relatively high compared with those of other reporting Parties, including the neighbouring countries Finland, Norway and Denmark. Several implied emission factors for road transportation vary considerably over the time series: the CO_2 IEF for gaseous fuels (51–65 t/TJ), the CH_4 IEF for diesel oil (5–15 kg/TJ) and the N_2O IEF for diesel oil (1.0–3.5 t/TJ). The CO_2 IEF for liquid fuels in Other transportation (category 1.A.3.e) is lower in 1998, 1999 and 2000 (about 72.5 t/TJ) compared with a constant value of 75.1 t/TJ in all other reported years. Generally, CH_4 emission factors in road transportation appear to be relatively high compared with those of other reporting Parties. The ERT recommends that Sweden check these inconsistencies and improve its estimates where necessary. In its response to the draft version of this report, the Party states that these inconsistencies will be checked and estimates improved in the 2003 and 2004 inventory submissions.

C. Non-key sources

1. Civil aviation, railways and navigation

27. N_2O emissions from civil aviation have only been estimated in 2000, CH_4 emissions from jet kerosene have not been estimated in 1990 and CH_4 emissions from aviation gasoline have only been estimated in 2000. The CH_4 IEF for jet kerosene decreases significantly from 1990 to 2000, with a sharp decrease by 54 per cent from 1999 to 2000. The CO_2 IEF for liquid fuels for railways is lower in 1998 and 1999 than in all other years, where the IEF has a constant value of 75.3 t/TJ. N_2O and CH_4 emissions from railways are only estimated in 2000. The CH_4 IEF for residual oil for navigation is out of the usual range in all reported years (amounting to 3,500 kg/TJ), except in 2000. N_2O emissions from residual oil for navigation are only reported from 1997 to 2000 and the IEF varies considerably (from 0.3 t/TJ to 33 t/TJ).

CH_4 and N_2O emissions from gas/diesel oil and gasoline for navigation are only reported in 2000. Activity data for civil aviation and navigation appear to differ from data reported to the International Energy Agency (IEA). The ERT recommends that Sweden complement the complete missing data, check the inconsistencies and improve its estimates where necessary. Sweden, in its response to the draft version of this report, explains that non-CO_2 emissions have been recalculated in the 2003 submission and that the time series are now consistent.

2. Fugitive emissions

28. In CRF table 1.B.2, most fugitive emissions are reported to be included elsewhere (IE). The NIR and table 9 of the CRF do not provide information as to where these emissions are included (except for emissions from venting and flaring which are stated to be included under Manufacturing industries and combustion). Sweden clarifies in its response to the S&A 2002 report that these fugitive emissions were not reported. It also appears rather unlikely that fugitive emissions from transportation and distribution of natural gas may not occur, as stated in the NIR. Sweden does not describe transparently the methodologies used for the estimates that are provided. Fugitive CO_2 and CH_4 emissions from oil vary significantly from year to year and in 2000 are about ten times less than in 1990. Fugitive emissions from oil and natural gas are reported as not occurring (NO) in 1999, but estimates are provided for all other years. The ERT recommends that Sweden improve the methodologies used to estimate fugitive emissions, applying at least the tier 1 approach of the IPCC Guidelines, report fugitive emissions from oil and natural gas separately and completely in the respective CRF tables, and describe in its NIR the methodologies applied to estimate these emissions. In the response to the draft version of this report, the Party states that in sector 1.B.2 the reported transmission losses of gas works gas and natural gas are measurement differences and do not necessarily correspond to any real emissions. Sweden further states that it is aware that fugitive emissions of oil and natural gas are probably not fully covered in the Swedish inventory and that further improvements will be made in future submissions.

D. Reference and sectoral approaches

29. CO_2 emissions from fuel combustion were calculated using the reference and the sectoral approaches. The difference between the two approaches amounted to 5.15 per cent in 2000. The difference is more significant for fuel consumption, where estimates based on the reference approach are 11–17 per cent higher than estimated based on the sectoral approach during 1990–2000. In appendix 12 of the NIR, Sweden in a logical manner adds those emissions (which are not accounted for in table 1.A.c) to the estimates arrived at on the basis of the sectoral approach, in order to make the two approaches more comparable. The emissions not accounted for in table 1.A.c are energy-related CO_2 emissions in industrial processes and fugitive CO_2 emissions. If these emissions are accounted for, the difference of CO_2 emissions is less than 2 per cent in most years. However, no explanation is provided for the remaining difference, which amounted to 4.7 per cent in 1998, 4.1 per cent 1995, 2.2 per cent in 1994 and 2.8 per cent in 1992. The ERT encourages Sweden to analyse and explain the remaining differences. In the response to the draft version of this report, Sweden states that the main explanations behind remaining differences between the reference and sectoral approaches is that different data sources are used for different approaches. It also states that according the IPCC good practice guidance the observed differences are in the range of the uncertainties resulting from systematic and random errors of ±5% for countries with well-developed energy data systems.

30. There are several differences between the apparent fuel consumption reported to the IEA and that reported in the CRF. Apparent consumption of liquid fuels is 12.1 per cent higher in the CRF, while solid fuels are 3.2 per cent lower. The ERT encourages Sweden to check the differences and to improve the consistency of data reported to the IEA and in the CRF. In its response to the draft version of this report, the Party states that two reporting organisations, Statistics Sweden and the Swedish Energy

Agency, have started a process aiming at finding consistency between different reporting mechanism, in order to minimise the divergence from IEA statistics in the future.

E. Bunker fuels

31. The NIR does not describe thoroughly how international aviation fuel consumption has been separated from domestic aviation fuel consumption. The NIR is also unclear and inconsistent with respect to the separation of national and international marine fuels. In chapter 1.2.1.2 (CO_2 emission), it is stated that emissions are calculated on the basis of a survey sent to wholesale dealers. In chapter 1.2.1.3 Non-CO_2 emissions, it is stated that this approach has only been chosen for the year 2000, while for all other years data have been collected from the Swedish Maritime Administration. According to the documentation box in table 1.C, in all years fuel consumption of marine international bunkers is reported separately in *Swedish Energy Statistics*. The ERT encourages Sweden to provide a more detailed and consistent description of how national and international fuel consumption have been separated and how emissions have been calculated. In the response to the draft version of this report, Sweden states that these calculations will be described in a consistent and transparent manner in the NIR of the 2004 submission.

32. CH_4 emissions from international marine bunkers have only been estimated in 2000, N_2O emissions from gas/diesel oil only in 1996 and 2000, and N_2O emissions from residual fuel oil only in 1995 and from 1997 to 2000. CH_4 emissions from international aviation bunkers have not been estimated in 1990, N_2O emissions have only been estimated in 2000. The ERT encourages Sweden to provide the missing data. Sweden, in its response to the draft version of this report, explains that the non-CO2 emissions were recalculated and a consistent time series reported in the 2003 submission.

F. Feedstocks and non-energy use of fuels

33. Sweden estimates feedstocks and non-energy use of fuels. In the CRF table 1.A.d it is assumed that all carbon from feedstocks is stored. However, no explanation is provided for this assumption in the documentation box or in the NIR. In its response to the draft version of this report, the Party states that most raw materials in different products are reported as "non energy use of fuels", hence emissions will occur first when the products in the end are combusted as waste. However, the ERT encourages Sweden to document and explain the underlying assumptions in the estimation of feedstocks and the fraction of carbon stored in a more transparent manner.

III. INDUSTRIAL PROCESSES AND SOLVENTS USE

A. Sector overview

34. Emissions from industrial processes represented around 8.7 per cent of total emissions (without LUCF), in terms of CO_2 equivalent in 2000 (0.7 per cent more than in 1990). CO_2 emissions amounted for 76.5 per cent of the CO_2 equivalent emissions within the Industrial processes sector in 2000, with cement production being responsible for 66.5 per cent of these CO_2 emissions. In the period 1990–2000, the increase of industrial processes CO_2 equivalent emissions was 6.5 per cent, due mainly to fluorinated gases (although cement production decreased by 11.5 per cent in the same period). Emission factors, equipment lifetimes, and trends for emissions and sources of the fluorinated gases are generally consistent with those in the IPCC good practice guidance and those used in other countries. Methodologies for CO_2 were country-specific, while methodologies for N_2O and CH_4 were CORINAIR. Emission factors for CO_2, N_2O and CH_4 were country-specific. As discussed below, the transparency of the Swedish inventory for industrial processes varies. Some activity data were reported as quantity of raw materials, not in terms of final production; thus the implied emission factors (calculated by formulae) are not comparable to the IPCC default or the IEFs of other reporting Parties.

B. Key sources

1. Cement production – CO_2 emissions

35. Sweden reports the use of limestone instead of cement production or (preferably) clinker production. The ERT recommends that the Party report the requested activity data in the CRF and then describe the methodology used to estimate the emissions in the NIR in order to assist comparison of he data of all reporting Parties. In the response to the draft version of this report, the Party states that the CO_2 emissions from cement production are currently recalculated using clinker production as activity data and the requested data will be submitted in 2004.

2. Nitric acid production – N_2O emissions

36. The ERT noted that the data activity figure presented by Sweden is 78 per cent lower than that reported by United Nations (UN). For 1990–1996 activity data were not provided. The ERT encourages Sweden to explain the differences between the CRF and UN activity data and to provide the missing activity data in its future submissions. Sweden, in its response to the draft version of this report, states that data in UN statistics are probably given in the unit kt nitrogen and data in Sweden statistics in nitric acid, which would give the same activity data. The missing activity data are provided in the 2003 submission.

3. Iron and steel production – CO_2 emissions

37. The ERT notes that Sweden reports the use of dolomite in iron and steel production instead of production of pig iron. The ERT recommends that the Party report limestone and dolomite emissions in source category 2.A.3 - Limestone and dolomite use, and report in 2.C.1 - Iron and steel production only the emissions related to the reducing agent. A description of the methodologies to estimate the emissions should be included in the NIR. This would assist comparison of data among the reporting Parties. In its response to the draft version of this report, the Party states that the requested suggestions will be incorporated and recalculated estimates will be submitted in 2004 with a proper description in the NIR.

4. Ferroalloys production – CO_2 emissions

38. In its 2002 submission, Sweden has corrected the 1990–1999 activity data that were reported in the previous submission.

5. Aluminium production – CO_2 and PFCs emissions

39. The ERT notes that the slope factor used for pre-bake aluminium smelters (which the Party provided in response to an ERT request) was 25 per cent lower than the lower end of the range provided in the IPCC good practice guidance for that technology. Sweden did not provide any explanation on the source of the "plant-specific emission factors" that it uses to estimate emissions from aluminium smelting (emissions could be based on default, technology-specific slope factors (tier 2) or smelter-specific slope factors (tier 3a)). The ERT recommends that Sweden clearly explain the source of these factors. In the response to the draft version of this report, the Party states that the necessary explanations on the source of the activity data and "plant specific emission factors" are provided in the 2003 inventory submission and the method used for estimation will be further investigated. The CO_2 IEF (3.66 t/t) was the highest amongst the reporting Parties (the IPCC default is 1.5–1.8 t/t). Sweden provides activity data for PFCs and CO_2 emissions from aluminium smelting in terms of coal elements consumed, which makes it difficult to compare Sweden's emission factors and activity levels with the IPCC values and the values used in other countries. The ERT recommends that Sweden include primary aluminium production in the CRF and describe the methodology used to derive the estimates in the NIR. Sweden in the response to the draft version of this report, states that the suggested changes and improvement will be included and more clearly stated in the CRFs and the NIR in the 2004 submission.

6. Consumption of halocarbons and SF_6 – HFCs and SF_6 emissions

40. The ERT notes that Sweden provides in the NIR complete information on many of the variables used to estimate emissions from air conditioning and refrigeration equipment and electrical equipment. However, with the exception of 'Large stationary refrigeration' and 'Air conditioning' (AC), Sweden does not provide data on equipment stock or total chemical bank in either the NIR or the CRF (table 2(II).F), and it does not provide the source of stock or bank estimates. The Party is encouraged to add stock information to the tables in appendix 14 and to refer readers to this appendix in the methodology section of the NIR. Sweden's per capita HFC emissions from refrigeration are in the middle of the range of values computed for the other countries being reviewed. In its comments, Sweden has adequately addressed the issues raised in the draft 2002 S&A report regarding the ratio of potential to actual emissions of PFCs. In its response to the draft version of this report, Sweden explains that the requested information has been provided for the year 2001 in the 2003 submission. The full time series will be included in future submissions.

C. Non-key sources

1. Ammonia production

41. The ERT notes that Sweden reports the production of and emissions from ammonia production as NO. However, according to United Nations statistics, a small amount (5 kt) of ammonia is produced in Sweden. The ERT recommends that this information be checked. In the response to the draft version of this report, the Party states that in the 2003 submission the notation key NO has been changed to the notation key NE, and the information is being checked.

2. Pulp and paper

42. The ERT recommends that the Party report the activity data for pulp and paper production for all years and not only for the year 1997, if there is no issue of confidentiality. In its response to the draft version of this report, Sweden states that the activity data for pulp and paper production are provided for all years in CRF Table 2(I).A-Gs2 under code 2.G, Other, since no space was available for reporting activity data under 2.D. The emissions in 1997 are emissions from use of lime, wrongly reported in submission 2003 and earlier. In the 2004 submission all emissions from use of lime will be reported under 2.A.3 according to the IPCC Guidelines.

3. Consumption of halocarbons and SF_6 – semiconductor manufacture

43. Sweden does not explain the origin of the surprisingly precise emission factor (0.73) that it uses for all chemicals used in semiconductor manufacturing. Emissions of hexafluoroethane (C_2F_6) from semiconductor manufacturing are denoted as NO in the CRF (table 2(II)), but C_2F_6 emissions are likely to occur, since C_2F_6 is typically the largest component of semiconductor emissions elsewhere. According to the NIR (appendix 14), it appears that the "NO" value for C_2F_6 results from the fact that C_2F_6 was not imported into Sweden in 2000. If actual use data are not available, imports are a reasonable substitute; emissions may simply be quantified before they actually occur. However, Sweden may wish to explain this in its NIR. In the response to the draft version of this report, Sweden states that the emission factor of 0.73 was provided by the producer, given as an average for semiconductor production, provided to the company by the trade association. This emission factor was previously erroneously used also for SF_6, but in the submission in 2003 the emission factor for SF_6 is assumed to be 100%. Sweden further states that since the submission in 2002 data have been obtained for 2000 not only from the Product Register as imported amount (which are the data reported in the CRF, e.g. no import of C_2F_6) but also as used amount from the semi-conductor producer. The producer has provided information that during the year 2000 0.52 ton C_2F_6 was used, and not NO as reported in the CRF. The difference in information between the Product Register on imported amount and that on used amount from the producer may either be a question

of different years of import and of use, or a problem with full coverage of data reported from importers to the Product Register.

4. Consumption of halocarbons and SF_6 – Other

44. The ERT notes that the lifetimes of Other electrical insulation and jogging shoes (60 and 8 years, respectively) appear high. The ERT recommends that Sweden re-evaluate these lifetimes. In the response to the draft version of this report, the Party states that the 60 years lifetime was set according to information from Swedish power companies, and is related to larger installations. A renewed investigation can easily be made to check this assumption. The 8-years lifetime for jogging shoes is based on information in Weholt (1999*), Substance Flow Analysis for SF_6. Assessment of time sequences of potential and real emissions* (in Norwegian), and in *UK emissions of HFCs, PFCs and SF_6 and Potential Emission Reduction Options, March Consulting Group* (1999) http://www.refrigeration-action.org/newfiles/DETRGW.pdf, where the assumption of respectively 8–10 and 8 years lifetime are given.

5. Solvent and other product use

45. It has been noted that Sweden used 1998 data to calculate emissions for all years because its methodologies are underdeveloped; no activity data were provided in the CRF tables. The ERT encourages the Party to carry out its proposal to perform a thorough inventory, including activity data, in the near future covering the whole time series. Sweden, in its response to the draft version of this report, states that a study was conducted during 2002 and recalculated time series 1990-2001 are reported in the 2003 submission.

IV. AGRICULTURE

A. Sector overview

46. The Agriculture sector accounted for 17.8 per cent of total national GHG emissions in 2000, reaching 7,469 Gg CO_2 equivalent. Over the period 1990–2000, emissions decreased by 6.5 per cent. A consistent emission time series from 1990 to 2000 is reported. Sweden reported a complete agricultural inventory using the relevant tables (4.A, 4.B(a), 4.B(b) and 4.D). GHGs reported in the Agriculture sector are CO_2, CH_4 and N_2O. The categories 4.C Rice cultivation, 4.E Prescribed burning of savannas and 4.F Field burning of agricultural residues were reported as NO. However, it is not clear from the NIR if the burning of agricultural residues (table 4.F) is not permitted in Sweden or if it is assumed not to occur. CO_2 emission was reported as IE (under LUCF). The NIR provided methodology, activity data and references for every source, and in the CRF information was presented in footnotes and additional information boxes. The activity data are based on information from Statistics Sweden. The methodology used is a combination of the IPCC good practice guidance (tier 1 and tier 2), CORINAIR and a country-specific methodology. The emission factors used are default, tier 2 and country-specific. The latter are based on an unpublished study. No uncertainty estimates according to the IPCC good practice guidance were provided for Agriculture sector. Qualitative uncertainty estimates were included in table 7. No QA/QC check according to the IPCC good practice guidance was performed in the sector.

B. Key sources

1. Enteric fermentation – CH_4 emissions

47. The IEF for dairy cattle is the highest value among the reporting Parties (154 kg CH_4/hd/yr), which is indicated in the CRF as country-specific and proposed in a report from the Swedish Environment Protection Agency. There is no additional information on how this country-specific factor was derived. The livestock characterization is updated annually, but the methane conversion factor is the same throughout the period 1990–2000. The NIR noticed that the emission factor for cattle is under review and

should be revised in the 2003 submission. The ERT encourages Sweden to continue its work on revising the emission factor for cattle. In its response to the draft version of this report, Sweden explains that the revised emission factor is used in the 2003 submission.

2. Manure management – N_2O emissions

48. Interpolation and extrapolation are used to derive the activity data for animal waste management systems (AWMS) and stable period for cattle. The ERT encourages Sweden to develop annual or periodic data collection. The N-excretion rates for swine, sheep and poultry are lower than the IPCC default ranges. This has a reasoning of change in proportion of subgroups in the population, for which enhanced characterisation is applied. The Party may wish to include these explanations in the NIR in future submissions. Sweden does not consider pasture range and paddock as AWMS. The ERT recommends replacing reporting NO for pasture range and paddock with IE and providing relevant information in the CRF and in the NIR. In the response to the draft version of this report, the Party states that in the 2003 submission, background data on nitrogen production from grazing animals are included in the table 4.B(b) on background data for AWMS, the table therefore supplies background information for emission from agricultural soils as well as AWMS.

3. Agricultural soils – direct N_2O emissions

49. The NIR indicates that data on the sales of mineral fertilizers are from Statistics Sweden. However, from the NIR it is unclear if the sales of fertilizer are equal to the input into soils. Accordingly, the proportion of emitted N-content in fertilizers calculated by using CORINAIR data could be wrong, as well as $Frac_{GASF}$, which is among the lowest values of reporting Parties. In Sweden's comments in response to questions by the ERT it is explained that statistics on fertilizers used are produced biannually and usually give lower estimates than data on sales of fertilizers. The ERT encourages the Party to continue this work and include an explanation in its future submissions. EFs for synthetic fertilizers and animal wastes applied to soils are taken from an unpublished study of Dr. Klemedtsson. The ERT suggests that the Party publish data on country-specific factors and the relevant reviewing process. Sweden, in its response to the draft version of this report, states that in the 2003 submission $Frac_{GASF}$ was recalculated, which is now based on statistics on sold fertilizers, instead of used mineral fertilizers. The former estimate has usually been somewhat lower than the sales figure, and is therefore considered a slight underestimation of the real use of fertilizers. In the 2003 submission the $Frac_{GASF}$ has been adjusted, and is now consistent with the sales statistics, and hence the estimated direct N_2O-emissions.

C. Non-key sources

1. Agricultural soils – indirect N_2O emissions

50. The IEF for N leaching and run-off is the lowest among reporting Parties. Reference is made to an unpublished study. The NIR indicates use of a leach factor per hectare (kg N-N_2O/ha) in the calculations. However, the reasoning behind changing the default IPCC factor (kg N-N_2O/kg applied N) is unclear from the NIR. This emission factor estimates N_2O emission on the basis of area only and could give equal assessment for every year independently of the amount of N input to soils. There are no explanations in the NIR of how the human-induced contribution was quantified in that case. Sweden explained in response to questions by the ERT that a national literature study of measurements from different studies undertaken in northern Europe and Canada was carried out. The estimation method, developed by the University of Agricultural Sciences depends on many parameters, such as N-fixation, climate, etc. The Party will probably be able to include a comparison of the result with the IPCC default method including comments in short form and the reference in future NIRs. The ERT encourages Sweden to carry out this work and recommends the Party to consider the possibility of updating this leach factor annually in accordance with varying N input to soils with fertilizers, crop residues, etc. In the response to the draft version of this report, Sweden states that in the 2003 submission it has revised the

inventory, and for many N_2O-sources the IPCC default emission factors are applied. Explanations for choice of emission factors are given in the NIR 2003. In the NIR 2004, a comparison between the national estimate of leaching and the IPCC-methodology will also be included.

2. Other

51. Background emissions of mineral soils and N-fixation on hayfield were calculated (reference provided to an unpublished study). The ERT suggests that the Party publish data on country-specific factors and information about the relevant reviewing process.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

52. In 2000, Sweden's total gross emissions were 69,356 Gg CO_2 equivalent, and net emissions were 42,051 Gg CO_2 equivalent, which means that LUCF accounted for more than 39 per cent of total emissions. Trend analysis of changes in LUCF carbon stocks between 1990 to 2000 important shows fluctuations in annual rates of net CO_2 uptake, although the trend over that period shows a gross increment of 34.5 per cent, since net removal was 20,292 Gg CO_2 and 27,305 Gg CO_2 in 1990 and 2000.

53. The ERT also notes that only CRF tables 5 and 5.D were completed, while CRF tables 5.A (Changes in forests and other woody biomass stocks), 5.B (Forest and grassland conversion) and 5.C (Abandonment of managed lands) are not reported. It is noted that the LUCF methodology in the NIR states that the country has a running National Forest Inventory that could provide reliable information on land use and vegetation classification, as this should be used to produce a more detailed estimation of conversion and expansion values for different regions of the country, forest types, age classes and tree species in order to improve the accuracy of the forest carbon stock estimates. This was noted by both the desk review report and the in-country review report in 2001. In the response to the draft version of this report, Sweden states that in future it will provide table 5.A, 5.B and 5.C as well as a better documentation of applied national methodology (tier 3).

54. Sweden does not report in either the NIR or the CRF tables on CO_2 and non-CO_2 gas emissions from biomass burning and cultivation of mineral soils and forest soils, although the NIR states that for the cultivation of mineral and forest soils this was attributed to a lack of available data. Sweden adopted a mix of default and country-specific methods for the LUCF sector, but failed to provide all of the documentation required by the IPCC Guidelines. In the NIR a complete time series from 1990 to 2000 is provided for sources and sinks in forest biomass, but a clear and detailed description of methodology used was not provided. This had also been noted by the in-country review report. Interpretation of tables 5.1 to 5.3 is made difficult by lack of information and some typing errors.

55. It is difficult to track every calculation of carbon stocks in managed forest land and other woody biomass, because a single figure is reported for land area (22.6 million ha) and a single conversion factor from biomass to carbon content for all types of forests (0.196 t C/m^3). In the case of the biomass expansion factor explained in the NIR, it is noted that there are some contradictions. In paragraph 4 of Forest Biomass Methodology it is stated that the expansion factor is 1.22, while in paragraph 10 it says that the factor would be 22%. But the actual factor applied in table 5.2 of the methodology is 2.3 over the stem wood increase. Comparison between Sweden's country-specific factors and the IPCC default factors indicates that the results are similar, considering the forest species composition, the carbon content of stem wood and the biomass expansion factor, since using the Swedish factor the average is 1.65 t CO_2/m^3 and the IPCC default value would be about 1.67 t CO_2/m^3. In the response to the draft version of this report, it is stated that in the future the Party will provide all conversion and expansion factors.

56. In the NIR, the "Harvested wood products" carbon pool was reported to have increased at a rate of 0.1 Tg C/yr during the period 1990–2000. As stated in the in-country review report of April 2002, this is not in agreement with the figure of 100 kt CO_2 provided in CRF table 5 sectoral report, because 0.1 Tg C is equivalent to 366.7 Gg CO_2. The same observation was stated in the desk review report of June 2002, and is mentioned in Sweden's NIR 2000. The ERT recommends that Sweden provide more detailed information on the above matters. In its response to the draft version of this report, Sweden states that in future it will provide detailed information about "harvested wood products".

B. Sink and source categories

1. Changes in forest and other woody biomass stocks

57. The ERT notes that there are large fluctuations in annual rates of net CO_2 removal, in spite of felling and natural loss rates remaining relatively constant from year to year. These fluctuations, which in several cases rounded to 10 per cent and 20 per cent between consecutive years, could have been due to a combination of several factors, including inter-annual variability in growth conditions and possibly errors in measurement procedures. Because of the paucity of information provided, it was not possible to make a proper assessment. The use of a single value for conversion factors for wood density (0.40 t dm/m^3) and carbon content in stem wood (0.49 tC/tdm), and a single value for biomass expansion factor on the stem wood carbon content (2.3), may have impaired the accuracy of the estimation of carbon stocks. Considering the availability of an extensive data set in National Forest Inventory and National Forest Site Inventory, the ERT recommends that Sweden consider providing more detailed calculations of emission factors for different forest types, age classes and regions of the country. In the response to the draft version of this report, it is stated that in the future the Party will provide all conversion and expansion factors.

2. Forest and grassland conversion

58. No information was provided in the NIR or the CRF. The ERT encourages the Party to report activity data as requested and then describe the methodology used to derive the estimates in the NIR. In the response to the draft version of this report, the Party states that in future the missing data concerning "Forest and grassland conversion" will be reported, probably as zero since they are very limited.

3. Abandonment of managed lands

59. Abandonment of managed lands was not reported. The ERT encourages Sweden to provide the missing data, reporting activity data as requested in the UNFCCC guidelines and then describing the methodology used to derive the estimates in the NIR. In its response to the draft version of this report, the Party states that in future the missing data concerning "Abandonment and grassland conversion" will be reported, probably as zero since they are quite limited.

4. CO_2 emissions and removal from soil

60. No official estimates of changes in the carbon stock of forest soils were made in the NIR, although the LUCF methodology in the NIR estimates that the humus layer of naturally well-drained forest soils could be an important sink, with increases in the carbon stock of between 50 and 300 kg C/ha/yr. The estimation of CO_2 emissions from cultivation of organic soils is sufficiently detailed. As noted in the draft 2002 S&A report, the carbon loss values reported in the NIR for cool temperate upland crops and cool temperate pasture/forest are 5.5 and 10 times larger, respectively, than IPCC default values. This was not addressed in Sweden's response to the draft 2002 S&A report. In CRF table 5.D, CO_2 emissions from liming of agricultural soils were estimated as 156.24 kt CO_2, similar to the figure for 1999, since in the NIR there was no information for year the 2000. The ERT recommends that Sweden provide an explanation for the difference between the carbon loss in the Swedish inventory and the IPCC default

values. In its response to the draft version of this report, Sweden states that for calculating CO_2 emissions from liming, statistics on sold lime to the agricultural sector, combined with IPCC emission factors, have been used, and that differences in carbon loss from one year to another depend solely on variations in sold quantities of lime.

VI. WASTE

A. Sector overview

61. Emissions from the Waste sector represented approximately 3 per cent of total GHG emissions in 2000, and there has been a 20 per cent decline since 1990, mostly as a result of changes in solid waste management practices, mostly reduced landfilling. Land disposal of solid waste is the only source category with estimated emissions in this sector. Waste incineration is reported in Energy sector, while emissions from waste-water handling and human sewage are reported as NO and NE, respectively. The first order decay method (FOD) was used for calculating CH_4 emissions from solid waste disposal system (SWDS). The model was modified with country-specific data which give more accurate emission estimates. Activity data on municipal solid waste (MSW) and industrial waste are in most cases obtained from Statistics Sweden, the Swedish Environment Protection Agency (EPA) and the Swedish Association of Waste Management, as well as from special studies and surveys. The assumptions and methodology used for estimating methane emissions from SWDS are described in the NIR. There is a detailed list of national references giving information additional to the NIR. Notation keys which are used for source categories in the CRF (tables 6, 6.A,C and additional information boxes) are not explained in the NIR. Methodology, emission factors and activity data given in the CRF and the NIR are comparable to those of other reporting Parties. Some additional information on population and waste generation and disposal should be provided in order to achieve greater comparability. All the CRF tables from 1990 to 2000 are submitted. There are some minor omissions which are specified further below. The FOD method used for estimating emissions in the period 1990–2000 is consistent with the IPCC Guidelines. Uncertainty assessments were not performed in Waste sector. It is pointed out that uncertainty assessment at the source category level will be provided in the coming years. CH_4 emissions from SWDS in the period 1990–2000 were not recalculated in the 2002 submission. In its response to the draft version of this report, the Party states that more background information on waste management are planned to be added in the NIR of the 2004 submission.

B. Key sources

1. Solid waste disposal on land

62. Land disposal of solid waste was the only source category with estimated emissions in the Waste sector. The NIR provides a list of parameters being used in the FOD model, but no additional information was provided on how some of the parameters, particularly $t_{1/2}$, were chosen. Some types of waste, for instance, commercial and market waste, are included in the household waste category in the NIR. The composition of MSW does not fully reflect new waste management practices. Depending on disposal technique (cover material, regular disposal), sewage sludge could have a significant but varying influence on gas potential. Additional information in the CRF for waste generation, recycling and treatment was only partially provided. The draft 2002 S&A report and previous review reports address the same issues. ERT recommends that Sweden review the amount of sludge disposed as a cover material in order to estimate actual amount of sludge in fact undergoing aerobic process, verify that all municipal solid waste types going to landfills have been included, and provide additional information in the CRF. In its response to the draft version of this report, the Party states that the data on sludge used in the calculations refer to land filled sludge only, which usually has been anaerobic or otherwise treated. Sludge used as cover material is considered to have no gas potential due to the more aerobic environment in the cover, and because the sludge usually is treated in compost before application.

C. Non-key sources

1. Waste-water handling

63. Emissions of methane and nitrous oxide from waste-water handling are considered to be insignificant since almost all waste water is treated in aerobic conditions. Therefore, emissions from waste-water handling are not further elaborated in the NIR, and in the CRF they are indicated as NO. Indirect emissions of nitrous oxide from human sewage are not estimated in either the NIR or the CRF. The ERT recommends that Sweden calculate emissions of nitrous oxide from human sewage in order to improve future submissions. However, it is important to point out that this source is of minor importance in comparison to key source(s). In its response to the draft version of this report, the Party states that N_2O from waste-water handling was recently calculated and reported for the first time in the 2003 submission.

2. Waste incineration

64. Waste incineration has been reported in the Energy sector, because all waste being incinerated is used for electricity and heat production. The ERT recommends that Sweden provide some additional information to show how complete its data on emissions from incinerated waste are according to IPCC Guidelines, as a check in order to improve future submissions. In its response to the draft version of this report, the Party states that all combustion of waste used for production of electricity and district heating is covered in the Swedish energy statistics. All combustion of waste for energy purposes within industries is also covered. Combustion of waste for pure destruction purposes in other facilities than SAKAB (Swedish major company, semi-public, with destruction of hazardous waste as their main work) is omitted. This is most likely a minor problem since almost all destruction takes place at SAKAB. Combustion of waste in the food- and drink industry is omitted since it is likely to take place only at very small scale. Further investigations on this issue will be conducted for future submissions.

ANNEX I: MATERIALS USED DURING THE REVIEW

A. Support materials on the CD ROM and the web page for the review

Sources of information used during the review include:

2000, 2001 and 2002 *Inventory submissions of Sweden*. 2002 submissions including CRF for years 1990–2000 and an NIR.

UNFCCC secretariat (2002). *Report of the individual review of the greenhouse gas inventory of Sweden submitted in the year 2001 (Desk review)*. FCCC/WEB/IRI(1)/2001/SWE [available at http://unfccc.int/program/mis/ghg/countrep/swedeskrev.pdf].

UNFCCC secretariat (2002). *Report of the individual review of the greenhouse gas inventory of Sweden submitted in the year 2001 (In-country review)*. FCCC/WEB/IRI(2)/2001/SWE [available at http://unfccc.int/program/mis/ghg/countrep/sweincountrep.pdf].

UNFCCC secretariat. *2000 Status reports for Sweden* [available at http://unfccc.int/program/mis/ghg/statrep00/swe00.pdf].

UNFCCC secretariat. *2001 Status report for Sweden* [available at http://unfccc.int/program/mis/ghg/statrep01/swe01.pdf].

UNFCCC secretariat. *2002 Status report for Sweden* [available at http://unfccc.int/program/mis/ghg/statrep02/swe02.pdf].

UNFCCC secretariat. *Synthesis and assessment report of the greenhouse gas inventories submitted in 2000*. FCCC/WEB/SAI/2000 [available at http://unfccc.int/program/mis/ghg/sai2000.pdf].

UNFCCC secretariat. *Synthesis and assessment report of the greenhouse gas inventories submitted in 2001*. FCCC/WEB/SAI/2001 [available at http://unfccc.int/program/mis/ghg/sai2001.pdf].

UNFCCC secretariat. *Draft synthesis and assessment report of the greenhouse gas inventories submitted in 2002* (Part I 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 2002 [unpublished].

UNFCCC secretariat. *Key source analysis for the year 2000*. [unpublished].

UNFCCC secretariat. *Handbook for review of national GHG inventories*. Draft 2002, [unpublished].

UNFCCC secretariat. *UNFCCC guidelines on reporting and review*. FCCC/CP/1999/7, [available at http://www.unfccc.int/resource/docs/cop5/07.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 provided by the Party

Responses to questions within the sector Industrial processes and solvents use during the review were received from Mr. Jörgen Fagerlund (Statistiska Centralbyrån – Sweden (Statistics Sweden)) including additional material on the methodology and assumptions used.

Answers to questions within the Agriculture and solid waste sectors during the review were received from Mr. Rolf Adolfsson (Miljöstatistik – Statistiska Centralbyrån – Sweden (Environment Statistics – Statistics Sweden)).

- - - - -