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

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

CONTENTS

I. Overview

A. Introduction

1. This report covers the centralized review of the 2005 greenhouse gas (GHG) inventory submission of Sweden, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 17 to 22 October 2005 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalists – Mr. Art Jaques (Canada) and Ms. Inga Konstantinaviciute (Lithuania); Energy – Mr. Matej Gasperic (Slovenia), Ms. Sophia Mylona (Norway) and Ms. Roberta Quadrelli (International Energy Agency (IEA)); Industrial Processes – Ms. Marisol Bacong (Philippines), Mr. Domenico Gaudioso (Italy) and Ms. Birna Hallsdottir (Iceland); Agriculture – Mr. Steen Gyldenkaerne (Denmark) and Mr. Vlad Trusca (Romania); Land Use, Land-use Change and Forestry (LULUCF) – Mr. Aquiles Neuenschwander Alvarado (Chile) and Mr. Nijavalli H. Ravindranath (India); Waste – Mr. Eduardo Calvo (Peru) and Ms. Sirintornthep Towprayoon (Thailand). Ms. Sirintornthep Towprayoon and Mr. Art Jaques were the lead reviewers. The review was coordinated by Mr. Matthew Dudley (UNFCCC secretariat).

2. In accordance with the "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention", a draft version of this report was communicated to the Government of 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 2005 submission, Sweden submitted a complete set of common reporting format (CRF) tables for the years 1990–2003 and a national inventory report (NIR). Where needed, the expert review team (ERT) also used the previous year's submissions, additional information provided during the review, and other information. The full list of materials used during the review is provided in the annex to this report.

4. In 2003, the most important GHG in Sweden was carbon dioxide (CO_2), which accounted for 79.4 per cent of total[1] national GHG emissions expressed in CO_2 equivalent, followed by nitrous oxide (N_2O), 11.6 per cent, and methane (CH_4), 7.8 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6), taken together, accounted for 1.2 per cent of GHG emissions in the country. The Energy sector accounted for 76.0 per cent of the total GHG emissions, followed by Agriculture (12.4 per cent), Industrial Processes (8.3 per cent), Waste (2.8 per cent) and Solvent and Other Product Use (0.4 per cent). Total GHG emissions amounted to 70,554 Gg CO_2 equivalent and decreased by 2.3 per cent from 1990 to 2003. Total GHG emissions, with Land-use Change and Forestry (LUCF) included, amounted to 49,055 Gg CO_2 equivalent and decreased by 5.5 per cent during the same period. The NIR provides a good summary of the factors affecting the decline in emissions. Total annual GHG emissions from energy sources increased until the mid-1990s, then declined until 2003, which marked a break in the downward trend. Nevertheless, policies (a carbon tax, grants for district heating conversions, and technology improvements) and measures (energy saving measures and fuel

[1] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 equivalent excluding LULUCF, unless otherwise specified. Sweden has not provided the tables of the common reporting format for LULUCF as required by decision 13/CP.9 using the land use categories of the Intergovernmental Panel on Climate Change *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Instead it used the common reporting format tables for Land-use Change and Forestry as contained in the common reporting format adopted by decision 18/CP.8, which are based on the categories of the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*.

switching for heating) implemented in Sweden since the early 1990s resulted in the overall decline in emissions.

C. Key categories

5. Sweden reported a key category tier 1 analysis, both level and trend assessments, as part of its 2005 submission. The key source analysis performed by Sweden and that performed the secretariat[2] showed similar results. The small differences were found to arise from differences in subsectoral classifications, as a result of comments provided by the ERT in the previous (2004) review. Sweden has since provided a more aggregated analysis of source categories to allow for better comparison with the secretariat's analysis. Sweden identified 31 key categories, compared to 30 key categories identified in the secretariat analysis.

D. Main findings

6. In general, Sweden's inventory submission adheres to 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" (hereinafter referred to as the revised UNFCCC reporting guidelines). A full set of CRF tables for the years 1990–2003 is provided. It is clear to the ERT that Sweden has focussed on providing adequate documentation on improvements in reporting emissions from key sources, as time and resources permit. The NIR is well laid out: it follows the structure of the revised UNFCCC reporting guidelines and contains most of the prescribed annexes. The ERT notes that the NIR is very good, but could be improved somewhat with additional explanations about data and methodological choices and a more detailed analysis of factors underlying the trends.

7. The ERT commends Sweden on its inventory, noting that many Intergovernmental Panel on Climate Change (IPCC) tier II methods or country-specific methods are being used in line with the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance), and on its implementation of a quality assurance/quality control (QA/QC) plan.

E. Cross-cutting topics

1. Completeness

8. Overall, the Swedish inventory is complete. It covers all years, the entire country and the six mandatory GHGs, and it includes an NIR, a complete set of CRF tables and estimates of emissions for all major sources. In addition, the inventory contains time series estimates of the indirect greenhouse gases (nitrogen oxides (NO_X), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO_2)) from 1990 to 2003. The standard notation keys are used in an appropriate way. The NIR identifies some minor sources that might have been excluded, such as in-house fuels generated and consumed in the chemical industry and other smaller industries, as well as some small sources of fugitive emissions, and notes that a study to collect data for waste generated in construction and demolition is under way.

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

2. Transparency

9. In general, the inventory is transparent, well laid out and informative. In line with the revised UNFCCC reporting guidelines, the NIR contains a general description of institutional arrangements, QA/QC procedures, uncertainty assessments, estimation methods, key source analysis, references to key source estimation methods, a summary of trends in emissions by gas, recalculations, and explanations of the minor differences between the reference and the sectoral approaches. Overall, the transparency and documentation are good, with country-specific methods, models, and factors influencing the trends described. As a result of the good documentation, the reader is provided with a good synopsis of the data and methods used.

3. Recalculations and time series consistency

10. The ERT noted that recalculations reported by the Party for the period 1990–2002 for all sectors, except for the Agriculture and the Land-use Change and Forestry sectors, had been undertaken to take into account either changes in methodologies or re-allocations, or the inclusion of a new source in all sectors, and to take into account comments provided in previous reviews. The major changes include: updated activity data (AD) for several sectors, and the use of new emission factors (EFs) and heating values. The rationale for these recalculations is provided in the NIR and appears to the ERT as justified. Recalculations reported in CRF table 8 follow descriptions of recalculations in the NIR. The recalculations resulted in total CO_2 equivalent increasing by 0.10 per cent in 1990 and decreasing by 0.17 per cent in 2002.

4. Uncertainties

11. Sweden undertook a tier 1 quantitative estimate of uncertainties for all sectors and based its estimates on expert judgement or IPCC default values. Overall uncertainty for the inventory is calculated to be approximately 7 per cent.

5. Verification and quality assurance/quality control approaches

12. The NIR indicates that Sweden is developing its QA/QC system as part of the implementation of the national system according to Article 5.1 of the Kyoto Protocol and plans to have it fully implemented in 2005. The current activities performed are described in the NIR and indicate that general tier 1 QC is carried out, together with source-specific tier 2 QC measures for some key sources. The NIR states that an external review by several experts at the Swedish Environmental Protection Agency has been undertaken, but does not include details about the review.

6. Follow-up to previous reviews

13. Sweden underwent a centralized review in 2004. At that time, the ERT recommended that the Party improve documentation relating to the quantification of uncertainties, consider implementing a tier 2 key category analysis, improve transparency in its NIR, provide more detailed descriptions of country-specific methodologies, continue development of its QA/QC system and reduce the amount of cross referencing in its NIR. To some extent Sweden has addressed these issues. The NIR is much more consistent with the revised UNFCCC reporting guidelines, and a full QA/QC system is being implemented and is expected to be in place before the next submission. As well, the NIR notes that further work will take place for the next submission to improve the uncertainty estimates and elaborate the methods used to determine the uncertainties.

F. Areas for further improvement

1. Identified by the Party

14. The NIR identifies several areas for improvement. Many improvements relate to a review of existing methods for allocating emissions, the addition of some small sources not currently included and the collection of AD which at present are unavailable.

2. Identified by the ERT

15. The ERT identified the following cross-cutting issues for improvement. The Party should:

(a) Provide additional detailed documentation on methods, data and assumptions;

(b) Continue the development and implementation of the QA/QC system;

(c) Improve the quantified uncertainty estimates;

(d) Provide a national inventory report that is structured better to be in line with the UNFCCC reporting requirements on presenting source-specific information on AD, EFs, methodology, uncertainty estimates, time series consistency, QA/QC, verification, recalculations and planned improvements.

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

II. Energy

A. Sector overview

17. The Energy sector accounted for 76.0 per cent of Sweden's total GHG emissions in 2003. CO_2 accounted for 95.4 per cent of GHG emissions in the sector. The largest source was Transport, followed by Energy Industries, Manufacturing Industries and Construction, contributing 39.0, 24.7 and 21.8 per cent to the Energy sector's total emissions, respectively. Although the sector's emissions have varied over time, the total levels in 1990 and 2003 are comparable. As the Party's relies heavily on hydropower generation, variations in weather play a major role in determining emission trends. For example, the peak in emissions observed in 1996 is attributed by the Party to drier and colder than normal conditions, which resulted in a shortfall in hydropower generation and consequently increased use of fossil fuels. Total emissions in the Energy sector increased almost steadily from 2000 to 2003, primarily due to the growth in emissions from Energy Industries.

18. In general, the CRF tables and the NIR provide data and related information in a complete and transparent way. Trends of emissions are also discussed in a comprehensive manner. The methodologies used are tier 1 and tier 2/tier 3, together with country-specific EFs and net calorific values, all documented in the NIR. The ERT recommends that the Party improve transparency by including a complete energy balance of the base year and the most recent year in future submissions.

19. The key category analysis conducted by the Party revealed that 14 key categories reside in the Energy sector. The Party's key category analysis differs from that performed by the secretariat in its level of disaggregation of source categories and in its lack of differentiation of fuel types.

20. Recalculations are provided and documented in both the NIR and the CRF tables. The Party explained that the main reason for recalculations in the Energy sector was a revision of calorific values and EFs. However, a few EFs (e.g. municipal waste – CO_2, CH_4) were not reviewed by the Party for the period 1990–1995 due to lack of information. As a consequence, discontinuities between 1995 and 1996

arise in the time series of these EFs. The ERT recommends that the Party provide more information to improve transparency and assure the ERT that the most appropriate methodology has been used, as prescribed in IPCC good practice guidance, to eliminate any discontinuities and ensure time series consistency.

B. Reference and sectoral approaches

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

21. Reference and sectoral approach estimates of CO_2 emissions from fuel combustion are provided for all years. For 2003, the difference in CO_2 emissions is 8.2 per cent, after adding to the reference approach calculation the emissions for gaseous fuels that were missing in tables 1.A(b) and 1.A(c), which the ERT considers a computational error in the CRF reference approach table 1.A(b), which in turn is linked to table 1.A(c). The Party explained that discrepancies between the reference and sectoral approach estimates are mainly due to the reference approach calculation, specifically: the inclusion of fugitive emissions and quantities of fuels entering industrial processes; and the use of an inaccurate calorific value for crude oil.

22. The Party acknowledged that the reference approach has not been subject to such improvements and revisions as have been implemented for the sectoral approach. The ERT recommends such improvements for future submissions. The Party is also encouraged to discuss its choice of one as the oxidation factor for all fuels, as reported in table 1.A(b), as well as to collect information on stock, imports and exports for peat and biomass, now reported as not estimated (NE).

2. International bunker fuels

23. Some discrepancies for international marine bunkers were observed between tables 1.A(b) and 1.C. The Party acknowledged the issue and advised the ERT that table 1.C provides corrected values. Statistics on international marine bunkers are based on information from a monthly survey of supply and delivery of petroleum products. For international aviation, data on international LTOs (landing/take off) and cruises are derived from the Swedish Civil Aviation, and their quality is claimed to be good only from 1995 onwards.

3. Feedstocks and non-energy use of fuels

24. The reporting of non-energy use for several liquid and solid fuels is based on quarterly fuel statistics collected by Statistics Sweden. The ERT recommends that the Party assess whether it is appropriate to use, as in table 1.A(d), a fraction of stored carbon equal to one for all products (e.g. lubricants).

C. Key categories

1. Stationary combustion – coal: CO_2

25. Inconsistencies for solid fuels in the source category 1.A.2.a (Iron and Steel) were detected in the CRF between AD and emissions, and between the AD reported in the CRF and in Annex 3 of the NIR. To ensure complete transparency, the ERT recommends that the Party include in its NIR an overall carbon balance for that source category, describing the derivation of quantities of fuels that are combusted (under the various CRF source categories), quantities of fuels serving non-energy uses, and fugitive emissions.

26. The ERT commends the Party's effort in allocating emissions associated with electricity and heat production from integrated steel and energy production industries. The ERT recommends that the Party enhance the NIR discussion of their energy production plants and their integrated steel and energy

production industries in section 1.A.1a Electricity and Heat Production by providing an explanation as to the primary activities of these units. If possible, the Party should include in the NIR the proportion of public electricity and heat contribution from their integrated steel-energy operations. Also, the Party should, if possible, allocate the emissions associated with electricity or heat that are internally generated and consumed by their iron and steel industry in CRF category 1.A.2.a Iron and Steel.

2. Mobile combustion – road transportation: CO_2, N_2O and CH_4

27. Sweden estimated CO_2 emissions using a tier 1 methodology, and non-CO_2 emissions using the EMV (emissions from road traffic) model, a national version of the COPERT model. The Party provided detailed information regarding EFs for road transportation. Although references are provided as documentation for the model, the ERT encourages the Party to include in its NIR a concise description of relevant parameters and assumptions used (such as vehicle categories, age distribution, fuel consumption rates).

28. The Party is encouraged to calculate N_2O and CH_4 emissions from use of natural gas and biofuels in road transportation. The ERT noticed that in appendix 17 of the NIR the N_2O EF for road traffic (gasoline and diesel) for 2003 is several times lower than for previous years (however, this is not reflected in the CRF data). This could simply be a mistake. The ERT recommends that Sweden clarify this anomaly.

D. Non-key categories

Fugitive emissions – oil and natural gas: CH_4, CO_2

29. Considering that as relevant AD are reported in the inventory, the Party is recommended to estimate CH_4 and CO_2 fugitive emissions from transport, refining and storage of oil, and transmission and distribution of natural gas.

III. Industrial Processes and Solvent and Other Product Use

A. Sector overview

30. Industrial processes accounted for 8.3 per cent (5,882 Gg CO_2 equivalents) of the total national emissions in 2003. CO_2 accounted for 76.6 per cent of GHG emissions in the sector, followed by fluorinated gases at 14.2 per cent and N_2O at 9.1 per cent. The emissions from industrial processes are primarily from production of iron, steel and other metals, with CO_2 accounting for 48.5 per cent of these emissions. GHG emissions from industrial processes in 2003 were 3.6 per cent higher than the 1990 emissions.

31. The GHG key categories in the industrial sector are: CO_2 from mineral and metal production, N_2O from nitric acid production, PFCs from aluminium production, and HFCs and PFCs from substitutes for ozone depleting substances (ODS). There is no reported production of halocarbons or SF_6 in Sweden.

32. Recalculations were done for CO_2, HFC, PFC and SF_6 gases, mostly because of changes or updates in AD. The reasons for the recalculations were presented in the NIR and in CRF table 8(b). CO_2, HFCs and SF_6 emissions have been recalculated in the latest submission: CO_2 emissions increased by 6 per cent and 5 per cent for 1990 and 2002, respectively; HFCs emissions increased by 20 per cent in 2002; and SF_6 emissions increased by 29 per cent and 10.4 per cent for 1990 and 2002, respectively.

33. Sweden used the activity and emissions data from facilities that are legally required to submit such data under the terms of Swedish environmental laws and the national production statistics. These data undergo audit and are made available through an emission database that is updated regularly. QA/QC of the reported emissions at the plant level is being undertaken, but without updating the

emissions database. This allows the Party to access comprehensive industry information for GHG emission calculations. However, the AD and EFs are reported by the industry at different tiers, which prevents the use of a single methodology in the same sector (e.g. iron and steel). The ERT encourages the Party to use the same methodology in each source category and improve transparency so as to allow a comparison of methods and EFs among Parties.

B. Key categories

1. Cement production

34. CO_2 emissions from cement production accounted for 20 per cent of the total industrial emissions in 2003. Compared to 1990, CO_2 emissions in 2003 were 14.5 per cent lower. There are only three cement plants in Sweden and they are owned by one company. The reporting of clinker production and CO_2 emissions is done by the company. The Swedish Environmental Protection Agency calculates the cement kiln dust (CKD) factor using information provided by the cement company.

35. In response to recommendations in the 2004 centralized review report, the Party included information on CKD correction factors in its NIR based on calculations. To improve the transparency of the submission, the Party is encouraged to conduct plant surveys on non-carbonate feeds to kilns, calcium oxide (CaO) content of the clinker, the amount of dust released and the fraction of dust recycled, and apply the results in the CO_2 emissions calculations.

2. Lime production

36. Lime production accounted for 9.5 per cent of total industrial emissions in 2003. CO_2 emissions from lime production in 2003 were 12.75 per cent higher than the 1990 emission level. Lime production reported in the 2005 NIR includes all commercial lime production (conventional, quicklime, hydraulic and captive), sugar production and pulp and paper production. Emission factors were provided for each of these processes. The conventional lime production used the IPCC EFs for dolomitic lime and quicklime, while production-specific EFs were used for sugar and pulp and paper. The CRF reported lime production amounting to 1,064.17 kilotonnes, with an EF of 0.53 tonnes CO_2 per tonne of lime.

37. When applying the tier 2 method as prescribed in the IPCC good practice guidance, the NIR is not transparent in how the EFs from each identified industry source was derived. For example, according to the NIR, the amount of CO_2 emissions from sugar production is based on the amount of limestone consumed, while the amount of CO_2 emissions from pulp and paper production is based on the amount of pulp produced. The Party is encouraged to report the calculation of CaO production and EFs in terms of CaO so as to improve transparency and comparability among Parties.

3. Nitric acid production

38. Nitric acid production is the major N_2O source in the industry sector (80 per cent). A decrease in production of nitric acid in 2003 (only about 69 per cent of the production in 1990) was observed due to the closing of two of the three plants in 2000 and 2001. Data on nitric acid production and emission estimates are provided directly to Sweden's Inventory Agency. In order to improve transparency, the Party is encouraged to provide in its NIR a summary of available plant-specific information.

4. Iron and steel production

39. Iron and steel production is the highest emitting source in the Industrial Processes sector, accounting for 35 per cent of the sector's emissions. Sweden reported on 20 iron and steel facilities, including three primary iron and steel facilities and about 10 steel plants. This is aside from primary processes and secondary steel production (such as rolling mills, pickling and other steel-related

processes). The Party used different approaches to account for CO_2 emissions from pig iron and steel production using reducing agents such as coke, coal and electrodes in electric arc furnaces.

40. Sweden has applied a country specific approach in estimating emissions from iron and steel production. Because of a lack of data, emissions from pig iron production are calculated from blast furnace gas consumption (this approach is not recommended by the IPCC good practice guidance, neither for tier 2 nor tier 1). Emissions from steel production are estimated on the basis of a tier 2 approach for the largest emitter, and on the basis of a tier 1 approach or the amount of steel produced for the other plants. The NIR is not clear on which calculation approach was used for each AD presented in CRF table 2(I).A-6 Section C.1-Other. Implied emission factors (IEFs) are, however, higher than the default EFs suggested in the IPCC good practice guidance with coal or coke as reducing agent. For electric arc furnaces the IEF is much lower than the default (5 kg/tonne of steel). To increase the transparency of methodologies used to estimate emissions from the iron and steel production industry, the ERT recommends for Sweden to enhance the methodological write-up in the NIR.

41. Because these methodological choices do not allow comparison of the estimates with other Parties, Sweden is encouraged to adopt the recommended tier 2 approach. In case the Party is unable to apply the tier 2 approach, it should at least provide, in its NIR, information on the source of AD and how the country-specific EF has been derived, as already recommended in previous review reports.

5. PFC from aluminium production

42. Aluminium production is the major contributor of PFC emissions (94.5 per cent) in the Industrial Processes sector. The reported PFC emissions cover C_2F_6 and CF_4 emissions from one aluminium plant using both pre-baked and Soderberg technologies. The PFC emissions were calculated by the company using the European Aluminium Association formula, with resulting emissions slightly higher than when calculated using the suggested EF from the IPCC good practice guidance.

43. The Party is encouraged to split production data, emissions and IEFs by type of technology (pre-baked and Soderberg) in order to improve transparency and comparability of the estimates.

6. HFCs from ODS substitutes

44. HFC emissions from ODS substitutes is the major source of halocarbons in Sweden. The major use of HFC is for refrigeration, thus HFC 134 is the highest emission (59 per cent). Activity data as described in the NIR are comprehensive. Actual emissions are estimated for all categories except solvents, as shown in table 2(II)s1; in the line corresponding to solvents, the Party should use the notation key "NE" rather than "NO" (not occurring). Complete data for potential emissions has been submitted only for 1995–2003.

7. CO_2 emissions from solvent use

45. CO_2 emissions from solvent use account for only a small portion (0.3 per cent) of the total industrial national CO_2 emissions, but over the years they have displayed a substantial reduction, by 26 per cent from 1990 to 2003. NMVOCs are accounted for as CO_2 in the emissions. Almost all industries using solvents reduced NMVOC emissions from 1990 to 2003. The main source of CO_2 emission reductions is paint, and attributed to a switch to use of water-based paints. Emission factors decreased from 0.35 Mg NMVOC per Mg of paint in 1992 to 0.15 Mg NMVOC per Mg of paint in 2003.

46. The Party has covered wide uses of solvent and has derived country-specific emissions factors and has set the default carbon content of solvent at 0.85 to convert NMVOC emissions to CO_2 emissions. The Party is encouraged to present in its NIR the basis for using this default carbon content of solvent and present how this correlates with the atmospheric oxidation of NMVOC.

IV. Agriculture

A. Sector overview

47. Emissions from the Agriculture sector accounted for 12.4 per cent (8,724.9 Gg CO_2 equivalent) of the total GHG emissions in 2003, making it the second most important source of emissions. During the period 1990–2003, emissions from the sector decreased by 8.9 per cent, mainly due to structural changes in the Agriculture sector in the last 50 years and in particular since 1995, when Sweden joined the European Union, and a decrease in CH_4 emissions from enteric fermentation and N_2O emissions from agricultural soils. The submission is complete in terms of gases, sources and years covered; additional information tables and documentation boxes in the CRF were filled in, except for the tier 2 table for enteric fermentation. Notation keys were used in all the CRF tables in the entire time series. The Party included estimates of CH_4 emissions from enteric fermentation, CH_4 and N_2O emissions from manure management, and N_2O emissions from agricultural soils as is recommended in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines). Rice cultivation and prescribed burning of savannas are not occurring in Sweden, so notation key "NO" was used; and as explained in the NIR, due to the fact that field burning of agricultural residues is marginal in Sweden, these emissions were also reported as "NO". Buffalo, camels, llamas, mules and asses populations were reported in the CRF tables as "NO".

48. The information presented in the CRF tables and NIR is consistent; the CRF tables also show consistency across the years, because the same methodologies and AD sources were used during the entire time series. One-year average AD were used for all livestock population characterization. The Party used a single enhanced livestock characterization in the entire time series, which is consistent across all the source categories and is in accordance with the IPCC good practice guidance.

49. Methodologies used were consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance, but more detailed information is needed in the NIR to facilitate the understanding of some methodological approaches (e.g. inclusion of the background emissions from soils). Activity data used were based on the Farm Register administered by the Swedish Board of Agriculture and Statistics Sweden and presented in detail in the NIR. Emission factors are mainly country-specific, but are not sufficiently explained in the NIR (e.g. N_2O emissions from manure management and from agricultural soils). The Party is recommended to provide detailed information in its NIR on the assumptions and national conditions supporting the calculation/selection of EFs used.

50. The Party performed a key category analysis, which was consistent for the Agriculture sector with the one performed by the secretariat, in terms of key categories identified. The key categories identified were: N_2O emissions from agricultural soils, CH_4 emissions from enteric fermentation, and CH_4 and N_2O emissions from manure management. No recalculations were reported in the CRF and NIR, and no specific improvements are planned in the Agriculture sector. Sweden has implemented most of the recommendations for the Agriculture sector from the previous (2004) review report.

B. Key categories

1. Enteric fermentation – CH_4

51. Activity data used were taken from Statistics Sweden and the Swedish Board of Agriculture and are one-year average data, but insufficient explanation was provided in the NIR to support the decrease in the dairy cattle population and the increase in the non-dairy cattle population in the period 1990–2003. The Party estimated CH_4 emissions from enteric fermentation using an IPCC tier 2 method, which is in line with IPCC good practice guidance when considering that cattle emission estimates represent about

90 per cent of the total CH_4 emissions from enteric fermentation. The Party is recommended to provide more explanatory information in its NIR to support the tier 2 method.

52. Country-specific EFs for cattle, together with default IPCC EFs for the rest of the animal species, were used in this category. For dairy cattle, the Party used a country-specific EF, which is higher than the IPCC default EF for Western Europe. At the same time, the methane conversion factor decreased from 1990 (7.16) to 2003 (6.70), while the average daily energy intake remained constant for all years. For non-dairy cattle, the conversion factor and energy intake were constant over the period. As requested in the 2004 review report, Sweden is recommended to provide an explanation for the increase in the EF, the decrease in the CH_4 conversion factor and the constant daily feed intake, which do not appear to be in line with the recorded increased productivity. The ERT was informed by the Party that it would provide more information on the methodology used in the NIR from 2007, and where necessary modify data on feed intake to reflect the actual feed intake for all years. The ERT also encourages Sweden to give detailed information on the change in feed constitution and compare the calculation method with other peer-reviewed calculation methods in a transparent manner to confirm that the CH_4 conversion factor is not overestimated and to confirm the decrease in the factor from 1990 to 2003, as stated in the CRF.

2. Manure management – CH_4

53. The Party applied an IPCC tier 2 method for CH_4 emissions from cattle and swine, along with country-specific and default EFs, which is in line with the IPCC good practice guidance. Activity data used were taken from the statistical office, but no information was provided in the NIR to support the decrease of emissions in the period 1990–2003.

54. The IEF for cattle, provided in the CRF, increased by 66 per cent for dairy cattle and 33 per cent for non-dairy cattle in the period 1990–2003 (the dairy cattle IEF being higher than the IPCC default EF for Western Europe). No information was provided in the NIR to explain this trend. The ERT recommends that Sweden provide more information in its NIR to support the trends and to explain in detail the methodology used for calculating the EFs.

55. The national CH_4 conversion factor used for liquid manure is the Revised 1996 IPCC Guidelines default value (10 per cent), which is lower than the updated default value presented in the IPCC good practice guidance (39 per cent). Sweden, in response to a recommendation of the previous (2004) review report, stated in its NIR that the lower value, which is based on a national research paper, is considered to be more appropriate for Swedish conditions. The ERT again recommends that Sweden explain in detail, in its NIR, the assumptions and the national circumstances relating to the selection of this value.

3. Manure management – N_2O

56. Activity data used is taken from Statistics Sweden and the Swedish Board of Agriculture, but the model used for animal waste management systems is not sufficiently explained in the NIR. An inconsistency was identified between the CRF, where the nitrogen excretion (Nex) for the swine population in the period 1990–2003 increased from 7.2 kg N (Nitrogen)/head to 10.1 kg N/head, and the NIR, where it is stated that the Nex rates remained constant. After consultation with the Party, Sweden agreed to provide more information on the methodology used in the NIR for the 2007 submission, and correct Nex data. The inconsistency may not have any influence on the total Nex rates, as it arises from how the number of pigs is calculated. Sweden is recommended to explain in its NIR the Nex rates, as shown in the CRF tables, in a clear and transparent manner. Furthermore, Sweden is recommended to explain the decreasing number of piglets, despite an unaltered number of sows, and how this affects the total Nex rates.

57. The Party applied the IPCC good practice guidance recommended method along with country-specific and default IPCC EFs. An inconsistency was identified by the ERT regarding the

Nex values presented in CRF table 4B(b) for all animal species and the values presented in the NIR. Sweden is recommended to provide more information in its NIR to support the selection of the values used.

4. Agricultural soils – N_2O

58. The Party used the default tier 1 method, together with CORINAIR country-specific EFs, to estimate N_2O emissions from agricultural soils as is recommended by the IPCC good practice guidance. Activity data indicate a substantial decrease in the amount of synthetic fertilizers applied to soils in the period 1990–2003. The IEF for N supply from fertilizers is lower than the default IPCC value, and the IEF for N supply from manure is higher than that presented in the Revised 1996 IPCC Guidelines; no sufficient information is provided in the NIR to explain the calculation of these values. The Party is requested to describe the methodology for calculating the parameters, because this source category is a key category.

59. The N_2O emissions from mineral soils are estimated in CRF table 4.D by using the EF 0.5 kg N_2O-N per ha per year. The EF is derived from the background emission information and is country-specific; there is no clear explanation in the NIR to support this selection. As the previous review mentioned, the Party is invited to provide more information relating to these estimates in its NIR.

V. Land Use, Land-use Change and Forestry

A. Sector overview

60. In its 2005 submission, Sweden reported the LUCF sector in accordance with the Revised 1996 IPCC Guidelines and relevant CRF tables. In 2003, Sweden's LUCF sector was a net sink totalling 21,498.94 Gg CO_2; this represents a removal of approximately 30.5 per cent of total GHGs (70,554.31 Gg CO_2 equivalent). CO_2 emissions and removals were reported in the LUCF sector for 1990–2003. Year-to-year emissions fluctuated about 20 per cent in that period (except between 1990 and 1991 which saw a 45 per cent increase). Net removals in 2003 were almost 6 per cent higher that removals in 1993.

61. The ERT made a simple assessment of the NIR and CRF tables based on the Revised 1996 IPCC Guidelines. Sweden stated in the NIR that the LULUCF CRF tables, as required by decision 13/CP.9, will be provided in the 2006 submission.

62. The ERT encourages Sweden to report emissions and removals from the LULUCF sector in accordance with decision 13/CP.9, including the LULUCF CRF tables, and to the extent possible make use of the IPCC *Good Practice Guidance for Land Use, Land-use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF).

63. Sweden's 2005 NIR states that forest fires are rare in Sweden, with about 400–6,400 ha burned annually, and so emissions from fires are reported as "0". According to NIR tables 7.1 and 7.3, the general average carbon stock is about 228 t CO_2 per ha and emissions from forest fires could vary between 91 Gg CO_2/year and 1,459 Gg CO_2/year in Sweden, depending on the surface burned per year and if forest fires occur in managed forests. Sweden could consider including in its next NIR a major explanation of its reporting of emissions from forest fires.

64. Only emissions from organic soils are reported in CRF table 5A, although the NIR states that cultivated mineral soils accounted for 91 per cent of the total arable land in 1996/1997. Sweden could consider making an effort to estimate emissions from mineral soils in future submissions.

VI. Waste

A. Sector overview

65. The Waste sector contributed 2.8 per cent in 2003 and 3.9 per cent in 1990 to the total GHG emissions of Sweden. The largest source of GHG emissions and the only key category in the sector is CH_4 from solid waste disposal sites (SWDS). Emissions from the Waste sector decreased constantly from 1992, due to a decrease in the total amount of organic waste disposed to landfills and increasing CH_4 recovery from SWDS.

66. CH_4 from SWDS contributed 2.4 per cent to total net national emissions in 2003. CH_4 emissions from Wastewater Handling are not included; they are reported as "NO". N_2O from Wastewater Handling and CO_2 emissions from Waste Incineration contributed 0.2 per cent to total national emissions in 2003.

B. Key categories

Solid waste disposal sites – CH_4

67. The IPCC tier 2 method with country-specific parameters was used to calculate emissions from SWDS. The NIR provides a detailed description of the methodology used. Comparisons between tier 1 and tier 2 methods are provided in the NIR.

68. The Party used in its calculations 7.5 years as the half-life of waste, instead of the IPCC default value of 14.5 years. No rationale for this assumption is given, or references provided. The ERT recommends that Sweden provide this information in its next submission.

69. The per capita waste generation rate is reported as 469.2 kg/day in table 6.A. This is a reporting mistake: the correct unit should be kg/year. The figures on the composition of landfilled waste do not add up to 100 per cent. The ERT encourages Sweden to explain these issues in its next submission.

C. Non-key categories

1. Waste-water handling – CH_4 and N_2O

70. Waste-water handling includes only N_2O emissions from all sources. Sweden did not estimate CH_4 emissions from industrial, domestic and commercial waste-water treatment, and hence the notation key "NO" is used. Sweden indicated in its response to the ERT that, because all sludge is treated at solid waste disposal sites and reported in 6.A Solid Waste Disposal on Land, it is assumed that no other CH_4 is emitted from the waste-water handling processes. The ERT encourages Sweden to explain in more detail the methodology used and the assumption that no additional CH_4 is released during waste-water treatment processes.

71. The notation key "NE" is used in the additional information box in CRF table 6.B. However, some data on waste-water streams are included in the NIR. The ERT encourages Sweden to provide these data in the CRF for completeness and greater transparency. Sweden indicated that it is difficult to provide disaggregated data for the additional information box, mainly because Swedish municipal waste-water treatment plants handle substantial amounts of industrial waste water and there is insufficient information to estimate the division between industrial waste water and domestic/commercial waste water.

2. Waste incineration – CO_2 and N_2O

72. Waste incineration in Sweden was accounted for under the Energy sector in previous submissions. Now it is properly located. N_2O is reported as "NE" even though there are occasional measurements. The ERT encourages Sweden to provide available values.

Annex

Documents and information used during the review

A. Reference documents

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

IPCC. Good practice guidance for land use, land-use change and forestry, 2003. Available at <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

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UNFCCC secretariat. Status report for Sweden. 2005. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/2005_status_report_sweden.pdf>.

UNFCCC secretariat. Synthesis and assessment report on the greenhouse gas inventories submitted in 2005. FCCC/WEB/SAI/2005. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/sa_2005_part_i_final.pdf>.

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B. Additional information provided by the Party

Responses to questions during the review were received from Mr. David Mjureke (naturvardsverket) including additional material on the methodology and assumptions used.

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