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Report of the individual review of the annual submission of Sweden submitted in 2011*

* In the symbol for this document, 2011 refers to the year in which the inventory was submitted, and not to the year of publication.

Contents

I. Introduction and summary

A. Overview

1. This report covers the centralized review of the 2011 annual submission of Sweden, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 5 to 10 September 2011 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalists – Mr. Paul Filliger (Switzerland) and Ms. Anke Herold (Germany); energy – Ms. Kristien Aernouts (Belgium), Mr. Vishwa Bandhu Pant (India) and Mr. Glen Whitehead (Australia); industrial processes – Mr. Menouer Boughedaoui (Algeria) and Ms. Youngsook Lyu (Republic of Korea); agriculture – Mr. Michael Anderl (Austria) and Mr. Jacques Kouazounde (Benin); land use, land-use change and forestry (LULUCF) – Mr. Nagmeldin Elhassan (Sudan) and Mr. Héctor Ginzo (Argentina); and waste – Mr. Davor Vešligaj (Croatia). Mr. Elhassan and Ms. Herold were the lead reviewers. The review was coordinated by Mr. Javier Hanna and Mr. Roman Payo (UNFCCC secretariat).

2. In accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol" (decision 22/CMP.1) (hereinafter referred to as the Article 8 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, into this final version of the report.

B. Emission profiles and trends

3. In 2009, the main greenhouse gas (GHG) in Sweden was carbon dioxide (CO_2), accounting for 77.6 per cent of total GHG emissions[1] expressed in CO_2 eq, followed by nitrous oxide (N_2O) (11.7 per cent) and methane (CH_4) (8.9 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 1.7 per cent of the total GHG emissions in the country. The energy sector accounted for 74.3 per cent of total GHG emissions, followed by the agriculture sector (13.6 per cent), the industrial processes sector (8.4 per cent), the waste sector (3.2 per cent) and the solvents and other product use sector (0.5 per cent). Total GHG emissions amounted to 60,068.82 Gg CO_2 eq and decreased by 17.3 per cent between the base year[2] and 2009.

4. Tables 1 and 2 show GHG emissions from Annex A sources, emissions and removals from the LULUCF sector under the Convention and emissions and removals from activities under Article 3, paragraph 3, and, if any, Article 3, paragraph 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector and activity, respectively. In table 1, CO_2, CH_4 and N_2O emissions included in the rows under Annex A sources do not include emissions and removals from the LULUCF sector.

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

[2] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. The base year emissions include emissions from Annex A sources only.

Table 1

Greenhouse gas emissions from Annex A sources and emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, by gas, base year to 2009[a]

			Gg CO_2 eq								*Change (%)*
		Greenhouse gas	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2007*	*2008*	*2009*	*Base year–2009*
Annex A sources		CO_2	56 646.32	56 646.32	58 543.74	53 913.49	53 186.63	51 896.67	49 876.19	46 621.42	–17.7
		CH_4	7 065.61	7 065.61	7 023.95	6 441.96	6 002.86	5 691.53	5 478.97	5 365.95	–24.1
		N_2O	8 336.34	8 336.34	8 194.81	7 700.97	7 263.88	7 007.95	7 068.36	7 032.05	–15.6
		HFCs	126.54	3.85	126.54	564.45	803.56	870.15	911.73	931.79	636.4
		PFCs	343.43	376.82	343.43	240.52	257.15	247.60	225.05	35.30	–89.7
		SF_6	126.68	107.49	126.68	93.59	142.48	151.49	83.87	82.31	–35.0
KP-LULUCF	Article 3.3[b]	CO_2							2 760.44	2 534.96	
		CH_4							NO	NO	
		N_2O							8.97	5.95	
	Article 3.4[c]	CO_2	NA						–37 950.82	–44 575.12	NA
		CH_4	NA						13.16	2.53	NA
		N_2O	NA						50.34	45.88	NA

Abbreviations: KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable, NO = not occurring.

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. The "base year" for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

[b] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the inventory years of the commitment period must be reported.

[c] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation. For cropland management, grazing land management and revegetation the base year and the inventory years of the commitment period must be reported.

Table 2
Greenhouse gas emissions by sector and activity, base year to 2009[a]

			Gg CO_2 eq							*Change (%)*
		Sector	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2007*	*2008*	*2009*	*Base year–2009*
Annex A		Energy	53 227.47	53 227.47	55 017.53	50 342.65	49 506.07	48 113.83	46 161.73	44 613.05	–16.2
		Industrial processes	6 426.76	6 318.26	6 627.36	6 783.42	6 987.60	6 933.54	6 837.20	5 031.45	–21.7
		Solvent and other product use	332.49	332.49	308.55	277.54	302.84	285.64	295.41	295.41	–11.2
		Agriculture	9 236.94	9 236.94	9 172.24	8 635.70	8 389.90	8 289.24	8 291.71	8 191.89	–11.3
		Waste	3 421.27	3 421.27	3 233.47	2 915.69	2 470.14	2 243.15	2 058.13	1 937.01	–43.4
		LULUCF	NA	–44 722.72	–39 266.49	–40 975.50	–36 243.94	–34 196.38	–33 878.70	–41 638.33	NA
		Total (with LULUCF)	**NA**	**27 813.70**	**35 092.67**	**27 979.49**	**31 412.61**	**31 669.01**	**29 765.47**	**18 430.49**	**NA**
		Total (without LULUCF)	**72 644.92**	**72 536.42**	**74 359.16**	**68 954.99**	**67 656.55**	**65 865.39**	**63 644.18**	**60 068.82**	**–17.3**
		Other[b]	NO	NO	NO	NO	NO	NO	NO	NO	NA
KP-LULUCF	Article 3.3[c]	Afforestation and reforestation							–1 269.60	–980.76	
		Deforestation							4 039.00	3 521.67	
		Total (3.3)							**2 769.41**	**2 540.91**	
	Article 3.4[d]	Forest management							–37 887.32	–44 526.70	
		Cropland management	NA						NA	NA	NA
		Grazing land management	NA						NA	NA	NA
		Revegetation	NA						NA	NA	NA
		Total (3.4)	**NA**						**–37 887.32**	**–44 526.70**	**NA**

Abbreviations: LULUCF = land use, land-use change and forestry, KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable, NO = not occurring.

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6. The "base year" for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

[b] Emissions/removals reported in the sector other (sector 7) are not included in Annex A to the Kyoto Protocol and are therefore not included in national totals.

[c] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the inventory years of the commitment period must be reported.

[d] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation. For cropland management, grazing land management and revegetation the base year and the inventory years of the commitment period must be reported.

5. Table 3 provides information on the most important emissions and removals and accounting parameters that will be included in the compilation and accounting database.

Table 3
Information to be included in the compilation and accounting database in t CO_2 eq

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]	*Accounting quantity*[c]
Commitment period reserve	299 968 998	300 344 090		300 344 090	
Annex A emissions for current inventory year					
CO_2	46 621 417			46 621 417	
CH_4	5 292 347	5 365 950		5 365 950	
N_2O	7 030 632	7 032 048		7 032 048	
HFCs	931 794			931 794	
PFCs	35 297			35 297	
SF_6	82 312			82 312	
Total Annex A sources	59 993 800	60 068 818		60 068 818	
Activities under Article 3, paragraph 3, for current inventory year					
3.3 Afforestation and reforestation on non-harvested land for current year of commitment period as reported	–980 757			–980 757	
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported	NO			NO	
3.3 Deforestation for current year of commitment period as reported	3 521 668			3 521 668	
Activities under Article 3, paragraph 4, for current inventory year[d]					
3.4 Forest management for current year of commitment period	–44 526 702			–44 526 702	
3.4 Cropland management for current year of commitment period					
3.4 Cropland management for base year					
3.4 Grazing land management for current year of commitment period					
3.4 Grazing land management for base year					
3.4 Revegetation for current year of commitment period					
3.4 Revegetation in base year					

Abbreviations: NA = not applicable, NO = not occurring.

[a] "Adjustment" is relevant only for Parties for which the expert review team (ERT) has calculated one or more adjustments.

[b] "Final" includes revised estimates, if any, and/or adjustments, if any.

[c] "Accounting quantity" is included in this table only for Parties that chose annual accounting for activities under Article 3, paragraph 3, and elected activities under Article 3, paragraph 4, if any.

[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2011 annual inventory submission was submitted on 31 March 2011; it contains a complete set of common reporting format (CRF) tables for the period 1990–2009 and a national inventory report (NIR). On the same date, Sweden also submitted information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and the minimization of adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 31 March 2011. The annual submission was submitted in accordance with decision 15/CMP.1.

7. Sweden officially submitted revised emission estimates on 21 October 2011 in response to the list of potential problems and further questions raised by the expert review team (ERT) formulated in the course of the review, and to provide other missing estimates identified (see paras. 52 and 54 below). The values used in this report are based on the values contained in the revised estimates submitted on 21 October 2011.

8. Where necessary, the ERT also used previous years' submissions during the review. In addition, the ERT used the standard independent assessment report (SIAR), parts I and II, to review information on the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and on the national registry.[3]

9. During the review, Sweden provided the ERT with additional information and documents which are not part of the annual submission. The full list of information and documents used during the review is provided in annex I to this report.

Completeness of inventory

10. The inventory covers all source and sink categories for the period 1990–2009 and is complete in terms of years, gases and geographical coverage, with the exception of the missing estimates of CH_4 and N_2O emissions from the combustion of ethanol in road transportation. Sweden has included all required CRF tables and notation keys are used throughout the tables. CRF table 7 on key categories, which had not been completed in previous submissions, was completed for 1990 and 2009 in the 2011 inventory submission.

11. Several recalculations reported in the 2011 inventory submission improved the completeness of the inventory, in particular the estimation of CO_2 emissions from the chemical industry under the category other and the estimation of CH_4 emissions from industrial wastewater treatment in CRF table 6.B for the years 1990–2007 (CH_4 emissions for year 2008 were already reported in submission 2010).

12. In response to the list of potential problems and further questions formulated by the ERT in the course of the review, Sweden submitted revised estimates for CH_4 and N_2O

[3] The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5(a), 6(c) and 6(k)), under the auspices of the international transaction log (ITL) administrator using procedures agreed in the Registry System Administrators Forum. Part I is a completeness check of the submitted information relating to the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and to national registries. Part II contains a substantive assessment of the submitted information and identifies any potential problem regarding information on the accounting of Kyoto Protocol units and the national registry.

emissions from the combustion of ethanol in road transportation. The ERT agreed with the revisions provided (see para. 54 below). In the same response, Sweden also submitted revised estimates for fugitive CH_4 emissions from natural gas distribution that had been identified in the list of potential problems and further questions raised by the ERT during the review of the annual submission of the European Union (EU). The ERT agreed with the revision to fugitive CH_4 emissions from natural gas distribution (see para. 52 below).

13. Sweden has reported emissions of F-gases from solvents under consumption of halocarbons and SF_6 as "not estimated" ("NE") in the NIR and as "not occurring" ("NO") in the CRF tables, and explained in the NIR that this subcategory contributes only a very minor share, not quantified, of F-gas emissions (see para. 69 below). In the LULUCF sector, for land converted to wetlands, only areas are reported whereas estimates for pools are reported as "not applicable" ("NA") (see para. 87 below).

2. A description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

Overview

14. The ERT concluded that the national system continued to perform its required functions.

15. In the NIR, Sweden has stated that no significant changes in the national system occurred since the previous annual submission (see para. 124 below).

Inventory planning

16. The NIR describes the national system for the preparation of the inventory. The Swedish Ministry of the Environment has overall responsibility for the national inventory and the submission to the secretariat. The Swedish Environmental Protection Agency (Swedish EPA) coordinates the preparation of the inventory and is also responsible for the final quality assurance and quality control (QA/QC) activities. A consortium called Swedish Environmental Emissions Data (SMED), which consists of the organizations Statistics Sweden, the Swedish Meteorological and Hydrological Institute, the Swedish Environmental Research Institute and the Swedish University of Agricultural Sciences, is also involved in the preparation of the inventory. SMED receives data and documentation from responsible authorities and produces the inventory estimates.

17. Other agencies and organizations provide data for the inventory compilation. In the energy sector, these are the Swedish Energy Agency and the Swedish Transport Administration, the National Maritime Administration and the Swedish Armed Forces. For the industrial processes and solvents and other product uses sectors, data are provided by the Swedish Chemicals Agency, which also conducts peer reviews of these sectors. For the agriculture sector, the Swedish Board of Agriculture provides the data and peer reviews the inventory. For the LULUCF sector, the Swedish University of Agricultural Sciences provides the data, and the National Board of Forestry is responsible for conducting a peer review of this sector; and in the waste sector the Swedish Association of Waste Management forms part of the national system as data provider. For the estimation of emissions and removals from KP-LULUCF activities, Sweden uses the same institutional arrangements as for the LULUCF sector.

18. Functions, roles and responsibilities are clearly defined in the national system, and a long-term contract between the Ministry of the Environment and SMED ensures the continued availability of sufficient capacity and resources.

19. Sweden has elaborated a QA/QC plan with the necessary elements such as quality objectives and QA/QC procedures, which is described in annex 6:2 to the NIR. Tier 2 QC activities are performed for the energy and the industrial processes sectors, but no tier 2 category-specific QC activities are documented for the agriculture, LULUCF or waste sectors. The ERT encourages Sweden to develop tier 2 QC activities in those sectors. The ERT noted that the areas identified by Sweden as areas for further improvement could be better linked with the pending recommendations from previous review reports, and the ERT therefore recommends that Sweden include any recommendations from the previous review report not yet addressed in the specific sections on category-specific planned improvements in the NIR of its next annual submission.

Inventory preparation

Key categories

20. Sweden has reported tier 1 and tier 2 key category analyses, both level and trend assessments, as part of its 2011 annual submission. The tier 1 key category analysis performed by Sweden and that performed by the secretariat[4] produced different results because Sweden has reported the categories with a higher level of disaggregation but has not disaggregated by fuel in the energy sector. Sweden has included the LULUCF sector in its key category analysis, which was performed in accordance with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF).

21. For the LULUCF sector, Sweden has used a higher level of aggregation per land-use category and gas compared with the disaggregation level recommended by the IPCC good practice guidance for LULUCF, and as a result all subcategories under these categories are identified as key in Sweden's approach. Sweden has not used qualitative criteria for the identification of key categories. According to the NIR, the key category analysis and the uncertainty analysis are used to prioritize and decide on future inventory improvements along with other criteria, such as recommendations in review reports and available budget.

22. Sweden has identified key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. For CO_2 emissions and removals, Sweden has identified afforestation and reforestation, deforestation and forest management as key categories. For non-CO_2 emissions, Sweden has not identified any key categories.

Uncertainties

23. Sweden has performed a tier 1 uncertainty analysis, both including and excluding LULUCF, following the IPCC good practice guidance.

24. In the NIR, Sweden has explained that the national estimated uncertainty does not include corrections for the correlation that may exist between gases (i.e. based on the same activity data (AD)) and does not include corrections for non-reported categories. The ERT

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

notes that a stochastic simulation, such as the tier 2 approach, takes into account the correlation structure of the AD and emission factors (EFs) and the ERT therefore encourages Sweden to implement a tier 2 uncertainty analysis in the inventory of its next annual submission.

25. According to the NIR, the uncertainty analysis is used to prioritize and decide on future inventory improvements (see para. 21 above). In the NIR, Sweden has also reported that the most recent study (from 2005) performed on the transparency of the information on values for uncertainties did not result in the improvement of a single uncertainty estimate. The ERT noted that it is not clearly explained in the NIR if the inventory improvements resulted in revised uncertainty estimates in the reported uncertainty analysis. The ERT considers that if methodological improvements and changes are not taken into account in the uncertainty analysis, then it loses its value in guiding future inventory improvements. The ERT recommends that, in the NIR of its next annual submission, Sweden improve the explanation of which inventory improvements lead to recalculated inventory estimates and improved uncertainty estimates, and how these improved uncertainties are considered in the uncertainty analysis.

26. There are several instances where the uncertainty of AD is indicated as "0" in table A.7.2. in annex 7 to the NIR (e.g. CH_4 and N_2O from road transportation, fugitive CH_4 emissions from oil and natural gas, CO_2, CH_4 and N_2O emissions from other (chemical industry), CO_2 and CH_4 emissions from ferroalloys production, and CH_4 and CO_2 emissions from waste incineration). The ERT considers it extremely unlikely that the AD used for these estimates have zero uncertainty. The ERT recommends that, in the NIR of its next annual submission, Sweden revise these uncertainty estimates. Sweden has reported only in qualitative terms the uncertainties for the KP-LULUCF activities (see para. 112 below). The ERT encourages Sweden to report quantitative estimates for the uncertainty of the AD and EFs of the KP-LULUCF activities.

Recalculations and time-series consistency

27. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. The ERT noted that recalculations reported by Sweden of the time series from 1990 to 2008 have been undertaken to: take into account revised AD and new EFs in the energy sector; include previously not reported CO_2 emissions from chemical industries in the industrial processes sector as a consequence of a QA/QC project; revise area estimates for histosols and organic soils in the agriculture sector; and revise AD in the waste sector.

28. In the LULUCF sector, the most significant quantitative changes occurred due to a change in the method used to compile data for litter and soil organic carbon on mineral soils (in the categories forest land remaining forest land and grassland remaining grassland) and an increase in the sample used for these calculations. The reporting of soil organic carbon changes in organic cropland soils has also been revised by using a new assessment of the total area of these lands (in the category cropland remaining cropland). A major part of the significant change in the total removals from 2005 and onwards is the result of the annual update of the reporting database. Improvements in the reporting of smaller trees has decreased the removal under living biomass and the introduction of reporting stump systems has increased the removal under dead organic matter.

29. The recalculations resulted in an increase in the estimated total GHG emissions without LULUCF in 1990 of 0.1 per cent and a decrease of total GHG emissions with LULUCF of 32.8 per cent. For the year 2008, the recalculations led to a decrease of total GHG emissions without LULUCF of 1.0 per cent and a decrease of 40.0 per cent for total GHG emissions with LULUCF. The main recalculations took place in the following categories for the year 2008:

(a) CO_2 emissions for other sectors: a decrease of 11.7 per cent;

(b) CO_2, CH_4 and N_2O emissions from oil and natural gas: an increase of 19.8 per cent;

(c) CO_2 emissions for chemical industry: an increase of 90.4 per cent;

(d) CO_2 net removals from LULUCF: an increase of 130.8 per cent (from 14,810.33 Gg CO_2 reported in the 2010 annual submission to 34,018.83 Gg CO_2 reported in the 2011 annual submission).

30. The rationale for these recalculations is provided for each category and gas in CRF table 8(b) and, in more detail, in the sector-specific chapters of the NIR. Chapter 10 of the NIR summarizes the recalculations in each sector.

Verification and quality assurance/quality control approaches

31. The ERT noted that Sweden has implemented a QA/QC system and a QA/QC plan which are documented in the NIR. The QA/QC plan also addresses the recommendations for improvements resulting from the review reports. Tier 1 QC activities are implemented in all sectors. Tier 2 QC activities are implemented for the energy and the industrial processes sector. The Swedish QA/QC system includes national peer reviews by sectoral authorities, but the results of these peer reviews are not described in the NIR. The tier 2 checks include a comparison of environmental reports and European Union emissions trading scheme (EU ETS) data; facilities are contacted for verification when differences occur. The implementation of the QA/QC plan resulted in recalculations, (e.g. for CO_2 emissions from other (chemical industry) after detailed QA/QC checks of reports from installations or in the detection of some errors). The ERT encourages Sweden to expand its tier 2 QC activities to the agriculture, LULUCF and waste sectors and to include the results of national peer reviews to the sections on sector-specific QA/QC activities in the NIR of its next annual submission.

Transparency

32. Sweden's inventory is generally transparent and its NIR follows the recommended outline of the UNFCCC reporting guidelines. The ERT noted that the transparency of the information on the agriculture sector in the NIR has improved compared with the previous submissions. However, the ERT identified specific areas in the NIR where the transparency of the information should be further improved. These areas include:

(a) In the energy sector, the method for estimating emissions from transfer losses of gas-works gas and the justification that emissions from venting are included in other categories of fugitive emissions (see paras. 51 and 53 below);

(b) In the industrial processes sector, the EF for cement production (see para. 62 below);

(c) In the agriculture sector, the calculation of average milk yield, the N flow model for indirect soil emissions and the trends of the CH_4 implied emission factor (IEF) in manure management (see paras. 73, 75 and 81 below).

33. The ERT recommends that Sweden further improve the transparency of the NIR in these areas in its next annual submission.

Inventory management

34. As described in the NIR, Sweden has a centralized archiving system, located at Swedish EPA, which includes the archiving of disaggregated EFs and AD, and documentation on how these factors and data have been generated and aggregated for the

preparation of the inventory. The archived information also includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on key categories and key category identification and planned inventory improvements. A system for data handling called TPS was implemented for the 2007 submission and has continued to be used since then.

3. Follow-up to previous reviews

35. The ERT noted that the annual review report for the 2010 annual submission, including its recommendations, was not available to the Party at the time when the 2011 annual submission was due to be submitted. Nevertheless, the ERT noted that the following recommendations made in that review report have been implemented by Sweden:

(a) The completion of CRF table 7 by including the key categories information for 1990 and 2009;

(b) An improved description of the national system;

(c) The improvement of information on the use of EU ETS data in the Swedish GHG inventory;

(d) The transparent and consistent reporting of civil aviation and aviation bunkers;

(e) The improvement of explanations for the reporting of fugitive emissions from the distribution of oil products;

(f) The improvement of the methodologies in the agriculture sector and the improvement of the transparency of the methodological descriptions;

(g) The provision of a land-use transition matrix;

(h) The inclusion of missing CH_4 emission estimates from wastewater handling for 1990–2007 in the waste sector;

(i) The correction of errors and the revision of the use of some notation keys.

36. Sweden has provided transparent documentation of the recommendations from previous review reports that were addressed in section 10.4 of the NIR and the ERT commends Sweden for this approach. Recommendations of the 2009 review report were addressed in a systematic and comprehensive manner in the 2011 annual submission.

4. Areas for further improvement

Identified by the Party

37. The NIR identifies several areas for improvement:

(a) The correct allocation of activities and emissions in the iron and steel industry;

(b) An improved method for estimating emissions from off-road vehicles and working machinery;

(c) The allocation of fuels to domestic or international bunkers;

(d) The separation of fugitive emissions from venting from other fugitive emissions;

(e) The improvement of the accuracy of the estimates for the below-ground dead wood pool.

Identified by the expert review team

38. During the review, the ERT identified cross-cutting issues for improvement. These are listed in paragraph 139 below.

39. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report.

B. Energy

1. Sector overview

40. The energy sector is the main sector in the GHG inventory of Sweden. In 2009, GHG emissions from the energy sector amounted to 44,613.05 Gg CO_2 eq, or 74.3 per cent of total GHG emissions. Since 1990, emissions have decreased by 16.2 per cent. The key driver for the fall in emissions is the decrease in fossil fuel consumption in residential and commercial and in manufacturing industries and construction. The reduction is largely attributed to substantially replacing the combustion of liquid fuels in residential and commercial with the combustion of biomass fuels used for district heating. Within the sector, 45.6 per cent of the emissions were from transport, followed by 23.4 per cent from energy industries, 19.6 per cent from manufacturing industries and construction and 8.6 per cent from other sectors. Fugitive emissions from fuels accounted for 2.3 per cent and the category other accounted for the remaining 0.6 per cent.

41. Sweden has performed recalculations for the energy sector between the 2010 and 2011 annual submissions following changes in AD and EFs and in response to recommendations in previous review reports. The impact of these recalculations is a decrease in total GHG emissions of 0.8 per cent for 2008 and an increase of 0.03 per cent for 1990 (GHG emissions for the energy sector decreased by 1.1 per cent for 2008 and increased by 0.05 per cent for 1990). The main recalculations took place in the following categories:

(a) CO_2 emissions from manufacturing industries and construction, mainly due to corrections in AD;

(b) CO_2 emissions from other sectors, due to improvements in the methods used to estimate AD;

(c) CO_2 and CH_4 emissions from fugitive emissions from oil and gas resulting from improved AD associated with the production of hydrogen;

42. The energy sector is generally complete in terms of gases, years and geographical coverage, with the exception of CH_4 and N_2O emissions from the combustion of ethanol in road transportation and CH_4 fugitive emissions from natural gas transmission and distribution that have not been estimated in the 2011 annual submission. Sweden provided emission estimates for these categories after the review week (see paras. 52 and 54 below).

43. Sweden utilizes facility-specific data collected through the EU ETS for several categories in the energy sector. Sweden has conducted a number of studies to compare facility data collected under the EU ETS and data reported by plants to the Swedish EPA. The latest study[5] reported on the differences in plant data between the two sources of information and was provided to the ERT during the review. These studies review if the EU ETS data are of sufficient quality, maintain time-series consistency and can be used to improve historical estimates. The ERT commends Sweden on this approach and

[5] Nyström, A-K. 2007. *Study of differences in plant data between the energy statistics and the EU emission trading scheme.* SMED report.

recommends that the Party continue to use this framework of verification and QC when considering the implementation of additional EU ETS data into the national inventory.

2. Reference and sectoral approaches

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

44. Estimates of CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. For 2009, the CO_2 emissions estimated using the sectoral approach were 1.5 per cent lower than the emissions estimated using the reference approach. The differences are mostly in CO_2 emissions from solid and liquid fuels (4.34 per cent and 1.23 per cent lower, respectively). Although explanations for the differences were provided by the Party in the NIR, the ERT noted that the documentation box of CRF table 1.A(c) referred to section 3.3.6 of the NIR, which is not correct. The ERT reiterates the recommendation of the previous review report that Sweden correct this reference in its next annual submission. For 1990–2008 the differences between the two approaches for fuel consumption and CO_2 emissions are very similar. However, for 2009, the energy consumption in the sectoral approach is 1.87 per cent higher than in the reference approach, but the CO_2 emissions are 1.51 per cent lower. The ERT encourages Sweden to solve or reduce this divergence and to explain it in its next annual submission.

45. The ERT noted several differences between the data reported in Sweden's annual submission and those reported to the International Energy Agency (IEA), including peat production figures, imports and exports of lubricants and liquid fuel stock changes. In its NIR Sweden notes that these differences were studied and analyzed during 2010. However, due to budget and time constraints, the recommendations from the study have not been fully implemented in the current submission. The ERT recommends that Sweden act on the recommendations of the study to improve alignment between the two data sets and report on this in its next annual submission.

International bunker fuels

46. In the NIR, Sweden reports on the methods used to identify international bunker fuels, recent trends in the data and methods to estimate emissions. Sweden reports that the allocation to international or domestic fuels is based on information from the monthly survey on the supply and delivery of petroleum products. The ERT noted that there are some differences between the data reported to the IEA and that in the 2011 annual submission. For example, for international aviation, discrepancies in fuel consumption are large (up to 40 per cent) in 1990–2001 and small from 2002 onwards (except for 2007); for international marine bunkers, residual fuel oil consumption is 5–10 per cent higher in the CRF tables than the IEA data for most years. Sweden conducted a study in 2010 showing that the differences between the IEA data and the CRF tables can, to some extent, be explained by the revisions to the CRF tables: data in the CRF tables are recalculated to ensure time-series consistency while data reported to the IEA are not necessarily recalculated.

47. The ERT noted that in the CRF tables, small inconsistencies occur between tables 1.C and 1.A(b) for jet kerosene used in international aviation bunkers for 2009, and for gas/diesel oil and residual fuel oil used in international marine bunkers for all years. The ERT recommends that Sweden correct these discrepancies in its next annual submission.

3. Key categories

Stationary combustion: solid fuels – CO_2 and N_2O

48. The EFs for coke oven gas and steel converter gas used in public electricity and heat production is based on measurements from one plant conducted in 2001. The ERT considers that EFs could vary over time and between plants. In response to a question raised by the ERT during the review, Sweden confirmed that these historical EFs will be revised in its next annual submission using facility-specific data coming from EU ETS data. Sweden also informed the ERT that it has completed a comparison of the AD sources and concluded that time-series consistency would be ensured. The ERT supports this improvement and recommends that Sweden describe any recalculations and changes clearly in the NIR of its next annual submission.

49. The ERT noted that Sweden's IEF for N_2O (8.41–15.97 kg/TJ) is the highest across all Parties for all years for the public electricity and heat production category (0.06–15.97 kg/TJ). The high IEFs are driven largely by high N_2O EFs for coal and coke. The N_2O EFs for these fuels are sourced from a country-specific study conducted in 2004.[6] The ERT recommends that Sweden review the N_2O EFs and report on any updates or provide further justification for the existing factors in the NIR of its next annual submission.

Stationary combustion: gaseous fuels – CO_2

50. Sweden reports the CO_2 emissions from the combustion of some CH_4 and CH_4-based gas mixtures under liquid fuels in chemicals (NIR, page 95). To estimate emissions from the combustion of these fuels, Sweden applied the EF for natural gas. In response to a question raised by the ERT during the review, Sweden confirmed that fuel-specific and year-specific CO_2 EFs will be used in its next annual submission. The updated EFs will be based on one facility that produces the majority (around 85 per cent) of this fuel in Sweden. The ERT supports this improvement. The ERT recommends that Sweden review the allocation and clearly explain any recalculations in its next annual submission, because depending on the mixture it may be more appropriate to report these emissions under gaseous fuels.

Oil and natural gas[7]: liquid and gaseous fuels – CO_2, CH_4 and N_2O

51. In CRF table 1.B.2, Sweden has reported CO_2 and CH_4 emissions from venting of oil, gas and combined as included elsewhere ("IE"), and reported that these emissions are included in the emissions from refining/storage of oil and in the flaring of oil refinery gases. The ERT notes that this justification is not sufficiently transparent to allow assessment of the completeness of the inventory. In response to a question raised by the ERT during the review, Sweden provided a comprehensive and transparent description of the analysis and justification that emissions from this category are included elsewhere. The ERT recommends that Sweden allocate these emissions correctly or, if this is not possible, include additional information indicating where they are allocated in its next annual submission.

52. In its submission of 31 March 2011, Sweden has reported CO_2 and CH_4 emissions from the transmission and distribution of natural gas as "NO" for the whole time series 1990–2009. Although these missing estimates were not included in the list of potential

[6] Boström, C, Flodström, E and Cooper, D. 2004. *Emissionsfaktorer för stationär förbränning.* SMED report 3.

[7] Not all emissions related to all gases and fuels under this category are key categories. However, since the calculation procedures for issues related to this category are discussed as a whole, the individual gases and fuels are not assessed in separate sections.

problems and further questions raised by the ERT during the review, Sweden provided emission estimates for CH_4 emissions (0.93 Gg from transmission and 1.26 Gg from distribution for 2009), and reported CO_2 emissions for transmission and distribution as "NE" and "NA", respectively, for the whole time series in its revised estimates submitted in response to this list (these missing estimates had been identified in the list of potential problems and further questions raised by the ERT during the review of the annual submission of the EU). The ERT agrees with these estimates and strongly recommends that Sweden report estimates for CO_2 emissions from natural gas transmission and CH_4 emissions from natural gas transmission and distribution and in its next annual submission.

53. In its 2011 annual submission, Sweden has reported CO_2, CH_4 and N_2O emissions from the transfer losses of gas-works gas under the distribution of oil products category. The ERT recommends that Sweden revise the allocation of these emissions, possibly allocating them to solid fuel transformation or other (fugitive emissions from solid fuels), and describe any recalculations in the NIR of its next annual submission. The method for estimating these emissions is not clearly described in the NIR. In response to a question raised by the ERT during the review, Sweden provided more information on the method used to estimate emissions from this category. The ERT reiterates the recommendation from the previous review report that Sweden describe the method to estimate emissions from the transfer losses of gas-works gas transparently and include the information provided to the ERT in its next annual submission.

4. Non-key categories

Road transportation: biomass – CH_4 and N_2O

54. The ERT noted that Sweden in its 2011 annual submission did not estimate CH_4 and N_2O emissions from the combustion of ethanol. For biomass fuels in road transportation, Sweden reported CH_4 emissions as "NE", "NO" and "IE" and, in its N_2O estimates, Sweden did not include emissions from ethanol combustion. The ERT notes that the IPCC good practice guidance states that non-CO_2 emissions from biofuels should be included in national totals. Of the 35 other Parties that reported consumption of biomass fuels for road transportation, none reported "NE" for CH_4 and N_2O. In response to a question raised by the ERT during the review, Sweden stated that it has not estimated emissions because there are no default EFs for ethanol in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) or the IPCC good practice guidance. However, the Revised 1996 IPCC Guidelines state that the engines and emission control systems used for the combustion of ethanol in road transportation are similar to those for advanced-technology gasoline vehicles and that the overall energy efficiency and emissions properties are similar. In response to the list of potential problems and further questions raised by the ERT, Sweden provided these emission estimates for the whole time series 1990–2009. For 2009 and for biomass used in road transportation, Sweden reported emissions of 0.10 Gg CH_4 and 0.01 Gg N_2O. AD were obtained from the model assessment and reliability of transport emissions models and inventory systems (ARTEMIS) while EFs were obtained from the model handbook of emissions factors for road transport (HBEFA) version 3.1. The ERT considers the potential problem to be solved and recommends Sweden to continue the reporting of these estimates in its next annual submission.

C. Industrial processes and solvent and other product use

1. Sector overview

55. In 2009, emissions from the industrial processes sector amounted to 5,031.45 Gg CO_2 eq, or 8.4 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 295.41 Gg CO_2 eq, or 0.5 per cent of total GHG emissions. Within the industrial processes sector, 36.5 per cent of the emissions were from mineral products, followed by 34.7 per cent from metal production, 19.6 per cent from consumption of halocarbons and SF_6 and 7.5 per cent from the chemical industry. The remaining 1.7 per cent were from the category other production.

56. Between 1990 and 2009, emissions have decreased by 20.4 per cent in the industrial processes sector and by 11.2 per cent in the solvent and other product use sector. Since 1990, emissions in the industrial processes sector have fluctuated, primarily because production volumes vary with economic cycles: the biggest drop occurred between 2008 and 2009, when emissions decreased by 26.4 per cent (by 1,806.75 Gg CO_2 eq) as a result of the global economic downturn that started in 2008 and deepened in 2009. This decrease was primarily due to a decline in metal production, where emissions declined by 46.3 per cent (by 1,506.05 Gg CO_2 eq).

57. Sweden has made recalculations for the industrial processes sector between the 2010 and 2011 annual submissions following changes in AD and includes emissions not previously reported from the production of organic chemicals, mainly in the chemical industry and from the consumption of halocarbons and SF_6. The impact of these recalculations is an increase in total GHG emissions of 0.1 per cent for both 2008 and 1990. For the industrial processes sector, the impact of recalculations is an increase of 0.6 per cent for 2008 and of 0.9 per cent for 1990.

58. Sweden has also made recalculations for the solvent and other product use sector between the 2010 and 2011 annual submissions for the period 2006–2008: Sweden has revised some AD, as the estimates are based in a moving average. For 2008, these recalculations increased total GHG emissions by 0.02 per cent (for emissions from the solvent and other product use sector, the impact is an increase of 4.0 per cent). The main recalculations took place in the categories: paint application (CO_2 emissions), other (CO_2 emissions from the printing industry) and other (N_2O emissions from other use of N_2O).

59. Sweden's inventory for the industrial process, and solvent and other product use sectors is complete except for solvents under consumption of halocarbons and SF_6 (see para. 69 below).

2. Key categories

Cement production – CO_2

60. Cement production occurs at three facilities in Sweden, owned by a single company. Emissions have been estimated based on data obtained from environmental reports, the EU ETS and by direct contacts with the facilities. To estimate CO_2 emissions, Sweden used a tier 2 methodology based on clinker production and a cement kiln dust (CKD) correction factor. The methodology is in line with the IPCC good practice guidance.

61. The NIR indicates that the Swedish inventory compilers are engaged in ongoing discussions with the facilities about the accuracy of CO_2 emissions from CKD reported by the facilities. The facilities indicate that CO_2 emissions from CKD no longer occur at Swedish cement production sites. However, until this issue is completely resolved, CO_2 emissions from CKD from 2005 and onwards are reported as the same amount as for 2004 (5.0 Gg CO_2). The ERT recommends that Sweden report on the progress of these

discussions by clarifying the occurrence of CO_2 emissions from CKD in its next annual submission.

62. The ERT also noted that the explanation of how the CO_2 EF used in this category was obtained is not completely transparent. According to the NIR (page 137), Sweden used the calcium oxide (CaO) content of the clinker reported by the cement production company for the years from 2005 onwards, which means that Sweden used plant-specific EFs for this category. However, in the formula to estimate CO_2 emissions from the production of clinker reported in the NIR there is a constant CO_2 EF (0.525 Gg CO_2/Gg clinker). In response to a question raised by the ERT during the review, Sweden indicated that it is aware of the lack of transparency of the text in the NIR and assured the ERT that the NIR of the 2012 annual submission will be more transparent on this matter. To increase transparency, the ERT recommends that Sweden include additional relevant information on how the CO_2 EF for cement production is obtained in its next annual submission.

63. The ERT also noted that there is an inconsistency between the CO_2 IEF for cement production reported for 2009 in CRF table 2(I)A-G (0.5593 t/t) and that reported in the NIR (0.5425 t/t). The ERT recommends that Sweden improve the consistency of the information on this category in its next annual submission and improve its QC procedures for this category.

Iron and steel production – CO_2

64. In Sweden, there are three primary iron and steel facilities and about ten secondary steel plants equipped with electric arc furnaces. Sweden used a tier 2 method from the IPCC good practice guidance to estimate CO_2 emissions from this category, with the AD collected from environmental monitoring reports and EU ETS data.

65. According to the Revised 1996 IPCC Guidelines, emissions of CO_2 from the use of limestone in iron and steel plants should be reported separately, as process emissions from limestone and dolomite use. However, Sweden has reported these emissions under pig iron. Since the Party's 2004 submission, the review reports have repeatedly recommended that Sweden follow the guidance in the Revised 1996 IPCC Guidelines, but Sweden continues to report these CO_2 emissions under the pig iron category. Sweden has explained in its NIR (page 174) that, as the CO_2 emissions from limestone and dolomite are small (less than 1 per cent of the plants total CO_2 emissions), Sweden does not consider it good practice to spend resources to obtain underlying data to separate these emissions. However, the ERT considers that Sweden is not following the Revised 1996 IPCC Guidelines and, therefore, the ERT reiterates the recommendation of the previous review report that Sweden report these emissions in accordance with the Revised 1996 IPCC Guidelines in its next annual submission.

66. According to the NIR (page 174), considerable amounts of gases from coke ovens, blast furnaces and steel plants are collected in a gas holder and sold to external consumers (mainly with activities under the category public electricity and heat production), and their associated emissions are allocated to the category where they are consumed, and thus not accounted for in the reporting for iron and steel production. Sweden has recognized that this allocation is not in accordance with the Revised 1996 IPCC Guidelines, but in line with the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* and more in line with emission reporting for the annual environmental reports and the EU ETS reporting, which ensures better data comparability and QA/QC procedures. The ERT recommends that Sweden report these emissions in accordance with the Revised 1996 IPCC Guidelines. To increase transparency in the allocation of emissions, the ERT encourages Sweden to provide a detailed carbon mass balance for all the processes involved.

3. Non-key categories

Limestone and dolomite use – CO_2

67. Sweden has reported the CO_2 emissions from limestone use in glass production in the subcategory glass production under mineral products (other) and not under limestone and dolomite use to increase the transparency of reporting and following the recommendation in the review report of the 2010 EU submission[8] to harmonize the allocation of these CO_2 emissions from limestone and dolomite use across member States. The ERT noted that the Revised 1996 IPCC Guidelines recommend the reporting of all other uses of limestone and dolomite, which produce CO_2 emissions (except for use in cement and lime production and in agriculture) and this does not exclude the option that a Party choses a more transparent way of reporting in a separate subcategory (e.g under other (glass production)) to avoid reporting a mix of different limestone and dolomite uses in one category. However, the ERT also noted that reporting with more transparency is in accordance with the IPCC good practice guidance.

Other production – CH_4 and N_2O

68. In its NIR, Sweden has reported CH_4 and N_2O emissions from combustion of cooking liquor under the subcategory pulp and paper. The cooking liquor was combusted in the pulp and paper industry to recover sodium and sulphur, but also for energy recovery. The ERT recommends that Sweden confirm that the main use of the cooking liquor is the recovery of chemicals, or else report these emissions under the pulp, paper and print category in the energy sector. In any case, the ERT recommends that Sweden separate the emissions associated with energy from the emissions associated with the chemical process, in accordance with the Revised 1996 IPCC Guidelines.

Consumption of halocarbons and SF_6 – HFCs and PFCs

69. Sweden has reported HFC and PFC emissions from the subcategory solvents as "NE" in its NIR (table 4.39) but as "NO" in CRF table 2(I). In its NIR (page 189), Sweden indicated that it has not been able to estimate the amount of F-gas emissions from solvents but that this is expected to be minor. The ERT recommends that Sweden, in its next annual submission, estimate these emissions, explain any recalculations and improve the consistency between the NIR and the CRF tables.

D. Agriculture

1. Sector overview

70. In 2009, emissions from the agriculture sector amounted to 8,191.89 Gg CO_2 eq, or 13.6 per cent of total GHG emissions. Since 1990, emissions have decreased by 11.3 per cent (by 1,045.05 Gg CO_2 eq). The key driver for the fall in emissions is the decrease in the number of livestock and a decrease in the application of nitrogen (N) fertilizer: between 1990 and 2009, N_2O emissions from agricultural soils decreased by 512.95 Gg CO_2 eq (by 10.1 per cent) and CH_4 emissions from enteric fermentation by 361.31 Gg CO_2 eq (by 11.8 per cent). For 2009, within the sector, 56.0 per cent of the emissions were from agricultural soils, followed by 32.9 per cent from enteric fermentation and the remaining 11.1 per cent were from manure management.

71. Sweden has made recalculations for the agriculture sector between the 2010 and 2011 annual submissions following updates in AD and EFs. The recalculations resulted in a

[8] FCCC/ARR/2010/EU, paragraph 48.

decrease in total GHG emissions of 0.3 per cent for 2008 and of 0.4 per cent for 1990 (the impact on emissions from the agriculture sector is a decrease of 2.1 per cent for 2008 and of 2.9 per cent for 1990). The main recalculations took place in the category agricultural soils.

72. The agriculture sector inventory is complete in terms of categories, gases, geographical coverage and years. Rice cultivation, prescribed burning of savannas and field burning of agricultural residues were reported as "NO", as these activities do not occur in the country.

73. The ERT notes that the transparency of reporting has improved compared with the previous annual submission. However, the ERT recommends that Sweden further increase the transparency of the NIR of its next annual submission by including further background information on the calculation of average milk yield, on the N flow model (STANK) and on the CH_4 IEF trends for manure management.

2. Key categories

Enteric fermentation – CH_4

74. Sweden has applied a country-specific methodology for the estimation of CH_4 emissions from cattle using metabolizable energy in its calculations. To increase the transparency of the estimate, Sweden includes in its NIR a formula for the calculation of gross energy intake and CH_4 conversion rate (Ym), but does not provide the results of these calculations. For 1990–2009, CRF table 4.A shows a specific value for Ym for each year, whereas for gross energy intake the value is constant. In response to a question raised by the ERT during the review, Sweden explained that it will report a specific value for each year for gross energy intake in its next annual submission. The ERT recommends that Sweden report a time series for gross energy intake and Ym in both its NIR and CRF in its next annual submission.

75. For the calculation of average milk yields, Sweden applies monitoring results published by the Swedish Dairy Association and, for the cows not included in the monitoring programme, model results based on sample surveys. The NIR presents the relevant milk yield data, but no further information. The ERT recommends that Sweden include additional information on the calculation of annual average milk yield in the NIR of its next annual submission.

76. In the additional information table of CRF table 4.A, Sweden reports all indicators as "NE", "NO" or "IE". In response to a question raised by the ERT during the review, Sweden answered that, for dairy cows, 600 kg was assumed for all reporting years for the indicator "weight". However, Sweden does not use the weight of cattle in the estimations of CH_4 emissions from non-dairy cattle, therefore the ERT considers that "NA" would be more appropriate. The ERT also considers that, for the indicator "work", "NO" would be adequate for all types of animals, because the use of draft cattle is not common in Sweden. Sweden explained that it plans to report the correct indicators for milk yield, digestibility of feed and feeding situation for the cattle categories in its next annual submission. The ERT recommends that Sweden improve its use of notation keys in the additional information table for CRF table 4.A in its next annual submission.

Manure management – N_2O

77. Sweden estimates emissions for the manure management systems liquid/slurry, solid storage and deep litter, including the manure deposited in stables during the grazing period. In contrast to the definitions used in the IPCC good practice guidance, the Swedish definition of fraction of total annual excretion for each livestock category (T) managed in manure management system (S) in the country ($MS_{(T, S)}$) does not include the fraction of N

excreted on pasture. Thus, Sweden adopted equation 4.18 of the IPCC good practice guidance by correcting the total amount of N excreted using the equation of "(365 – $GrazPeriod_T$)/365". In response to a question raised by the ERT during the review, Sweden explained that GrazPeriod is defined as the time that animals actually spent grazing and consequently, the fraction of manure deposited on the pasture. The ERT considers that this is not in line with the IPCC good practice guidance. The ERT, therefore, recommends that Sweden apply consistent definitions of animal waste management systems in the NIR for both the CH_4 and the N_2O calculations, in line with the IPCC good practice guidance equations 4.17 and 4.18.

78. Table 6.15 of the NIR on N excretion rates gives no information on the consideration of annual growing cycles of piglets. In response to a question raised by the ERT during the review, Sweden explained that the value of piglets presented in the NIR assumes that piglets do not grow during their first year and that the number of piglets listed in the table takes this assumption into consideration. The ERT recommends that Sweden include this information in the NIR of its next annual submission.

Direct soil emissions – N_2O

79. Sweden includes legumes and other crops in the fractional parameter of N content of non-N-fixing crops ($Frac_{NCRO}$). In response to a question raised by the ERT during the review, Sweden indicated that it will improve the transparency by reporting both the N fraction of legumes ($Frac_{NCRBF}$) and that of other crops ($Frac_{NCRO}$) separately in its next annual submission. The ERT, therefore, recommends that Sweden report these fractional parameters in the additional information table of CRF table 4.D, in its next annual submission.

Pasture, range and paddock manure – N_2O

80. Following a recommendation of the previous review report, Sweden changed the country-specific EF used in the 2010 annual submission to the IPCC good practice guidance default EF of 0.02 kg N_2O–N/kg N excreted. However, in its emission calculations, Sweden continues to subtract the N lost as ammonia ($Frac_{GASM}$) from the total amount of nitrogen excreted on pastures, which is not in line with the definition of the IPCC default EF (N_2O–N per kg N excreted) and equation 4.18 of the IPCC good practice guidance. The ERT strongly recommends that Sweden apply the default EF and equation 4.18, in line with the IPCC good practice guidance, in its next annual submission.

Indirect soil emissions – N_2O

81. Sweden enhanced the transparency of its NIR by including additional information on losses of N caused by ammonia emissions at different stages of manure handling. The ERT welcomes this development, but recommends that Sweden provide more information on the STANK model in the NIR of in its next annual submission, especially showing whether underlying studies reflect field data, expert judgement or studies reported in the scientific literature.

E. Land use, land-use change and forestry

1. Sector overview

82. In 2009, net removals from the LULUCF sector amounted to 41,638.33 Gg CO_2 eq, and offset 69.3 per cent of the total GHG emissions. Since 1990, net removals have decreased by 6.9 per cent (by 3.084.39 Gg CO_2 eq). The key driver for this fall is the decrease in removals for forest land remaining forest land (by 3,523.74 Gg CO_2 eq). For

2009, within the sector, net removals occurred for forest land (45,921.23 Gg CO_2 eq) and grassland (573.06 Gg CO_2 eq), while net emissions occurred for settlements, cropland and wetlands (2,766.00 Gg CO_2 eq, 2,028.16 Gg CO_2 eq and 61.80 Gg CO_2 eq, respectively).

83. In Sweden, net removals occurred for the LULUCF sector for every year in the reporting period 1990–2009, although the trend for the period up to 2008 is a decrease in the net removals mainly as a result of increased harvesting and, for the latest years, the effect of two severe storms. In response to a question raised by the ERT during the review, Sweden explained that the trend for the last years is affected by the random variation in the sample since the latest reported year is based on only one fifth (6,000 plots) of the full sample (30,000 plots). Since 2003, net removals have decreased annually except for 2009 (net removals increased by 22.9 per cent between 2008 and 2009). Sweden indicated that the reason for this could be the decrease in felling due to the recession in the world economy, which began in 2008. The ERT encourages Sweden to provide sufficient information on the changes in the trend of its net removals in its next annual submission.

84. During the review, the ERT requested information on how the randomness of sampling can cause such fluctuations in the carbon stock changes from year to year and how this is affecting the time-series consistency and the accuracy of the estimates. In response, Sweden provided information showing how accuracy declines towards the later years of a complete inventory cycle (every five years). Sweden indicated that, in order to provide consistent estimates, it performs a recalculation each year after obtaining new data for 20 per cent of the total sample plots. Sweden indicated that all reported years in its 2012 annual submission will be based on five different inventory cycles to maximize accuracy, and that all emissions and removals for the last years in the time series will be recalculated. To increase transparency, the ERT recommends that Sweden include additional information on these recalculations in the NIR of its next annual submission.

85. Sweden has made recalculations for the LULUCF sector between the 2010 and 2011 annual submissions in response to recommendations in the previous annual review report and following changes in methods and AD. For 2008, the impact of these recalculations on the total GHG emissions including LULUCF is a decrease by 64.5 per cent (net removals for the LULUCF sector increased by 130.8 per cent, from 14,675.82 Gg CO_2 eq to 33,878.70 Gg CO_2 eq). For 1990, the impact is a decrease in total GHG emissions including LULUCF of 32.8 per cent (net removals for the LULUCF sector increased by 44.1 per cent, from 31,042.39 Gg CO_2 eq to 44,722.72 Gg CO_2 eq). The main recalculations took place in CO_2 emissions and removals for forest land remaining forest land (see para. 92 below), land converted to forest land (see para. 95 below) and settlements remaining settlements (see para. 97 below).

86. The ERT noted that Sweden has substantially revised the notation keys used in CRF table 5 in its 2011 annual submission. For 2008:

(a) For wetlands remaining wetlands and land converted to wetlands, the "IE", "NE" and "NO" for CH_4 and N_2O emissions in the 2010 annual submission have been changed to "NA" in the 2011 annual submission;

(b) For land converted to settlements, the "NE" for CH_4 and N_2O emissions in the 2010 annual submission has been changed to "IE" in the 2011 annual submission;

(c) For land converted to other land, the "NE" used for CO_2, CH_4 and N_2O emissions in the 2010 annual submission has been changed to "NA" in the 2011 annual submission.

87. The reporting of this sector is complete. All mandatory categories are reported, although for land converted to wetlands, areas are reported but pools are reported as "NA" (in pages 246, 256–257 and 265 of its NIR Sweden has indicated that wetlands are

considered unmanaged except 10 kha used for peat extraction; see para. 98 below). The ERT considers that if Sweden reported areas of land converted to wetlands then all pools should be reported or otherwise the notation key "NE" can be used with the appropriate justification in the NIR. The ERT recommends that Sweden provide estimates for land converted to wetland or otherwise revise its use of notation keys for carbon stock changes in wetlands in its next annual submission.

88. The 2011 annual submission also includes emissions from N fertilization of forest land, disturbance associated with land conversions to cropland, liming and biomass burning. However, the ERT noted that Sweden has reported emissions as "IE" for a few categories: N_2O emissions from fertilization of land converted to forest land in CRF table 5(I); CO_2 emissions from liming in grassland, in table CRF 5(IV); CO_2, CH_4 and N_2O emissions from biomass burning for land converted to forest land, all cropland subcategories and land converted to grassland. The ERT encourages Sweden to disaggregate these emissions and report them in the appropriate categories in its next annual submission.

89. Sweden mainly uses country-specific methods in line with the IPCC good practice guidance for LULUCF. The methods used for the main land-use categories are mostly tier 3 and 2 (stock change method), while the methods used for non-CO_2 gases are mostly tier 1 methods. EFs, parameters and AD are mostly country specific, based on the well-developed national forest inventory, monitoring the most relevant carbon pools since 1983. The ERT commends Sweden for using country-specific data and higher tier methods in line with the IPCC good practice guidance for LULUCF, and the ERT encourages Sweden to further improve methods used for the estimation of non-CO_2 gases.

90. The ERT welcomes the positive response of Sweden to a recommendation in the previous review report by providing a land-use transitional matrix in its 2011 annual submission. However, there are still some discrepancies between the areas reported for the different land-use categories (NIR tables 7.1a and 7.4) and also for the total area of the country (NIR tables 7.1a, 7.1b and 7.4 report 45,250 kha, 45,158 kha and 45,080 kha, respectively, for total area). This issue is also observed when comparing land areas in the 2010 annual submission with the 2011 annual submission for all land-use categories. In response to a question raised by the ERT during the review, Sweden explained the influence of its sampling system (see paras. 83 and 84 above). Sweden also explained that NIR table 7.1a is based on 6,000 plots while NIR table 7.1b is based on 30,000 plots and considered more accurate. Sweden also explained that the Party considered the magnitude of the discrepancy small (e.g. 0.2 per cent for 2009). Sweden indicated that this discrepancy will be better explained in its next annual submission. The ERT recommends that Sweden address the inconsistencies in the reporting of areas in its next annual submission.

2. Key categories

Forest land remaining forest land – CO_2

91. Country-specific methodologies used for the estimates are in line with tier 2 and 3 of the IPCC good practice guidance for LULUCF and AD and EFs are country-specific.

92. The ERT noted that there are large differences in the areas of all land-use categories reported in the 2011 annual submission compared with the 2010 annual submission, especially in forest land area (for 2008, the 2010 annual submission reported 27,992.24 kha but the 2011 annual submission reported 28,668.02 kha; for 2009, the 2011 annual submission reported 29,388.21 kha). In response to a question raised by the ERT during the review, Sweden stated that the discrepancy is due to sample randomness (see paras. 83 and 84 above). Sweden further stated that the results indicate that total forest land area is increasing and that the value for forest land area for 2009 is probably an overestimation but

this overestimation is expected to average out after recalculation at the end of the five-year inventory cycle. The ERT notes that the discrepancy and inconsistency in reporting of land areas of the different land-use categories is a problem that has been raised also in previous review reports, therefore, the ERT recommends that Sweden demonstrate that this discrepancy is reduced with decreasing uncertainties for each year that adds to the full five-year inventory cycle in its next annual submission.

93. In the previous review report, it has been recommended that Sweden provide in its NIR more information on the drivers of the emission/removal trends and their impacts on the annual carbon stock change, in order to improve the transparency of the reporting and facilitate the review of the inventory. The ERT considers that the justifications provided by Sweden in its 2011 annual submission need to be further elaborated (e.g. the inter-annual change between 2008 and 2009 for net CO_2 removals and net carbon stock change in living biomass and dead organic matter are significant). In response to a question raised by the ERT during the review, Sweden explained that the main driver for the trend is the harvest rates, which are influenced by the international demand for forest products, and also the storms, which caused the removal of a large volume of living biomass. Sweden indicated that it will make the information it provides on these issues more transparent in the NIR of its next annual submission. The ERT recommends that Sweden include additional information on the drivers of the emission/removal trends and their impacts on the annual carbon stock change and improve the transparency of the information in its next annual submission.

Land converted to forest land – CO_2

94. Country-specific methodologies used for the estimates are in line with tiers 2 and 3 of the IPCC good practice guidance for LULUCF and the AD and EFs are country specific. The net removal reported for 2009 (1.913.64 Gg CO_2 eq) has decreased by 59.5 per cent compared with the net removal reported for 2008 (4.728.03 Gg CO_2 eq), and the ERT considers that this inter-annual change is significant. In response to a question raised by the ERT during the review, Sweden explained that this inter-annual change is due to changes in the living biomass pool and the random variation of the sampling system (see paras. 83 and 84 above). The ERT encourages Sweden to improve the explanation of the factors behind this inter-annual fluctuation in the NIR of its next annual submission.

95. In the NIR, when discussing the recalculations for the LULUCF sector (page 311), Sweden has reported that a major part of the changes in the total removals from 2005 onwards is due to the annual update of the reporting database used for reporting, which affects carbon pools (mainly living biomass for all categories). For 2008, net carbon stock change in living biomass for land converted to forest land increased from 620.32 Gg carbon (C) in the 2010 annual submission to 1,063.98 Gg C in the 2011 annual submission.

Land converted to cropland – CO_2

96. As with land converted to forest land (see para. 94 above), the inter-annual change of net removals is significant (44.3 per cent) and Sweden provided the same reasoning. The ERT reiterates the encouragement made in paragraph 94 above that Sweden address the underlying factor behind this inter-annual fluctuation and improve the time-series consistency of its reporting.

Settlements remaining settlements – CO_2

97. For 2008, net carbon stock change in living biomass for settlements remaining settlements decreased from –32.25 Gg C to –371.60 Gg C as a result of the recalculations. The ERT encourages Sweden to explain in more detail this recalculation in its next annual submission.

3. Non-key categories

Wetlands remaining wetlands – CO_2, CH_4 and N_2O

98. In CRF table 5.D, Sweden has reported for wetlands remaining wetlands an area of 6,484.58 kha. However, the ERT noted that in the NIR (pages 246, 256–257 and 265), Sweden has reported that wetlands are considered unmanaged except for a small managed area (approximately 10 kha) used for peat extraction. The ERT encourages Sweden to report the area of managed wetlands, and not the total area of wetlands (managed and unmanaged) in the CRF tables in its next annual submission.

F. Waste

1. Sector overview

99. For 2009, emissions from the waste sector amounted to 1,937.01 Gg CO_2 eq, or 3.2 per cent of total GHG emissions. Since 1990, emissions have decreased by 43.4 per cent. The key drivers for the fall in emissions are the implementation of policies, measures and economic instruments which resulted in the improvement of waste management practices and techniques in Sweden (e.g. the reduction of organic waste deposited and the increased collection of CH_4 in landfills). Within the sector, 70.6 per cent of the emissions were from solid waste disposal on land, followed by 23.6 per cent from wastewater handling. The remaining 5.9 per cent were from waste incineration.

100. Sweden has made recalculations for the waste sector between the 2010 and 2011 annual submissions following changes in AD. The impact of these recalculations in the waste sector is an increase in total GHG emissions of 0.03 per cent for 2008 and of 0.4 per cent for 1990 (GHG emissions for the waste sector increased by 0.9 per cent for 2008 and by 9.6 per cent for 1990). The main recalculations took place in the following categories:

(a) CH_4 emissions for solid waste disposal on land;

(b) N_2O emissions for wastewater handling.

101. The inventory for the waste sector is generally complete and transparent, except for CH_4 emissions from industrial sludge treatment (see para. 107 below). Emissions from all categories were estimated. Emissions trends are explained.

102. Sweden reported that all QC procedures were implemented according to the QA/QC plan and that no improvements are planned in the waste sector for the next annual submission. However, the ERT noted that Sweden has reported relatively high uncertainties for the categories in the waste sector (56.0 per cent for CH_4 emissions from solid waste disposal on land, 49.0 per cent for CH_4 from wastewater handling and 100.0 per cent for N_2O from waste incineration). The ERT therefore encourages Sweden to assess potential improvements that could reduce the uncertainty of the emissions for these categories.

2. Key categories

Solid waste disposal on land – CH_4

103. Sweden has used the IPCC first order decay method with mostly default parameters and country-specific AD for estimating CH_4 emissions from solid waste disposal sites. The ERT recommends that Sweden develops country-specific parameters to estimate the emissions from this category in its next annual submission. There have been significant changes in waste management practices since 1990, which resulted in the reduction of municipal solid waste disposal on land to only 1.4 per cent of total generated household

waste for 2009 compared with 43.8 per cent in 1990. All solid waste disposal sites are categorized as managed in Sweden.

104. The NIR and the CRF tables provide transparent and complete information on the method and data sources that are used to estimate CH_4 emissions.

Wastewater handling – CH_4

105. Sweden has reported CH_4 emissions from wastewater handling for the whole time series in its 2011 annual submission for the first time. For estimating CH_4 emissions from industrial wastewater, Sweden has chosen a country-specific method, which is based on CH_4 leakage factor during energy recovery from anaerobic wastewater treatment and which is in the range of 2–5 per cent (Sweden has reported that only four industrial plants perform anaerobic wastewater treatment). Data for the period 1990–2004 were obtained by extrapolating backwards the data for 2005 because data on energy recovery is only available for the period 2005–2009. The ERT recommends that Sweden provide additional information on how this extrapolation was done, including how the potential changes, upgrades or modifications of the recovery system in each plant in the period 1990–2005 was considered, in its next annual submission.

106. For estimating CH_4 emissions from domestic and commercial wastewater treatment Sweden has applied the simple check method from the IPCC good practice guidance. The ERT noted that this guidance indicates (box 5.1 in page 5.16) that, for countries that are extensively sewered, employ exclusively aerobic processes and whose sludge is treated without producing or releasing CH_4, the full method of the Revised 1996 IPPC Guidelines is more accurate. The ERT therefore recommends that Sweden apply the method from the Revised 1996 IPCC Guidelines in order to improve the accuracy of emission estimates or justify why the check method gives more accurate estimates in its next annual submission.

107. CH_4 emissions from industrial sludge treatment are reported as "NO" because anaerobic treatment of industrial sludge is not a practice in Sweden according to the information provided in the NIR. CH_4 emissions from industrial sludge treatment in anaerobic plants are estimated based on a country-specific CH_4 leakage factor during energy recovery. However, the ERT noted that this leakage factor is obtained from a study on two plants, which are assumed to be representative of all 138 plants that engage in the anaerobic treatment of sludge in Sweden (NIR, page 302). The ERT recommends that Sweden include additional information on how the Party ensures that the leakage factor obtained from two plants is representative of the other 136 plants and does not lead to an underestimation of emissions.

3. Non-key categories

Waste incineration – CO_2

108. Emissions from waste incineration with energy recovery were estimated on a plant-specific level and reported in the energy sector in line with the Revised 1996 IPCC Guidelines. Emissions from the incineration of hazardous waste, and in later years also municipal solid waste (MSW) and industrial waste, from one large plant without energy recovery are reported under waste incineration. Sweden has assumed the same carbon content for all waste incinerated at the plant (MSW, hazardous waste and industrial waste) and has applied a country-specific fraction of fossil carbon content of 30.0 per cent based on a study on MSW incineration. The ERT notes that this fossil carbon fraction of 30.0 per cent is the lowest value of the default range for MSW provided in table 5.6 of the IPCC good practice guidance (30–50 per cent) and lower than the default values for hazardous waste (90–100 per cent). To increase transparency, the ERT strongly recommends that Sweden, in its next annual submission, justify why the country-specific fossil carbon

fraction for all waste incinerated at that plant can be assumed to be the same as the value obtained from a study on MSW incineration. The ERT also recommends that Sweden provide more transparent information on the carbon content used in the estimation in its next annual submission.

G. Supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

1. Information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

Overview

109. In its 2011 annual submission, Sweden has provided the required supplementary information on KP-LULUCF in its NIR and CRF KP-LULUCF tables. Sweden's reporting of its activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is in line with the requirements included in paragraphs 5 to 9 of the annex to decision 15/CMP.1. With regard to activities under Article 3, paragraph 4, of the Kyoto Protocol, Sweden elected forest management only and chose a commitment period accounting for all the activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

110. Sweden's approach to identify the geographical location of the boundaries of the areas that encompass units of land of activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is in line with the IPCC good practice guidance for LULUCF. The identification is based on the national forest inventory and its permanent sample plots system, which covers all land-use categories. Each sample plot has an identification code and a registered geographical position. The status of activities on sample plots could be traced back from the current year to 1990.

111. Sweden's reporting of GHG removals and emissions resulting from all its activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is complete and all pools are reported (above-ground biomass, below-ground biomass, litter, dead wood and soil organic carbon). Direct N_2O emissions are reported for N fertilization and are assumed to occur under forest management; N_2O emissions from disturbance associated with land-use conversion to cropland are reported as occurring under deforestation; CO_2, CH_4 and N_2O emissions from biomass burning are reported under forest management. The ERT noted that N_2O emissions from the drainage of soils under forest management is reported as "NE" in table NIR-1 but as "NA" in table 5(KP-II)2. The ERT recommends that Sweden address this inconsistency in its next annual submission.

112. In the NIR (page 340), Sweden has indicated that the estimates for carbon stock changes for afforestation, reforestation and deforestation are "very uncertain" and, for forest management, "quite uncertain". Sweden has also stated that afforestation, reforestation and deforestation activities are not common in Sweden. In response to a question raised by the ERT during the review, Sweden explained that as the reporting of activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol for the last reported year (2009) is based on only 20 per cent of the sample plots, Sweden will, in every future annual submissions and until the annual submission due in 2014 (when the last year of the first commitment period under the Kyoto Protocol is reported), recalculate the already reported years of the commitment period. Sweden also explained that it plans to develop methods to further increase the accuracy of the estimates. Sweden further stated that, for these reasons, it opted for commitment period accounting, which allows the Party to provide more accurate estimates of all activities in its last report of the first commitment period under the Kyoto Protocol. However, the ERT noted that, although Sweden has chosen to account for KP-LULUCF activities at the end of the commitment period,

reporting on KP-LULUCF activities is mandatory since the 2010 annual submission, and therefore recommends that Sweden make every possible effort to reduce the uncertainty of these estimates in its next annual submission.

113. With regard to why afforestation, reforestation and deforestation activities are not common, Sweden stated in the NIR that the average annual conversion to afforestation and reforestation, and deforestation, is about 12 and 13 kha, respectively, and is considered very small when compared with the forest land area of 28 Mha (0.04–0.05 per cent of the forest land area), and that the afforestation and reforestation and deforestation areas are represented by 2–3 sample plots (per activity) out of the 6,000 sample plots inventoried every year. The ERT recommends that Sweden justify how 2–3 sample plots can be representative of an activity or, if not possible, address this sampling issue, in its next annual submission.

114. The Party has made recalculations for the KP-LULUCF activities between the 2010 and 2011 annual submissions following changes in AD (the areas for each activity) as a result of the sampling methodology and timing, as indicated in the NIR (section 11.3.1.4 in page 339). Compared with the 2010 annual submission, the impact of these recalculations on each KP-LULUCF activity for 2008 is as follows:

(a) Afforestation and reforestation: net GHG removals for units of lands not harvested since the beginning of the commitment period have decreased by 306.41 Gg CO_2 eq (by 19.4 per cent);

(b) Deforestation: net GHG emissions have increased by 1,645.16 Gg (by 69.0 per cent);

(c) Forest management: net GHG removals have increased by 19,488.80 Gg (by 105.9 per cent).

Activities under Article 3, paragraph 3, of the Kyoto Protocol

Afforestation and reforestation – CO_2

115. Sweden has provided estimates of carbon stock changes for all pools under these activities using the same methods, EFs, parameters and AD used in the inventory of the LULUCF sector under the Convention.

116. In the previous review report, an inconsistency between the reported afforestation and reforestation area and the area of land converted to forest land was identified. In the 2011 annual submission, Sweden has not addressed this inconsistency. In response to a question raised by the ERT during the review, Sweden explained that the timeline for the start of the accumulation of afforestation, reforestation and deforestation land and land converted to forest land is different and that the areas under afforestation, reforestation and deforestation accumulate from 1990 whereas areas reported under the Convention can start prior to 1990. Sweden also explained that the areas of afforestation, reforestation and deforestation land stay as afforestation, reforestation and deforestation land while land converted to forest land is transferred to forest land remaining forest land after 20 years. Sweden further explained that this is why it is not necessary that afforestation and reforestation areas and land converted to forest land areas are exactly comparable. To improve transparency, the ERT recommends that Sweden include this information in its next annual submission.

Deforestation – CO_2

117. Sweden has provided estimates of carbon stock changes for all pools under this activity using the same methods, EFs, parameters and AD as used in the inventory of the

LULUCF sector under the Convention. The definition of deforestation used by Sweden is consistent with the definition given in the IPCC good practice guidance for LULUCF and Sweden uses its five-year inventory cycle to monitor and distinguish land-use conversions and deforestation. The ERT noted that Sweden considers its estimates of carbon stock changes for deforestation as "very uncertain" and therefore reiterates the recommendation made in paragraph 112 above that Sweden make every possible effort to reduce the uncertainty of these estimates in its next annual submission.

Activities under Article 3, paragraph 4, of the Kyoto Protocol

Forest management – CO_2, CH_4 and N_2O

118. Sweden has provided estimates of carbon stock changes for all pools under forest management, in addition it provided estimates of non-CO_2 emissions from fertilization and biomass burning. The methods, EFs, parameters and AD used are in line with the inventory of the LULUCF sector under the Convention.

119. The table NIR-2 shows that, for 2009, the area for forest management has increased by 720.2 kha while at the same time the area for afforestation and reforestation has not changed and the deforestation area has increased by 34.1 kha. The ERT considers that this situation indicates inconsistency in the reporting of the KP-LULUCF land areas. In response to a question raised by the ERT during the review, Sweden explained this is due to the method used to estimate areas, which produces averages for five-year periods compared with other methods, which result in estimates for individual years. Sweden also explained that this discrepancy is of minor importance. The Party further stated that, in its next annual submission, after recalculations due to new data the Party expects afforestation and reforestation and forest management areas to follow the trend 1990–2005 and this rather high reported forest management area in 2009 will probably decrease. The ERT recommends that Sweden address the inconsistencies in the Party's reporting of areas for KP-LULUCF activities in its next annual submission.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

120. Sweden has reported information on its accounting of Kyoto Protocol units in the required SEF tables, as required by decisions 15/CMP.1 and 14/CMP.1. The ERT took note of the findings included in the SIAR on the SEF tables and the SEF comparison report.[9] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterates the main findings contained in the SIAR.

121. Information on the accounting of Kyoto Protocol units has been prepared and reported in accordance with chapter I.E of the annex to decision 15/CMP.1, and reported in accordance with decision 14/CMP.1 using the SEF tables. This information is consistent with that contained in the national registry and with the records of the international transaction log (ITL) and the clean development mechanism registry and meets the requirements set out in paragraph 88(a–j) of the annex to decision 22/CMP.1. The transactions of Kyoto Protocol units initiated by the national registry are in accordance with the requirements of the annex to decision 5/CMP.1 and the annex to decision 13/CMP.1. No discrepancy has been identified by the ITL and no non-replacement has occurred. The national registry has adequate procedures in place to minimize discrepancies.

[9] The SEF comparison report is prepared by the international transaction log administrator and provides information on the outcome of the comparison of data contained in the Party's SEF tables with corresponding records contained in the ITL.

National registry

122. The ERT took note of the SIAR and its finding that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT further noted from the SIAR and its finding that the national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with decisions 16/CP.10 and 12/CMP.1. The national registry also has adequate security, data safeguard and disaster recovery measures in place and its operational performance is adequate.

Calculation of the commitment period reserve

123. Sweden has reported its commitment period reserve in its 2011 annual submission. Sweden originally reported its commitment period reserve to be 299,968,998 t CO_2 eq based on the national emissions in its most recently reviewed inventory (59,993.80 Gg CO_2 eq). The ERT disagrees with this figure. Based on the submission of revised emission estimates on 21 October 2011, Sweden reported its commitment period reserve to be 300,344,090 t CO_2 eq based on the national emissions in its most recently reviewed inventory (60,068.82 Gg CO_2 eq). The ERT agrees with this figure.

3. Changes to the national system

124. Sweden has reported that there are no significant changes to its national system since the previous annual submission, except for the change of names of some agencies involved in the national system. The ERT concluded that the Party's national system continues to be in accordance with the requirements of national systems outlined in decision 19/CMP.1.

4. Changes to the national registry

125. Sweden has reported that there are changes in its national registry since the previous annual submission. These refer to an update of the registry software (GRETA) and changes to the database and capacity of the national registry. Sweden has reported on the testing activities carried out with the new software. All system, regression and user-acceptance test activities are complete and there were no outstanding issues to prevent general release and upgrading. The ERT concluded that, taking into account the confirmed changes in the national registry, Sweden's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions.

5. Minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol

126. Sweden did not provide information on changes in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, in its annual submission. However, Sweden reported detailed information on the minimization of adverse impacts as requested in chapter I.H of the annex to decision 15/CMP.1, in its 2011 annual submission (annex 6:9 of the NIR). The ERT concluded that the reported information is complete and transparent.

127. Sweden reported on how it is striving to implement its commitments in such a way as to minimize adverse social, environmental and economic impacts (e.g. through environmental impact assessments on the decision-making process, consultation procedures and interdisciplinary research efforts improving the Party's knowledge of the global effects). Sweden has introduced sustainable criteria for vehicle biofuels used in the country.

A climate strategy with many different measures across all sectors is also considered in Sweden to minimize the risk of adverse effects. Market imperfections have been phased out with the reformation of energy markets and no subsidies for fossil fuels are in place. Sweden also provided information on how it contributes to capacity building and technology development in developing country Parties.

III. Conclusions and recommendations

128. Sweden made its annual submission on 31 March 2011. The annual submission contains the GHG inventory (comprising CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, Kyoto Protocol units, and changes to the national system and the national registry and minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1. Sweden submitted revised emission estimates on 21 October 2011.

129. The ERT concludes that the inventory submission of Sweden has been prepared and reported in accordance with the UNFCCC reporting guidelines. The inventory submission is complete and the Party has submitted a complete set of CRF tables for the years 1990–2009 and an NIR; these are complete in terms of gases, geographical coverage, years and sectors, as well as generally complete in terms of categories, with the exception of CH_4 fugitive emissions from natural gas transmission and distribution (see para. 52 above), CH_4 and N_2O emissions from the combustion of ethanol in road transportation (see para. 54 above), and HFC and PFC emissions from solvents (see para. 69 above), which have not been estimated. In response to the list of potential problems and further questions raised by the ERT during the review and in response to the list of potential problems and further questions raised by the ERT during the review of the annual submission of the EU, Sweden provided emission estimates for CH_4 and N_2O emissions from the combustion of ethanol in road transportation, CH_4 fugitive emissions from natural gas transmission and distribution but not for HFC and PFC emissions from solvents.

130. The submission of information required under Article 7, paragraph 1, of the Kyoto Protocol has been prepared and reported in accordance with decision 15/CMP.1.

131. Sweden's inventory is in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF, except for the estimation of emissions from manure management (see para. 77 above), pasture, range and paddock manure (see para. 80 above), anaerobic treatment of domestic and commercial sludge (see para. 107 above) and waste incineration (see para. 108 above).

132. Sweden has performed recalculations for the inventory between the 2010 and 2011 annual submissions in response to recommendations in the 2010 annual review report, following changes in AD and EFs, in order to rectify identified errors and due to methodological improvements. For the year 2008, the recalculations led to a decrease of total GHG emissions of 1.0 per cent and a decrease of 40.0 per cent for total GHG emissions including LULUCF. The main recalculations took place in the following sectors/categories for the year 2008:

(a) Energy sector: CO_2 emissions for other sectors – a decrease of 11.7 per cent;

(b) Energy sector: CO_2, CH_4 and N_2O emissions for fugitive emissions from oil and natural gas – an increase of 19.8 per cent;

(c) Industrial processes sector: CO_2 emissions for chemical industry – an increase of 90.4 per cent;

(d) LULUCF sector:

(i) Net GHG removals from forest land – an increase of 90.0 per cent;

(ii) Net GHG emissions from cropland – a decrease of 37.3 per cent;

(iii) Net GHG emissions from settlements – an increase of 41.3 per cent.

133. Sweden has provided all mandatory information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol in its NIR and CRF tables in accordance with the requirements outlined in decision 15/CMP.1, annex, paragraphs 5–9. With regard to activities under Article 3, paragraph 4, of the Kyoto Protocol, Sweden elected forest management only and chose a commitment period accounting for all the activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. However, the ERT identified some inconsistencies in the information reported (see para. 111 above) and had some concerns about the accuracy of the estimates of carbon stock changes for afforestation, reforestation, deforestation and forest management activities (see paras. 112, 113 and 117 above).

134. Sweden has made recalculations for the KP-LULUCF activities between the 2010 and 2011 annual submissions, following changes in AD, in order to rectify identified errors and due to methodological improvements. The impact of these recalculations for 2008 is as follows:

(a) Afforestation and reforestation: net GHG removals decreased by 19.4 per cent (from 1,576.00 Gg CO_2 eq to 1,269.60 Gg CO_2 eq);

(b) Deforestation: net GHG emissions have increased by 68.5 per cent (from 2,396.86 Gg CO_2 eq to 4,039.00 Gg CO_2 eq);

(c) Forest management: net GHG removals increased by 105.9 per cent (from 18,398.52 Gg CO_2 eq to 37,887.32 Gg CO_2 eq).

135. Sweden has reported information on its accounting of Kyoto Protocol units in accordance with chapter I.E of the annex to decision 15/CMP.1, and used the required reporting format tables as required by decision 14/CMP.1.

136. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1.

137. The national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions.

138. Sweden has reported complete and transparent information under chapter I.H of the annex to decision 15/CMP.1, "Minimization of adverse impacts in accordance with Article 3, paragraph 14" as part of its 2011 annual submission (see paras. 126 and 127 above).

139. The ERT identifies the following cross-cutting issues for improvement:

(a) Include, in the specific sections of the NIR, category-specific planned improvements and the recommendations in the previous review report not yet addressed (see para. 19 above);

(b) Implement a tier 2 uncertainty analysis (see para. 24 above) and revise the uncertainty estimates reported as zero (see para. 26 above);

(c) Improve the explanation of which inventory improvements and recalculations resulted in revised uncertainty estimates and reduced the uncertainty of these estimates (see para. 25 above);

(d) Extend the tier 2 QC activities to the agriculture, LULUCF and waste sectors (see para. 19 above).

140. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of the information presented in Sweden's annual submission. The key recommendations are that Sweden, in its next annual submission:

(a) Report estimates for CO_2 emissions from natural gas transmission and CH_4 emissions from natural gas transmission and distribution in its next annual submission. (see para. 52 above);

(b) Report estimates for CH_4 and N_2O emissions from the combustion of ethanol in road transportation (see para. 54 above);

(c) Reallocate the emissions from the combustion of gases from coke ovens, blast furnaces and steel plants used for energy (see para. 66 above);

(d) Estimate the HFC and PFC emissions from solvents (see para. 69 above);

(e) Review its estimates from manure management (see para. 77 above) and from pasture, range and paddock manure (see para. 80 above);

(f) Improve the consistency and accuracy of the areas reported in the LULUCF sector in the CRF tables (see paras. 90 and 92 above) and the areas for afforestation and reforestation and forest management (see para. 119 above), and improve the transparency of the information on areas for afforestation and reforestation and land converted to forest land (see para. 116 above);

(g) Use country-specific parameters to estimate CH_4 emissions from solid waste disposal on land (see para. 103 above);

(h) Review its estimates of CH_4 emissions from domestic and commercial sludge treated in anaerobic plants (see para. 107 above) and of CO_2 emissions from waste incineration (see para. 108 above);

(i) Improve the accuracy of the estimates for carbon stock changes for afforestation, reforestation, deforestation and forest management (see paras. 112, 113 and 117 above);

(j) Improve the transparency of the information on:

(i) The calculation of the average milk yield, the N flow model for indirect soil emissions, the consideration of animal growth, the indicators for different cattle categories and the trends of the CH_4 IEF in manure management (see paras. 73, 75, 76, 78 and 81 above);

(ii) The N fractions of different crops (see para. 79 above);

(iii) The carbon stock changes for forest land remaining forest land (see para. 93 above).

IV. Questions of implementation

141. No questions of implementation were identified by the ERT during the review.

Annex I

Documents and information used during the review

A. Reference documents

Intergovernmental Panel on Climate Change. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.

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"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/SBSTA/2006/9. Available at <http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf>.

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"Guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol". Decision 19/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf# page=14>.

"Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol". Decision 15/CMP.1. Available at <http://unfccc.int/resource/docs/2005/cmp1/ eng /08a02.pdf#page=54>.

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FCCC/ARR/2010/SWE. Report of the individual review of the annual submission of Sweden submitted in 2010.
Available at <http://unfccc.int/resource/docs/2011/arr/swe.pdf>.

UNFCCC. *Standard Independent Assessment Report*, parts I and II. Available at <http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php>.

2011 annual submission of Sweden:

Common Reporting Format tables. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/swe-2011-crf-21oct.zip>;

Kyoto Protocol – Land use, land-use change and forestry tables. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/swe-2011-kplulucf-21oct.zip>;

National inventory report. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/swe-2011-nir-31mar.zip>;

Standard Electronic Format tables. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/swe-2011-sef-31mar.zip>.

B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Hakam Al-Hanbali (Swedish Environmental Protection Agency), including additional information on the methodology and assumptions used. The following documents[1] were also provided by Sweden:

Martin Jerksjö. 2011. *A Description of the AD and EFs Used to Estimate Emissions of CH_4 in 1.B.2.b.iii Natural Gas Transmission and 1.B.2.b.iv Natural Gas Distribution; Resubmission 2011*. Stockholm: Svenska MiljöEmissionsData.

Nyström, A-K. 2007. *Study of Differences in Plant Data Between the Energy Statistics and the EU Emission Trading Scheme*. SMED report 2007.

Veronica Eklund and Martin Jerksjö. 2011. *A Description of the AD and EFs Used to Estimate Emissions of CH_4 and N_2O from Road Traffic Using Ethanol Fuel; Resubmission 2011*. Stockholm: Svenska MiljöEmissionsData.

[1] Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AD	activity data
ARTEMIS	assessment and reliability of transport emissions models and inventory systems
C	carbon
CH_4	methane
CKD	cement kiln dust
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
EF	emission factor
EPA	Environmental Protection Agency
ERT	expert review team
EU	European Union
EU ETS	European Union emissions trading scheme
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
HBEFA	handbook of emissions factors for road transport
HFCs	hydrofluorocarbons
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
KP-LULUCF	Land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
kg	kilogram (1 kg = 1,000 grams)
kha	kilohectare
LULUCF	land use, land-use change and forestry
Mt	million tonnes
MSW	municipal solid waste
NA	not applicable
N_2O	nitrous oxide
NE	not estimated
NIR	national inventory report
NO	not occurring
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
SMED	Swedish Environmental Emissions Data
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change