Advance Version

COMPLIANCE COMMITTEE

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6 June 2011

Report of the individual review of the annual submission of Sweden submitted in 2010

Note by the secretariat

The report of the individual review of the annual submission of Sweden submitted in 2010 was published on 6 June 2011. For purposes of rule 10, paragraph 2, of the rules of procedure of the Compliance Committee (annex to decision 4/CMP.2, as amended by decision 4/CMP.4), the report is considered received by the secretariat on the same date. This report, FCCC/ARR/2010/SWE, contained in the annex to this note, is being forwarded to the Compliance Committee in accordance with section VI, paragraph 3, of the annex to decision 27/CMP.1.

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Report of the individual review of the annual submission of Sweden submitted in 2010*

* In the symbol for this document, 2010 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 2010 annual submission of Sweden, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 6 to 11 September 2010 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalists – Ms. Suvi Monni (Finland) and Mr. Dennis Rudov (Belarus); energy – Mr. Benon Yassin (Malawi), Mr. Takeshi Enoki (Japan), Mr. Jongikhaya Witi (South Africa) and Mr. Alexander Zahar (Australia); industrial processes – Ms. Alice Au (Canada), Ms. Laura Elena Dawidowski (Argentina) and Ms. Natalya Parasyuk (Ukraine); agriculture – Ms. Yauheniya Bertosh (Belarus) and Mr. Donald Kamdonyo (Malawi); land use, land-use change and forestry (LULUCF) – Mr. Vladimir Korotkov (Russian Federation) and Ms. Naoko Tsukada (Japan); and waste – Ms. Mayra Rocha (Brazil) and Mr. Kai Skoglund (Finland). Ms. Monni and Mr. Witi were the lead reviewers. The review was coordinated by Mr. Javier Hanna and Ms. Inkar Kadyrzhanova (UNFCCC secretariat).

2. In accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol" (decision 22/CMP.1), 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 2008, the main greenhouse gas (GHG) in Sweden was carbon dioxide (CO_2), accounting for 78.5 per cent of total GHG emissions[1] expressed in CO_2 eq, followed by nitrous oxide (N_2O) (11.3 per cent) and methane (CH_4) (8.4 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 1.8 per cent of the overall GHG emissions in the country. The energy sector accounted for 72.6 per cent of total GHG emissions, followed by agriculture (13.2 per cent), industrial processes (10.6 per cent), waste (3.2 per cent) and solvent and other product use (0.4 per cent). Total GHG emissions amounted to 64,270.96 Gg CO_2 eq and decreased by 11.4 per cent between the base year[2] and 2008.

4. Table 1 shows GHG emissions from Annex A sources, and emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (KP-LULUCF), by gas. Table 2 shows GHG emissions from Annex A sources, and emissions and removals from the LULUCF sector under the Convention and from KP-LULUCF activities, by sector and by activity. 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.

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.

[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 2008[a]

			Gg CO_2 eq								*Change*
		Greenhouse gas	*Base year*	*1990*	*1995*	*2000*	*2005*	*2006*	*2007*	*2008*	*Base year–2008 (%)*
Annex A sources		CO_2	56 614.95	56 614.95	58 521.15	53 888.49	53 328.27	52 942.60	52 291.05	50 424.22	–10.9
		CH_4	6 733.41	6 733.41	6 691.73	6 102.88	5 654.94	5 568.23	5 341.35	5 387.41	–20.0
		N_2O	8 682.52	8 682.52	8 530.76	8 048.77	7 627.91	7 685.18	7 377.86	7 234.09	–16.7
		HFCs	126.54	3.85	126.54	564.45	803.32	835.21	869.95	916.70	624.4
		PFCs	343.43	376.82	343.43	240.52	257.15	245.32	247.60	225.05	–34.5
		SF_6	126.68	107.49	126.68	93.59	142.48	111.31	151.49	83.48	–34.1
KP-LULUCF	Article 3.3[b]	CO_2								808.87	
		CH_4								NO	
		N_2O								11.99	
	Article 3.4[c]	CO_2	NA							–18 462.01	NA
		CH_4	NA							13.16	NA
		N_2O	NA							50.34	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 2008[a]

			Gg CO_2 eq								*Change*
		Sector	*Base year*	*1990*	*1995*	*2000*	*2005*	*2006*	*2007*	*2008*	*Base year–2008 (%)*
Annex A		Energy	53 203.35	53 203.35	54 997.60	50 312.06	49 644.38	49 294.32	48 520.25	46 684.41	–12.3
		Industrial processes	6 373.99	6 264.88	6 578.65	6 734.90	6 931.07	6 942.63	6 880.26	6 793.07	6.6
		Solvent and other product use	332.49	332.49	308.55	277.54	302.84	297.26	283.97	283.97	–14.6
		Agriculture	9 515.04	9 515.04	9 455.44	8 922.81	8 ,667.06	8 665.96	8 549.10	8 469.57	–11.0
		Waste	3 122.19	3 122.19	2 934.39	2 613.65	2 166.15	2 068.31	1 929.43	2 039.95	–34.7
		Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
		LULUCF	NA	–31 042.39	–23 676.42	–36 124.99	–20 298.07	–16 966.03	–14 813.72	–14 675.82	NA
		Total (with LULUCF)	**NA**	**41 395.56**	**50 598.22**	**32 735.96**	**47 413.43**	**50 302.44**	**51 349.30**	**49 595.14**	**NA**
		Total (without LULUCF)	**72 546.45**	**72 437.95**	**74 274.64**	**68 860.96**	**67 711.50**	**67 268.47**	**66 163.02**	**64 270.96**	**–11.4**
KP-LULUCF	Article 3.3[b]	Afforestation & reforestation								–1 576.00	
		Deforestation								2 396.86	
		Total (3.3)								**820.86**	
	Article 3.4[c]	Forest management								–18 398.52	
		Cropland management	NA							NA	NA
		Grazing land management	NA							NA	NA
		Revegetation	NA							NA	NA
		Total (3.4)	**NA**							**–18 398.52**	**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, LULUCF = land use, land-use change and forestry, NA = not applicable.

[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 commitment period must be reported.

Table 3
Information to be included in the compilation and accounting database, in tonnes of carbon dioxide equivalent

	As reported	*Adjustment*[a]	*Final*[b]	*Accounting quantity*[c]
Commitment period reserve	**319 814 750**		**321 354 810**	
Annex A emissions for current inventory year				
CO_2	50 416 034		50 424 223	
CH_4	5 087 736		5 387 414	
N_2O	7 234 092		7 234 092	
HFCs	916 702		916 702	
PFCs	225 048		225 048	
SF_6	83 484		83 484	
Total Annex A sources	**63 963 095**		**64 270 962**	
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	–1 576 002		–1 576 002	
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	2 396 862		2 396 862	
Activities under Article 3, paragraph 4, for current inventory year[d]				
3.4 Forest management for current year of commitment period	–18 398 517		–18 398 517	
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 for base year				

Abbreviation: NO = not occurring.

[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or several 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 of these activities.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2010 annual inventory submission was submitted on 14 April 2010; it contains a complete set of common reporting format (CRF) tables for the period 1990–2008, with the exception of CRF table 7 (summary overview for key categories), and a national inventory report (NIR). 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 minimization of adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 14 April 2010 and resubmitted on 5 May 2010. The annual submission was made generally in accordance with decision 15/CMP.1. The expert review team (ERT) reiterates the recommendation of the previous review report that Sweden provide information on CRF table 7 as presented in its NIR in its next annual submission.

7. Sweden officially submitted revised CRF tables on 21 October 2010 and resubmitted them on 26 January 2011, in response to questions raised by the ERT in the course of the review. In addition, on 26 January 2011 Sweden officially submitted its revised estimate of the commitment period reserve of its 2010 annual submission. The values in this report are based on the submission of 26 January 2011.

8. 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] Where necessary, the ERT also used the Party's 2009 annual submission during the centralised review.

9. During the review, Sweden provided the ERT with additional information and documents which are not part of the annual submission and have not been referenced in the NIR. 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 is generally complete in terms of categories and is complete in terms of gases, geographical coverage, years and sectors. In its 2010 annual submission, Sweden did not include the emission estimates for the following categories: CH_4 emissions from industrial wastewater and domestic and commercial wastewater were reported as not estimated ("NE"); CO_2, CH_4 and N_2O emissions from civil aviation related to private aviation, educational training flights and military flights (see paras. 46, 97–99 below).

11. The ERT noted in the case of private aviation, educational training flights and military flights, Sweden can estimate CO_2, CH_4 and N_2O emissions using general emission factors (EFs) used for civil aviation that are available in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC

[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.

Guidelines). In response to the list of potential problems and further questions raised by the ERT during the review, Sweden provided the missing emission estimates from civil aviation, industrial wastewater and domestic and commercial wastewater. These emission estimates were incorporated in the revised CRF tables submitted on 26 January 2011. The ERT assessed the information provided by Sweden and agreed with the revised estimates. The ERT recommends that Sweden continue to include these emission estimates and report on the methods, activity data (AD) and EFs used for estimating these emissions in its next annual submission.

12. The ERT noted some improvements in the completeness of the Party's reporting since its previous annual submission. Sweden has reported for the first time on the following: fugitive CH_4 emissions from transport (oil) and fugitive CH_4, CO_2 and N_2O emissions from exploration (oil); CH_4 and N_2O emissions from waste incineration; and carbon stock changes in the dead organic matter and organic soil carbon pools for all land-use conversion categories. The ERT commends Sweden for these improvements.

13. Sweden submitted a generally complete set of CRF tables for the period 1990–2008. However, CRF table 7 (summary overview for key categories) was not filled in, despite the recommendation made in the previous review report. The ERT noted that Sweden provided an overview of the key categories for all years of the time series in appendix 20A to the NIR; it also provided all background information in appendix 20B to the NIR and a reference to this information in annex 1 to the NIR. The ERT reiterates the recommendation that Sweden fill in CRF table 7 as appropriate, in order to ensure the consistency and completeness of the reporting in its next annual submission.

14. In the NIR, Sweden has reported that in 2007, in response to the Government's call to reduce the number of requests for statistical compilations, the Swedish Transport Agency did not provide the AD necessary to estimate emissions from aviation. The ERT noted that this may lead to underestimation of emissions in the future annual submissions as reflected in para. 11 above. Furthermore, the ERT noted that one of the key functions of the national system is to ensure that the institutional, legal and procedural arrangements are maintained, in accordance with paragraph 14(c) of the annex to decision 19/CMP.1 (see para. 45 below). The ERT further recommends that Sweden maintains the key functions of the national system. The ERT recommends that Sweden improve the completeness of its reporting by ensuring that AD necessary to estimate emissions from civil aviation are made available and reported in its next annual submission.

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

Overview

15. The ERT concluded that the national system continued to perform its required functions. Sweden has provided information in accordance with chapter I.F of the annex to decision 15/CMP.1 on changes in its national system. Sweden has reported that there have been no changes in its national system since its previous annual submission.

Inventory planning

16. The NIR and additional information submitted by the Party during the review described the national system for the preparation of the inventory. The Swedish Ministry of the Environment has overall responsibility for the national inventory. 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 before the submission of the inventory to the UNFCCC secretariat. 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 (SLU), is also involved in the preparation of the inventory.

17. As indicated in the NIR, Sweden has elaborated an inventory QA/QC plan in accordance with the annex to decision 19/CMP.1 and the IPCC good practice guidance. This plan covers general QC procedures (tier 1) as well as category-specific procedures (tier 2) for key categories, descriptions of roles and responsibilities, databases, models and documented procedures for the uncertainty and key category analyses. It also includes the procedures for responding to questions raised during the annual review by the ERT. The documented QA/QC procedures are in place and have been regularly performed.

18. In annex 6:1 to the NIR, Sweden has provided an extensive description of the structure of the national system, corresponding legal and procedural arrangements, and responsibilities for peer reviews. According to the NIR, regarding the assignment of responsibility for the inventory preparation, a document (Ordinance 2005:626) defines the data providers and the information that they must provide for inventory compilation. However, the ERT noted that the description of SMED has not been improved since the previous annual submission as was recommended in the previous review report. Thus, the ERT reiterates the recommendation made in the previous review report that Sweden provide more information on the national system, including the specific responsibilities of the organizations participating in SMED and of the consultants assisting Swedish EPA in the inventory preparation process.

Inventory preparation

Key categories

19. Sweden has reported a tier 1 key category analysis, both level and trend assessments, as part of its 2010 annual submission. The key category analysis performed by the Party and that performed by the secretariat[4] produced different results, owing to the different levels of disaggregation used. The ERT noted that Sweden used highly aggregated categories, with the exception of the energy sector which is disaggregated in accordance with the IPCC good practice guidance. Sweden performed its key category analysis, including the LULUCF sector, in accordance with the IPCC good practice guidance and the *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). During the review, the ERT found that the estimate of total GHG emissions for 2008 in the latest key category analysis (63,962.94 CO_2 eq) is different from the total amount reported in the CRF tables (63,963.10 CO_2 eq). In response to a question raised by ERT, Sweden clarified that the estimate of total GHG emissions reported in CRF table summary 2 is the correct total amount. The ERT noted that the same issue was raised in the previous review report; therefore the ERT reiterates the recommendation made in the previous review report that Sweden perform the key category analysis correctly and report the results in its next annual submission. The ERT further recommends that Sweden strengthen the QC procedures in relation to the key category analysis.

[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 IPCC *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.

20. According to the key category analysis performed by the Party, forest management was identified as a key category for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. However, according to the key category analysis performed by the secretariat, afforestation, deforestation and forest management were identified as key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. In response to a question raised by the ERT during the review, Sweden explained that it plans, for its next annual submission, either to improve the key category analysis or alternatively to consider all activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol as key categories. The ERT recommends that Sweden perform its key category analysis at a more disaggregated level of categories, and as a result revise its key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, for its next annual submission and explain in the NIR how it plans to use the key category analysis to prioritize improvements in the inventory.

Uncertainties

21. Sweden has reported in the NIR a tier 1 uncertainty analysis and its results. The level assessment was provided at the summary level and at individual category level; whereas the trend assessment was provided at the summary level. The uncertainty analyses were performed for AD, EFs and emission estimates; the relevant information was well presented in the NIR and in annex 7 to the NIR. The ERT noted that this is in accordance with the IPCC good practice guidance. The total uncertainty by level was estimated at 6.5 per cent for 1990 and at 6.1 per cent for 2008. The total uncertainty by trend was estimated at 2.5 per cent. In the 2010 annual submission, the uncertainty estimates by level and by trend were lower than those reported in the previous annual submission (8.0 per cent for 1990 by level and 6.4 per cent by trend). Sweden noted in the NIR that the main reason for this decrease in uncertainty is the revision of the estimate of emissions from off-road vehicles and working machinery that was introduced in the previous annual submission. The ERT recommends that Sweden use the results of uncertainty analysis to prioritize improvements in the inventory for its next annual submission.

Recalculations and time-series consistency

22. Recalculations were performed and have been reported in accordance with the IPCC good practice guidance. The ERT noted that the recalculations reported by the Party of the time series 1990–2007 were performed to take into account the following: the revision of methods and EFs and update of AD used in the energy and industrial processes sectors; revision of net calorific values (NCVs) for most fuels; the update of AD and correction of rounding errors in the agriculture and LULUCF sectors; and the recommendations made in the previous review report in relation to the waste sector. The recalculations that were made due to the correction of errors were performed as a result of the implementation of the Party's inventory QA/QC plan. The major changes, and the magnitude of the impact, resulted in the increase total GHG emissions of 0.7 per cent for 1990 and of 1.2 per cent for 2007. An extensive description of the rationale for these recalculations was provided in chapter 10 of the NIR and cross-referenced in CRF table 8(b). The ERT commends Sweden for providing explanatory information on the recalculations. The ERT encourages Sweden to maintain this quality of reporting in its next annual submission.

Verification and quality assurance/quality control approaches

23. Sweden has reported in the NIR information on its inventory QA/QC plan and has provided a description of the QA/QC activities and verification procedures following a tier 1 approach and a tier 2 approach (for key categories) from the IPCC good practice guidance. The QA/QC system has been well documented in annex 6:2 to the NIR. Swedish EPA is responsible for the inventory QA/QC plan. The quality management system is an

integrated part of the national system. However, the ERT noted that there were errors identified in AD used for CO_2 emissions from agriculture/forestry/fishing in the energy sector (see para. 43 below). In response to a question raised by the ERT during the review, Sweden informed the ERT that these errors will be corrected in its next annual submission. The ERT recommends that Sweden correct the errors in AD in its next annual submission.

24. Sweden makes use of data from the European Union emissions trading scheme (EU ETS) for verification of its emission estimates and in some cases, calculation of emission estimates. Sweden has reported in the NIR that data of the EU ETS and environmental reports are verified and cross-checked. However, the ERT noted that the Party has not reported transparently on the activities undertaken for verification of the EU ETS data. The ERT reiterates the recommendation made in the previous review report that Sweden provide information on the QA procedures applied in relation to the EU ETS data.

Transparency

25. Sweden's inventory is generally transparent, except for the reporting on the energy, agriculture and waste sectors, where there is a lack of transparent information on some AD and EFs used (see paras. 33, 67 and 97–99 below). The NIR contains information on key categories, methods, data sources, uncertainty estimates, QA/QC procedures and verification activities. Sweden has completed CRF table 9(a) and has provided information on the use of the notation keys. However, the ERT noted that Sweden can improve the use of its notation keys (see paras. 48, 66 and 101 below) in the energy, agriculture and waste sectors. The ERT recommends that Sweden continue to improve the transparency of its reporting, especially in relation to the energy, agriculture and waste sectors, for its next annual submission.

Inventory management

26. As indicated 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 annual key categories and key category identification and on planned inventory improvements. Sweden has reported in the NIR on a new system for handling emissions data that was developed in 2006 and has been used since the Party's 2007 annual submission. This system allows multiple-user access to the CRF access codes and sub codes which ensures different level of access to the CRF tables and to the 1990–2008 time series of emission estimates, AD and implied EFs (IEFs).

3. Follow-up to previous reviews

27. The ERT further noted that the following recommendations made in the previous review report have been implemented by Sweden:

(a) The use of the notation keys in the reporting on the industrial processes and LULUCF sectors was corrected;

(b) The accuracy of the estimates of CO_2 removals from the dead organic matter (DOM) pool in the LULUCF sector was improved, by taking a higher number of repeated measurements on permanent sampling plots;

(c) All net carbon stock changes were reported in the "gain" column in the CRF tables for the LULUCF sector;

(d) Estimates of CH_4 emissions from carbon black were included in the reporting on the industrial processes sector, thereby improving the accuracy and completeness of reporting.

4. Areas for further improvement

Identified by the Party

28. In the 2010 NIR, Sweden identified several areas for improvement, including: the revision of emission estimates and EFs for several industries in the energy sector, motivated by a study performed by SMED; the addition of a new carbon pool, such as below-ground deadwood, in the LULUCF sector and provision of the missing land-use transition matrices for some years of the time series.

Identified by the expert review team

29. The ERT identified the following cross-cutting issues for improvement:

(a) The provision of more detailed information on the national system, including a description of the specific responsibilities of the organizations participating in SMED and of the consultants assisting Swedish EPA in the inventory preparation process (see para. 18 above);

(b) The ensuring that AD necessary to estimate emissions from civil aviation are made available and reported in the next annual submission;

(c) The provision of the emission estimates for the categories that were reported as "NE" and for which IPCC methodologies and EFs are available;

(d) The performance of the key category analysis at a more disaggregated level in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF, and paying special attention to the identification of key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol (see para. 20 above);

(e) The provision of information on summary overview on key categories in CRF table 7 (see para. 13 above);

(f) The strengthening of the QC procedures in relation to the key category analysis (see para. 19 above);

(g) The ensuring of appropriate use of notation keys as observed in the agriculture and waste sectors (see para. 25 above);

(h) The improvement of the QC procedures for the identification and correction of errors as observed in the estimation of CO_2 emissions from agriculture/forestry/fisheries (see para. 23 above);

(i) The provision of information on the QA procedures applied in relation to the EU ETS data (see para. 24 above);

(j) The ensuring of a consistent use of the notation keys in the CRF tables for the energy, agriculture and waste sectors to improve the transparency of reporting (see para. 25 above).

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

B. Energy

1. Sector overview

31. The energy sector is the main sector in the GHG inventory of Sweden. In 2008, emissions from the energy sector amounted to 46,684.41 Gg CO_2 eq, or 72.6 per cent of total GHG emissions. Since 1990, emissions from the sector have decreased by 12.3 per cent. The key driver for the fall in emissions is the decrease in fuel consumption in the commercial and residential sectors as well as in the manufacturing industries and construction sector. This is largely attributed to replacement of oil by biomass fuels used in the district heating systems in the commercial and residential sectors. Besides this, fuel prices, electricity certificate system and EU ETS contributed to emission reductions in the manufacturing industries. Within the energy sector, 44.3 per cent of the emissions were from transport, followed by 22.9 per cent from manufacturing industries and construction, 21.4 per cent from energy industries and 9.2 per cent from other sectors. Fugitive emissions accounted for 1.8 per cent and the category other accounted for 0.4 per cent.

32. Sweden's inventory for the energy sector is complete in terms of gases, years and geographical coverage, and generally complete in terms of categories, with the exception of CO_2, CH_4 and N_2O emissions from civil aviation that have not been included. Sweden has reported in the NIR that, since 2008, the AD on private aviation and educational training flights as well as on military flights have not been available, and that, therefore, the corresponding emission estimates were not included in the inventory for 2008. In response to the list of potential problems and further questions raised by the ERT, Sweden estimated the missing AD for 2008 using background information from 2007 and provided complete estimates for these activities under the corresponding categories (see paras. 45–46 below).

33. The ERT further noted that Sweden, in the NIR of its 2010 annual submission, did not provide information on the amount of fuel consumed in construction. In response to a question raised by the ERT during the review, Sweden informed the ERT about the results of a survey performed in 2005 on fuel consumption in construction in 2004, which was conducted by Statistics Sweden on behalf of the Swedish Energy Agency. The results of the survey showed little agreement with the fuel consumption as estimated in the emissions inventory for 2004. In 2005 it was not possible for the Party to further investigate this issue. In its 2009 annual submission, Sweden reported that AD for construction for the period 2002–2006 had been revised following a recalculation of the national energy balance. The revised data showed more coherence with the survey on fuel consumption in 2004. Sweden further informed the ERT that the results of this analysis had not been described in the NIR. The ERT recommends that Sweden provide this information and improve the transparency of its reporting in its next annual submission.

34. Sweden used several data sources for AD for the energy sector. For the energy industries category, the Party used a combination of yearly statistics and quarterly fuel statistics: at plant level and by fuel type for the period 1990–1996, the quarterly statistics for the period 1997–1999, the yearly statistics for the period 2000–2002 and the quarterly statistics again for 2003 onwards. The site-specific AD from the quarterly fuel surveys were used for all subcategories, except for the subcategory other sectors. For the largest plants, the AD for 2008 have been verified against environmental reports, EU ETS data or the yearly industrial energy survey. For the largest iron and steel plants, both emission estimates and AD have been collected directly from the plants. The ERT reiterates the recommendation made in the previous review report that Sweden include in the NIR of its next annual submission explanatory information on the accuracy of these AD and the consistency of the time series of data. This should include information on the efforts made by Sweden to ensure the accuracy of its reporting without compromising the consistency of

the time series of data. During the review, Sweden informed the ERT that it will include this information in the NIR of its next annual submission.

35. Sweden has reported in the NIR that it revised the NCVs for gasoline, biogas, ethanol, aviation gasoline and aviation kerosene for the entire time series, on the basis of data from different sources. For example, for its previous annual submission Sweden used the NCVs for aviation gasoline and aviation kerosene that were provided by the Swedish Petroleum Institute, but for its 2010 annual submission the Party used the default NCVs taken from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines). The NCVs for gasoline reported in the 2010 annual submission were provided by Statistics Sweden, but the NCVs for gasoline for the emission estimates were provided by the Swedish Petroleum Institute. Sweden has stated in the NIR that the revision of the NCVs used for the previous annual submission was due to the questionable quality of the country-specific values. However, the ERT noted that for other fuels, like gasoline and diesel oil, the Swedish Petroleum Institute was considered to be the most reliable source of data. The ERT recommends that Sweden investigate the reliability of the different sources of information, use appropriate and consistent sources of data for NCVs for its next annual submission, and provide the justification and reasoning for revising the previously used NCVs in the NIR of its next annual submission.

36. Sweden mostly used higher-tier methods and country-specific EFs for estimating the emissions from the energy sector. Confirming and reviewing EFs is a collective effort by Swedish EPA, the Swedish Energy Agency and SMED. For oil refineries, the plant-specific EFs from the EU ETS data were used for estimating CO_2 emissions, and these EFs were compared across the installations and across different years. On page 102 of the NIR, Sweden reported on its plan to revise several EFs for its next annual submission.

37. All of the QC procedures recommended in the IPCC good practice guidance related to the energy sector were performed by the Party. Recalculations have been performed by Sweden as part of its general inventory improvements. Recalculations were made due to the revision of NCVs (see para. 35 above), improved reallocation of emissions from integrated iron and steel plants, revision of AD for landfill gas, reallocation of emissions associated with use of coke to process emissions and revision of EFs for some categories. The overall impact of the recalculations on the estimated total sectoral emissions was a decrease of 0.2 per cent for 1990 and an increase of 0.6 per cent for 2007. The ERT commends Sweden for improving the accuracy of its reporting. However, the ERT noted that Sweden has not provided in the NIR of its 2010 annual submission explanatory information on the rationale for the recalculations. The ERT recommends that Sweden include such information in its next annual submission.

2. Reference and sectoral approaches

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

38. Estimates of CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. For 2008, the emissions estimated using the sectoral approach were 3.7 per cent lower than the emissions estimated using the reference approach. The discrepancies between the reference and sectoral approaches were due, inter alia, to the following: the difference in the treatment of other fuels; statistical differences between energy supply and energy consumption in the national energy balance; and the use of different calorific values. While this explanation was provided by the Party in the NIR, the documentation box of CRF table 1.A referred to section 3.3.6 of the NIR, which relates to the chemicals category of the energy sector and does not address the issue raised above. The ERT recommends that Sweden correct this reference in its next annual submission. The

ERT noted that the difference between the reference and sectoral approaches is largely associated with solid fuels (24.9 per cent) and other fuels (2.2 per cent). The ERT recommends that Sweden investigate the ways to properly separate fugitive emissions and emissions from fuel combustion in the industrial processes sector.

39. The ERT noted several differences between the data reported to the secretariat and those reported to IEA. During the review, Sweden informed the ERT that the discrepancies were analysed in 2010. In response to a question raised by the ERT during the review, Sweden provided a report[5] on discrepancies in the data sets, reasons for discrepancies in specific fuel data and possible ways to revise the data sets. In addition, Sweden confirmed to the ERT that these improvements will be reflected in its next annual submission. In relation to two specific discrepancies, Sweden informed the ERT during the review that the amount of imported brown coal/peat briquettes was very small and was mistakenly not reported in the 2010 annual submission. Sweden also informed the ERT that the figure for the relative amounts of coking coal and other bituminous coal has been revised for 2008 onwards and, thus, should be the same in both the reports to the IEA and the secretariat. The ERT recommends that the Party correct the errors and discrepancies between the data sets for its next annual submission.

International bunker fuels

40. Estimates of fuel consumption for and emissions from domestic and international aviation for the period 1995–2007 were based on studies conducted by the Swedish Civil Aviation Authority (SCAA). For estimating the emissions for the period 1990–1994 Sweden applied a different methodology, owing to gaps in the data on fuel combustion and emissions. In its NIR of the 2010 annual submission, Sweden has reported its methodology used to fill in the gaps in data for the period 1990–1994. It has further elaborated on the reasons for its emissions from domestic and international aviation reported to the secretariat being lower than those reported to IEA. The reasons relate to differences in the standards used by the International Civil Aviation Organisation and the methodology used by Sweden, due to the fact that its airports are small and take-off times are shorter and therefore lesser emissions are emitted by airplanes. The ERT commends Sweden for improving the consistency of time series of emissions from domestic and international aviation and reporting transparently on the methodology and assumptions used to fill in the gaps in data for the time series.

41. There are discrepancies between the data reported to IEA and those reported to the secretariat on residual fuel oil consumption for international navigation as well as on domestic navigation. During the review, the Party stated that a study undertaken in 2010 had shown that the differences between the data reported to IEA and those reported to the secretariat could to some extent be explained by the different reporting obligations. For example, in 2007 a company was identified as reporting twice, but the corrections were made to the data reported to the secretariat but not to the IEA data. In response to a question raised by the ERT during the review, Sweden confirmed that these issues have been listed for improvement for its next annual submission. The ERT encourages the Party to implement such improvements in the consistency of the time series in this area for its next annual submission.

42. Sweden reported in its 2009 NIR that verification has not been carried out as to how well the distribution of marine distillate fuels and residual fuel oil between the data on domestic and international navigation corresponds to the definition of international and domestic marine transport as set out in the IPCC good practice guidance. In the 2010 NIR,

[5] Hedlund H and Lidén M. (2010) *Jämförelse av energirapportering till IEA och UNFCCC* (Comparison of information on the energy sector reported to the IEA and the UNFCCC).

only brief reference was made to marine distillate fuels on pages 33 and 34 of annex 2 to the NIR. The ERT reiterates the recommendation made in the previous review report that Sweden investigate the issue mentioned above and include a discussion of this issue in its next annual submission. In response to a question raised by the ERT during the review, Sweden confirmed that a study will be done in 2011 and its results will be included in the NIR of its next annual submission.

3. Key categories

Stationary combustion: solid fuels – CO_2

43. Sweden reported CO_2 emissions from agriculture/forestry/fisheries as not occurring ("NO") for the period 2001–2004. In response to a question raised by the ERT during the review, Sweden explained that the combustion of solid fuels has not occurred under this category since 2000, but that small amounts of coal were erroneously reported for 2005 onwards. During the review, Sweden informed the ERT that this error will be corrected in its next annual submission. The ERT recommends that Sweden make the correction as stated.

Stationary combustion: other fuels – CO_2

44. The ERT noted that the trend in the CO_2 IEFs of other fuels for public electricity and heat production fluctuates. For example, the inter-annual changes of the CO_2 IEFs in the period 1990–2003 range from –14.2 per cent to 5.9 per cent and the CO_2 IEF for 2008 (28.19 t/TJ) is 20.3 per cent lower than that for 1990 (35.36 t/TJ). During the review, Sweden stated that the changes in the CO_2 IEFs were due to inter-annual variations in the combusted amount of certain fuels. In particular, Sweden stated that the EF for municipal waste was lower than that for other fuels in the fuel mix. This means that a high relative amount of municipal waste gives a relatively low IEF. Consumption of biomass in Sweden has increased almost tenfold since 1990. Sweden further explained that as the category other fuels includes very different types of fuels, even quite small variations in the relative amounts of the different fuels combusted caused significant fluctuations in the IEF. During the review, the Party informed the ERT that it plans to describe the types of fuel used and include a discussion of the fluctuating trend in the IEFs in the NIR of its next annual submission. The ERT recommends that Sweden include such information in its next annual submission.

Civil aviation: liquid fuels – CO_2

45. Sweden informed the ERT that, in 2007, the Swedish Transport Agency reduced the extent of its statistical compilations. As a result, emissions from private aviation, educational training flights and military flights are no longer included in the estimates of CO_2, CH_4 and N_2O emissions from civil aviation The NIR did not provide information on an alternative method of estimating these emissions. In response to a question raised by the ERT during the review, Sweden informed the ERT that, as the statistics used do not cover private aviation, educational training flights and military flights, there is an underestimation of the emissions for 2008. Sweden added that the issue of providing emission estimates for civil aviation covering the entire nation would be addressed in its next annual submission, but that no priority had been given to this issue and no strategy to address it had been prepared. The ERT recommends that Sweden maintains the key functions of the national system aimed to ensure that the institutional, legal and procedural arrangements are in accordance with paragraph 14(c) of the annex to decision 19/CMP.1.

46. In response to the list of potential problems and further questions raised by the ERT, Sweden provided estimates for 2008 of CO_2 and CH_4 emissions from aviation gasoline and

jet kerosene used in civil aviation and from jet kerosene used in international aviation bunkers, using the same AD and EF that were used in 2007. Further, Sweden provided additional information explaining that N_2O emissions from civil aviation had not been underestimated for 2008 as they are based on detailed statistics on landing and take-off and cruise data provided by the Swedish Defence Research Agency. The revised emission estimates for 2008 were included in the revised CRF tables. Emissions related to military aviation were reported in CRF table 1.A(a). The impact of the revised estimates of emissions from civil aviation in 2008 was an increase in CO_2 emissions by 8.19 Gg from jet kerosene. For CH_4 emissions the impact was insignificant (below 0.1 Gg CO_2 eq). The ERT agreed with the revised emission estimates from Sweden. Overall, this translated into an increase in total emissions from civil aviation by 1.3 per cent and an increase in total sectoral emissions from the energy sector by less than 0.1 per cent in 2008. The ERT recommends that Sweden explain in more detail the method used to estimate the AD for 2008 in its next annual submission. The ERT further recommends that Sweden include estimates of emissions from private aviation, military flights and educational training flights in its next annual submission.

4. Non-key categories

Road transportation: biomass – CH_4

47. In its 2010 annual submission, Sweden has reported CH_4 emissions from biomass combustion in road transportation as "NE", included elsewhere ("IE") and "NO". The Party explained in CRF table 1.A(a) that the emissions from liquid biomass used in road transportation were included in the emissions from diesel and gasoline, and that the model used for emission estimations did not allow for a further disaggregation of CH_4 emissions from road transportation. The Party has reported the aggregate AD for road transportation in the CRF tables without estimating CH_4 emissions that are reported as part of emissions from diesel and gasoline. The ERT recommends that Sweden investigate the ways to separate the emissions from biomass and from diesel and gasoline in the model used for emission estimations from road transportation.

Oil and natural gas: liquid fuels – CO_2

48. In its 2010 annual submission, Sweden has reported the AD for fugitive emissions from distribution of oil products as "NE", but has reported corresponding estimates of CO_2, CH_4 and N_2O emissions. The ERT commends Sweden for this effort to improve the completeness of its reporting. The ERT recommends that Sweden, in its next annual submission, explain the approach and method used to estimate these emissions.

C. Industrial processes and solvent and other product use

1. Sector overview

49. In 2008, emissions from the industrial processes sector amounted to 6,793.07 Gg CO_2 eq, or 10.6 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 283.97 Gg CO_2 eq, or 0.4 per cent of total GHG emissions. Since the base year, emissions have increased by 6.6 per cent in the industrial processes sector and decreased by 14.6 per cent in the solvent and other product use sector. Within the industrial processes sector, 47.9 per cent of the emissions were from metal production, followed by 31.8 per cent from mineral products, 14.0 per cent from consumption of halocarbons and SF_6 and 5.0 per cent from chemical industry. The remaining 1.3 per cent was from the category other production. The key drivers for the increase in emissions in the industrial processes sector are the increases in: HFCs consumption replacing ozone

depleting substances; iron and steel production; and production of lime and clinker. The key driver for the decrease in emissions in the solvent and other product use sector is the reduction in the use of solvents in paint application owing to a shift to water-based paints, which contain a smaller fraction of solvents than solvent-based paints.

50. Sweden's inventory for the industrial processes and solvent and other product use sectors is generally complete. Sweden reported CO_2 emissions from road paving with asphalt and from food and drink in the industrial processes sector as "NA" and the relevant AD as "NE". The ERT noted that methodologies to estimate these emissions are not available in the IPCC good practice guidance and the Revised 1996 IPCC Guidelines. The ERT encourages Sweden to make efforts to estimate these emissions and to report the emission estimates in its next annual submission.

51. Since the Party's previous annual submission, recalculations of emission estimates have been performed for almost all categories in the industrial processes sector. Sweden has provided in the NIR clear and transparent explanations of and justification for the recalculations made and a description of the significant impacts on the reported emission estimates. The ERT noted an increase in total sectoral emissions from the industrial processes sector by 8.2 per cent in 1990 and by 5.3 per cent in 2007 since the Party's previous annual submission. The main reasons for the recalculations were new AD, reallocation of emissions for glass production and iron and steel production from the energy sector.

52. In the solvent and other product use sector, the update of data for 2007 from the Swedish Chemicals Agency resulted in a decrease in the total sectoral emissions for 2007 by 3.5 per cent since the Party's previous annual submission. The ERT welcomes the improvements made and encourages Sweden to continue such efforts for its next annual submission.

2. Key categories

Cement production – CO_2

53. Cement production occurs at three facilities in Sweden owned by a single company. AD are obtained from the EU ETS and from the company directly. The method for estimating CO_2 emissions was consistent with a tier 2 method taken from the IPCC good practice guidance based on clinker production and a cement kiln dust (CKD) correction factor.

54. In the NIR, Sweden has provided information on discussions with the cement producing company on CO_2 emissions from CKD, which no longer exists at the Swedish cement production sites, and on the accuracy of the current estimates of CO_2 emissions from CKD. Until this issue is resolved, the estimated CO_2 emissions from CKD for 2005 onwards were kept at the same level as for 2004 (5 Gg). In addition, the CKD correction factor is generally lower than the IPCC default value, which supports the idea that emissions from CKD in Sweden are at a low level or non-existent. This implies that the CO_2 emissions from cement production for the period 2005–2008 may have been overestimated. The ERT recommends that Sweden report on the results of the aforementioned discussions with the cement producing company, improve the emission estimates, as appropriate, and provide clear descriptions of the AD used in its next annual submission.

Lime production – CO_2

55. In the Party's previous annual submissions, there was a double counting of the lime used within the pulp and paper industry. In response to the recommendations made in the

previous review report, Sweden revised its estimates of CO_2 emissions and the AD for the whole time series for lime production. New and detailed data were used for the 2010 annual submission. AD on amounts of limestone used for lime production for sugar production were obtained from the sugar producing company directly. All other AD were collected from the Swedish Lime Association and the Swedish lime industry, and these AD represent the total lime production in conventional lime mills and the limestone used for lime production within the pulp and paper industry. All EFs used were taken from the 2006 IPCC Guidelines which are the same as in the IPCC good practice guidance. In the 2010 annual submission, the estimates of CO_2 emissions from lime production were lower by 203 Gg (41 per cent) for 1990 and by 84 Gg (13 per cent) for 2007 than those in its previous annual submission. The ERT welcomes the efforts made by Sweden to improve its emission estimates and encourages a continuing use of the same approach for its next annual submission.

Iron and steel production – CO_2

56. To estimate CO_2 emissions from iron and steel production, Sweden used a tier 2 method from the IPCC good practice guidance that is based on carbon mass balances. The method made use of plant-specific AD collected from environmental monitoring reports and EU ETS data. In the NIR of its 2010 annual submission, Sweden has provided an overview (chart) of the input and output materials, the carbon flows between the different processes and the sources of CO_2 emissions.

57. The time series of CO_2 emissions for the period 1990–2007 has been recalculated. Before the Party's 2010 annual submission, CO_2 emissions from all iron and steel facilities were not included in the inventory. Estimates of the missing CO_2 emissions were calculated using the production data for the period 1990–2004 and the EU ETS data for the period 2005–2008. Thus, CO_2 emissions from carbon-containing raw material, previously not included in the inventory, were added in the 2010 annual submission for five facilities. In response to the recommendation made in the previous review report, the CO_2 emissions from integrated primary iron and steel production were recalculated for all years of the time series. The recalculations of the CO_2 emissions from two integrated primary iron and steel production plants in the period 1990–2007 had a minor impact on the estimated total sectoral emissions, but, owing to the reallocation of emissions between the categories, the estimated emissions from pig iron in the industrial processes sector have increased for all years of the time series.

58. In the Party's 2009 and 2010 annual submissions, the emissions from two major iron ore mines and three facilities producing pellets in Sweden were reallocated within the industrial processes sector from the category other to the subcategory sinter under iron and steel production. The ERT noted with appreciation the efforts made by Sweden to improve the accuracy and completeness of its reporting.

59. According to the Revised 1996 IPCC Guidelines, CO_2 emissions from limestone use in iron and steel plants should be reported separately under the limestone and dolomite use category as process emissions from limestone and dolomite use. In the previous review reports it has been repeatedly recommended that Sweden follow the Revised 1996 IPCC Guidelines. Sweden has explained in the NIR that, as the level of CO_2 emissions from limestone and dolomite use is low (less than 1 per cent of the plants' total CO_2 emissions), it did not consider it practical to spend resources obtaining underlying data to separate these emissions. Hence, Sweden chose to report these CO_2 emissions under the pig iron category. The ERT recommends that Sweden further investigate this issue, with a view to reporting these emissions in accordance with the Revised 1996 IPCC Guidelines in its next annual submission.

Consumption of halocarbons and SF_6 – HFCs

60. Sweden reported in the NIR that for some categories its HFCs emission estimates were of a high quality, while for others they were of a medium or low quality. The estimates for the categories contributing the largest share of these emissions (refrigeration and air-conditioning equipment and foam blowing) were considered, according to expert judgment, to be of medium quality. Sweden reported a combined uncertainty of 28 per cent for this category for 2008. The ERT encourages Sweden to undertake additional investigations in order to improve the data quality and reduce uncertainties in its estimates, for example, to identify and survey major importers/distributors of HFCs and request their import data by market segment. The data obtained from the importers could then be used by the Party to cross-check the data from the product register and to help when filling in the sectoral background data in the CRF tables of its next annual submission.

3. Non-key categories

Limestone and dolomite use – CO_2

61. The reported AD and estimated CO_2 emissions for this category represent limestone and dolomite use within the facilities producing glass and mineral wool, iron pellets and chemical products, as well as their use for flue gas purification in energy producing facilities. AD on limestone and dolomite use were collected from environmental monitoring reports, EU ETS data and through direct contacts with the companies. The emissions have been estimated by applying the default EFs from the Revised 1996 IPCC Guidelines.

62. Following the recommendations made during the EU internal review, the CO_2 emissions from limestone and dolomite use within the glass industry were reallocated from the limestone and dolomite use category to the glass production category and reported together with all other process-related CO_2 emissions from glass production. The ERT noted that, in the NIR of its 2010 annual submission, Sweden explained well this change. Furthermore, Sweden has reported in its 2010 annual submission that three other facilities use limestone and dolomite for flue gas desulphurization. In the Party's 2010 annual submission, due to the reallocation of the estimate of CO_2 emissions from limestone and dolomite use for 2007 was lower by around 25 Gg (17 per cent) than that reported in the 2009 annual submission. The ERT noted that this is not fully in accordance with the Revised 1996 IPCC Guidelines as all uses of limestone should be reported under this category, except for those in cement and lime production and liming in the LULUCF sector. The ERT recommends that Sweden consider reallocating CO_2 emissions from limestone and dolomite use in glass production to the limestone and dolomite use category.

Other production – CH_4 and N_2O

63. As was noted in the previous review report, Sweden reported CH_4 and N_2O emissions from combustion of cooking liquor under the category other production. The cooking liquor was combusted in the pulp and paper industry to recover sodium and sulphur, but also for energy recovery. Therefore, the ERT recommends that Sweden report these emissions under the pulp, paper and print category in the energy sector in accordance with the Revised 1996 IPCC Guidelines.

Ferroalloys production – CO_2

64. Sweden reported CO_2 emissions from silicium production as "NE" for 1990 and "NO" for the rest of the time series. During the review, the ERT questioned the Party as to the existence of a silicon (wafer) producer in Sweden and requested the Party to verify this information. Sweden responded that its only facility for silicon production was shut down in 1990. Hence, Sweden reported CO_2 emissions from silicium production as "NO" for

1991 and onwards. In response to another question raised by the ERT during the review, Sweden provided the information that currently in Sweden there is a company producing photovoltaic systems that makes large solar power modules from solar cells. The raw materials used for the production of these solar modules are not produced in Sweden. The ERT is satisfied with this clarification.

D. Agriculture

1. Sector overview

65. In 2008, emissions from the agriculture sector amounted to 8,469.57 Gg CO_2 eq, or 13.2 per cent of total GHG emissions. Since 1990, emissions have decreased by 11.0 per cent. The key driver for the decrease in emissions is the structural change in the sector over the past 50 years. Since the 1950s one fifth of arable lands has not been cultivated, small holdings have been closed and the remaining operations have been growing larger. Within the sector, 56.9 per cent of the emissions were from agricultural soils, followed by 32.0 per cent from enteric fermentation and the remaining 11.1 per cent from manure management.

66. In its 2010 annual submission, Sweden has provided a complete set of CRF tables for the agriculture sector, which include emission estimates for all gases and most of the categories in the sector. As field burning of agricultural residues, prescribed burning of savannas and rice cultivation do not occur in the country, Sweden reported these categories as "NO". The ERT noted that some of the notation keys used need to be revised, in particular in CRF table 4.D. For example, Sweden reported the fraction of manure and crops burned for fuel as zero for the entire time series. Given that these activities do not occur in the country, the ERT recommends that Sweden instead use the notation key "NO" that is in accordance with the IPCC good practice guidance.

67. Sweden used country-specific methodologies and EFs for the estimation of emissions from most of the key categories in the agriculture sector. In the NIR, Sweden has not provided transparent explanations of the applied methodologies justifying the use of country-specific EFs, in particular for estimating N_2O emissions from agricultural soils. However, the ERT noted that since the Party's previous annual submission the transparency of its reporting has slightly improved. The ERT reiterates the recommendation made in the previous review report that Sweden improve the transparency of its reporting and include all relevant information on the country-specific EFs and methodologies used in the NIR of its next annual submission.

68. In the 2010 annual submission, the recalculations in the agriculture sector were performed for agricultural soil due to the harmonization of the sources of data on agricultural lands used across the LULUCF and agriculture sectors. The impact of these recalculations was an increase in the estimated total sectoral emissions from the agriculture sector by 1.4 per cent for both 1990 and 2007.

2. Key categories

Enteric fermentation – CH_4

69. CH_4 emissions from enteric fermentation were estimated using country-specific EFs for significant animals, such as dairy and non-dairy cattle, and also for minor animals, such as reindeer using the IPCC tier 2 method. For other animals the IPCC default EFs were used. Sweden reported CH_4 IEFs for dairy cattle, ranging from 120.26 kg/head/year to 132.03 kg/head/year, that were consistently higher than the IEFs used by most of the other reporting Parties. The ERT agrees, however, that the higher IEF for dairy cattle was supported by the higher milk productivity and estimated energy requirements of the cows in

Sweden. However, in the CRF tables Sweden has reported a constant value for gross energy intake for the whole time series 1990–2008. The ERT recommends that Sweden include in the NIR and in the CRF tables additional information relating to these emission estimates, such as milk yield per cow, digestibility of feed and gross energy intake, in order to improve the transparency of its reporting in its next annual submission.

Manure management – CH_4

70. For the estimation of CH_4 emissions from manure management, Sweden has used a tier 2 methodology for significant animal species, such as cattle and swine, in accordance with the IPCC good practice guidance. For other minor livestock it has used the IPCC tier 1 method and IPCC default EFs. This is in line with the IPCC good practice guidance. The IEF for non-dairy cattle for 2008 (6.67 kg/head/year) was higher by 72.5 per cent than the value for 1990 (3.87 kg/head/year), and the IEF for dairy cattle for 2008 (19.49 kg/head/year) was higher by 95.5 per cent than that for 1990 (9.97 kg/head/year). The increasing trend in the IEFs for non-dairy cattle was caused by the decrease in the use of solid manure systems and an increasing trend in deep litter systems with a higher methane correction factor. The IEFs for dairy cattle have increased due to decreasing trend of fraction of manure stored in solid systems and increasing trend of fraction of manure stored in liquid systems. However, the ERT noted that Sweden has not provided sufficient explanation in the NIR for the changes in the IEF trends for this category. The ERT reiterates the recommendation made in the previous review report that Sweden include explanations for the fluctuations and the increasing IEF trends in its next annual submission.

Manure management – N_2O

71. Following the recommendation made in the previous review report, in the 2010 annual submission Sweden corrected the data on nitrogen (N) excretion values per animal waste management system (AWMS) provided in CRF table 4.B, which in the previous annual submission was reported 1,000 times lower for cattle, swine and poultry than in this annual submission. However, the ERT noted that this correction did not have an effect on the emission estimates that were estimated correctly, the corrections also resulted in usage of IEFs for different AWMS. In the 2010 annual submission, the reporting error described above was resolved.

72. The ERT noted that according to table 6.7 of the NIR on N excretion rates Sweden has not taken into account the annual growth cycles of animals. The ERT reiterates the recommendation made in the previous review report that Sweden account for the average livestock population of all growing animal species, namely piglets.

Direct soil emissions – N_2O

73. On the basis of the results of research conducted by Swedish EPA, Sweden used country-specific EFs to estimate direct N_2O emissions from synthetic fertilizers (0.008 kg N_2O–N/kg N) and from manure applied to soils (0.025 kg N_2O–N/kg N). The country-specific EF for fertilizers is lower than the IPCC default value (0.0125 kg N_2O–N/kg N), while the country-specific EF for manure applied to soils mentioned above is higher than the IPCC default value of 0.0125 kg N_2O–N/kg N. In the NIR, Sweden has not provided sufficiently clear information on the scientific basis and methods used for the identification of these EFs, but it has provided references to the research papers. The ERT reiterates the recommendation made in the previous review report that Sweden include further explanations regarding these country-specific EFs in its next annual submission.

Pasture, range and paddock manure – N_2O

74. Sweden used country-specific EFs for cattle (0.018 N_2O–N/kg N) and other animals (0.01 N_2O–N/kg N) to estimate N_2O emissions from grazing animals. The IPCC good practice guidance provides a default EF value of 0.02 N_2O–N/kg N and does not make a distinction between the animal groups in recommending the EFs. In the NIR, Sweden has not provided a sufficiently clear explanation to justify the use of these country-specific EFs. The ERT recommends that Sweden provide more information to justify the use of these country-specific EFs, in order to improve the transparency of its reporting, in its next annual submission.

75. In CRF table 4.D, Sweden has reported constant values for the fraction of total above-ground biomass that is removed from the field as a crop product (0.2 kg N/kg crop-N) and for the fraction of total above-ground biomass of N-fixing crop that is N (0.02 kg N/kg of dry matter) for the whole time series 1990–2008. These fractions are lower than the IPCC default values (0.45 kg N/kg crop-N and 0.03 kg N/kg of dry matter, respectively). In response to a question raised by the ERT during the review, Sweden explained that for calculating the emission estimates it used the country-specific methods that do not take into account the above-mentioned fractions. For example, emissions from N fixation were estimated on the basis of data on harvested area and N fixation per ha as well as using the IPCC default EF. However, the ERT noted that formula given on page 176 of the NIR was not consistent with this explanation. The ERT recommends that Sweden provide in its next annual submission consistent information in the NIR and in the CRF tables, in order to improve the consistency and transparency of its reporting. The ERT further recommends that Sweden provide in the NIR of its next annual submission transparent explanations of the relevant corrections and changes made.

Indirect soil emissions – N_2O

76. To estimate N_2O emissions from atmospheric deposition, Sweden used country-specific fractions of the ammonia (NH_3) that volatilizes during application of N with fertilizers and manure and with manure applied during grazing. The methodology and parameters referenced are included in the Swedish Informative Inventory Report. During the review, Sweden provided the ERT with that report, which described a methodology relating to volatilization ratios of NH_3 and nitrogen oxide (NO_x). The ERT recommends that, in order to improve the transparency of its reporting, Sweden include all relevant information on country-specific methodologies in the NIR of its next annual submission. The ERT further recommends that Sweden provide well-documented explanations with regard to all country-specific EFs and parameters used in its next annual submission.

E. Land use, land-use change and forestry

1. Sector overview

77. In 2008, net removals from the LULUCF sector amounted to 14,675.82 Gg CO_2 eq. Since 1990, net removals have decreased by 52.7 per cent. The key drivers for the decrease in net removals are the increased felling and the impact of the severe storms that occurred in 2005 and 2006. Within the sector, forest land is a major category, accounting for a net sink of 20,869.27 Gg CO_2 eq in 2008. Meanwhile, 3,039.82 CO_2 eq of the net emissions were from settlements, 2,957.66 CO_2 eq were from cropland, 134.17 Gg CO_2 eq were from grassland and 61.80 Gg CO_2 eq were from wetlands.

78. In comparison with the Party's previous annual submission, the completeness of the reporting for this sector has improved substantially, owing to the Party's reporting of emission estimates or use of the notation keys for all mandatory reporting categories.

Estimates of carbon stock changes in DOM and soil organic matter for land-use conversion categories were provided for the first time. Following the recommendation made in the previous review report, Sweden reported the carbon stock changes in wetlands and other lands as "NE" instead of "NO", as land under these categories was considered unmanaged. The ERT commends the Party for these improvements. The reporting of non-CO_2 emissions from drainage of soils and wetlands is optional and corresponding estimates have not been provided by Sweden in its 2010 annual submission.

79. Until its 2009 annual submission, Sweden provided the estimates of carbon stock changes in living biomass for each category using both the "gain" and "loss" columns in the CRF tables. Sweden used a stock change approach as provided in chapter 3 of the IPCC good practice guidance for LULUCF to estimate the carbon stock changes in living biomass. In its 2010 annual submission, Sweden has reported all the net carbon stock changes in the "gain" column in the CRF tables. This small change improved the transparency of the Party's reporting in its 2010 annual submission.

80. Sweden estimated the areas under each land-use category and land-use change category on the basis of the permanent plot sampling data provided by the Swedish National Forest Inventory. The number of sampling plots is approximately 30,000, which covers the entire country, and this number is updated every five years. In the NIR, Sweden has provided detailed information on how land uses were defined and stratified taking into account the IPCC categories, but it was not made clear how the annual reported area for each land-use category was estimated, especially for the years between the forest inventories. This made it difficult for the ERT to check whether the land areas and the land-use change were reported consistently throughout the reporting period 1990–2008.

81. In the previous review report, the ERT recommended that Sweden provide a land-use transition matrix for each year of the reporting period, in order to improve the transparency and consistency of its reporting. Responding to the questions raised by the ERT during the review, Sweden explained that it plans to provide such land-use transition matrices for some years of the time series in its next annual submission. The ERT welcomes Sweden's continuous efforts to improve the transparency and consistency of its reporting and encourages the Party to provide additional information to clarify how the plot sampling data were used to estimate the areas of land use and land-use change in accordance with the IPCC good practice guidance for LULUCF. These clarifications are also important in relation to fulfilling the reporting requirements under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

82. The ERT noted that the reported total land area of Sweden fluctuates from 2005 onwards. In response to a question raised by the ERT during the review, Sweden explained that these fluctuations are due to the update of the forest inventory, which takes place every five years. Furthermore, Sweden informed the ERT that it is difficult to fix the country's total land area before the forest inventory cycle is complete. Using the plot sampling approach with a five-year inventory cycle is good practice. The ERT welcomes Sweden's substantial effort to continue this comprehensive sampling approach, but the ERT noted that the explanation provided by the Party in the NIR was not completely transparent. The ERT encourages the Party to provide more information in the NIR to clarify why this inconsistency in the estimated land area has occurred and recommends that Sweden consider using the category other land to adjust the annual fluctuations in its total land area in its next annual submission.

83. Carbon stock changes in living biomass, land-use areas and areas subject to land-use conversions were recalculated for the period 2005–2007, on the basis of newly obtained sampling data. The estimates for the DOM and soil organic carbon pools in the land-remaining categories were recalculated for the entire time series 1990–2008, also on the basis of the updated sampling data. The emissions from the DOM and soil organic carbon

pools in the land-use conversion categories were reported for the entire time series 1990–2008 for the first time. This resulted in increases in the estimated net CO_2 emissions equal to 1,147.41 Gg CO_2 for 1990 and 2,482.04 Gg CO_2 for 2007 in the land converted to settlements category.

84. The estimated carbon stock changes in living biomass are consistent throughout the time series. The carbon stock changes in DOM and soil organic carbon were estimated for 1993 onwards. The sampling methodology used to estimate soil organic carbon was revised in 2003. However, the consistency of the time series was ensured by comparing results from two different process models.

85. An uncertainty assessment was performed for all estimated categories and pools based on national methods. The uncertainty level for the total net removal of the LULUCF sector in 2008 is estimated as 39 per cent. The accuracy of reporting on the net CO_2 removals from the DOM pool has improved since the Party's previous annual submission, as there were more repeated measurements taken on the permanent sampling plots.

86. Sweden has performed tier 1 QC procedures based on the IPCC good practice guidance for LULUCF. The QA procedures were carried out in an internal review by experts from SLU. However, the ERT noted that there were some errors in the NIR, especially in the references related to the figures and tables provided in the NIR; for example, table 10 in annex 3 was referred to in section 7.3.1.2 of the NIR but could not be found in annex 3. The ERT recommends that Sweden improve the consistency of the reporting within the NIR, enhance its QC procedures and correct such errors in its next annual submission.

2. Key categories

Forest land remaining forest land – CO_2

87. Forest land remaining forest land is a dominant category in the LULUCF sector, and in 2008 the net removals from this category were equal to over 40 per cent of the total CO_2 emissions of the country (without LULUCF). However, the annual variability of CO_2 emissions from this category was relatively high, the net removals from this category decreased by 49 per cent from 1990 to 2008. During the review, Sweden explained that this annual variability was caused by the fluctuating volume of harvested forest and some natural disturbances, while the decreasing trend in removals reflected mainly the increased demand for wood products. The ERT agrees with these explanations. However, taking into account the importance of this category, the ERT recommends that Sweden provide in its NIR more information on the drivers of the emission trends and their impact on the annual carbon stock changes, in order to improve the transparency of the reporting and facilitate the review of the inventory of the Party's next annual submission.

Land converted to forest land – CO_2

88. The ERT noted that there is an inconsistency between the reported area of land converted to forest land and the area subject to the afforestation/reforestation activities reported under Article 3, paragraph 3, of the Kyoto Protocol. In response to the questions raised by the ERT during the review, Sweden indicated that the land converted to forest land category includes the land converted from 1983 onwards. A part of this land was transferred to the forest land remaining forest land category in 2003. Since this land-use conversion category should include only the land converted in the past 20 years, the ERT recommends that Sweden revise the method used to identify the relevant area and ensure the consistency of its reporting under the Convention and under the Kyoto Protocol, thus improving the transparency and accuracy of its reporting.

Cropland remaining cropland – CO_2

89. In the previous review report, the ERT noted a small discrepancy between the area of organic soils reported as cropland remaining cropland under the LULUCF sector and the area of cultivated organic soils reported under the agriculture sector. This discrepancy was still present in the Party's 2010 annual submission. In response to a question raised by the ERT during the review, Sweden indicated that it had tried to make the reporting on these two sectors comparable by using the same estimates of areas (the relative numbers for the areas reported under the LULUCF sector); however, further investigations were needed to fully align the reporting on these categories. The ERT welcomes Sweden's continuous efforts to improve the consistency of its reporting across the sectors and encourages the Party to improve the transparency of its reporting of information on land representation in its next annual submission.

3. Non-key categories

Forest land remaining forest land – N_2O

90. Sweden reported estimates of N_2O emissions from N fertilization in the category forest land remaining forest land. Although the contribution of these emissions to the total emissions from the sector was not significant, it is good practice to monitor these emissions as the amount of fertilizer applied to forest land in Sweden fluctuates annually. The emissions from this category decreased from 1990 to 2002 by about 80 per cent and then increased by about 70 per cent from 2003 onwards. The ERT encourages Sweden to estimate the emissions from this category continuously and to provide background information in the NIR to justify such fluctuations in the emission trend, in order to ensure the completeness and consistency of the time series in its next annual submission.

Land converted to settlements – CO_2

91. Sweden is one of a few Parties included in Annex I to the Convention reporting the living biomass pool as a net sink under the category forest land converted to settlements. In the previous review report, it is stated that Sweden informed the ERT that removals from the living biomass pool in this category were attributed to the annual increment of the remaining trees in the deforested area. However, the ERT noted that under the corresponding deforestation activity under Article 3, paragraph 3, of the Kyoto Protocol the carbon stock changes were reported as net emissions, and that the difference between the estimated removals and emissions was considerably large, even taking into account the different time periods for land area accumulation. In response to a question raised by the ERT during the review, Sweden explained that in the forest land conversion categories the land area represents the land converted from forest land from 1983 onwards, while the land subject to deforestation activity is the land converted from forest land from 1990 onwards. The ERT reminds Sweden that, regardless of when the data collection started, according to the definition of the IPCC default land-transition period, the land included in a land-use conversion category is the land converted from other land uses in the past 20 years. The ERT encourages Sweden to review the land classification and to provide more information to clarify the substantial differences in its reporting under the Convention and under the Kyoto Protocol, in order to improve the completeness, accuracy and transparency of its reporting in its next annual submission.

F. Waste

1. Sector overview

92. In 2008, emissions from the waste sector amounted to 2,039.95 Gg CO_2 eq, or 3.2 per cent of total GHG emissions. Since 1990, emissions have decreased by 34.7 per cent. The key drivers for the fall in emissions are the increased recovery of landfill gas, the implementation of policies for the treatment of solid waste and the introduction of a landfill tax. Within the sector, 71.8 per cent of the emissions were from solid waste disposal on land, followed by 21.9 per cent from wastewater handling and 6.3 per cent from waste incineration.

93. The inventory for the waste sector in the Party's 2010 annual submission is generally complete in terms of categories, with the exception of CH_4 emissions from industrial wastewater and domestic and commercial wastewater, which were reported as "NE". In response to the list of potential problems and further questions, Sweden provided these missing emission estimates and revised the notation keys (see paras. 97–99 below).

94. Sweden has implemented all QA/QC procedures in accordance with its QA/QC plan. Sweden reported a tier 1 uncertainty analysis for all categories in the waste sector. Combined uncertainties for the waste sector were 58 per cent for CH_4 emissions from solid waste disposal on land, 51 per cent for N_2O emissions from wastewater handling and 112 per cent for N_2O from waste incineration. The Party did not report on any category-specific improvements for this sector planned for its next annual submission.

95. In its 2010 annual submission, Sweden has improved the completeness of the inventory for the waste sector by estimating CH_4 and N_2O emissions from waste incineration for the entire time series. The ERT commends Sweden for this improvement.

2. Key categories

Solid waste disposal on land – CH_4

96. CH_4 emissions from solid waste disposal on land decreased by 47.4 per cent during the period 1990–2008, owing to the increased amount of waste recovered, recycled or incinerated and the decreasing amount of solid waste disposed to landfills. Sweden reported the use of a tier 2 IPCC first order decay method and country-specific AD for estimating CH_4 emissions from solid waste disposal sites. The ERT commends Sweden for transparently reporting on the method that it uses to estimate CH_4 emissions from solid waste disposal on land, following the recommendation of the previous ERT.

3. Non-key categories

Wastewater handling – CH_4

97. In its 2010 annual submission, Sweden reported CH_4 emissions from industrial wastewater and sludge as "NE" for the entire time series. In response to the list of potential problems and further questions raised by the ERT, Sweden informed the ERT that a majority of the industrial wastewater treatment plants in Sweden use aerobic processes, whereby no CH_4 emissions are generated. Sweden further informed the ERT that in 2008 there were four industrial wastewater treatment plants using anaerobic processes. These facilities were in the pulp industry and the food industry. Sweden informed the ERT that there are data available on the energy recovery from anaerobic processes, and that the loss of CH_4 in the energy recovery process is within the range of 2 to 5 per cent. During the review Sweden used the upper value (5 per cent) and calculated an estimate of CH_4 emissions from industrial wastewater of 0.49 Gg CH_4 for 2008. This contributes to 10.29

Gg CO_2 eq or 2.3 per cent of the total emissions from wastewater handling. The ERT agreed with this estimate, which was included in the revised CRF tables submitted on 26 January 2011. In addition, also in response to the list of potential problems and further questions raised by the ERT, Sweden changed the notation key used to report CH_4 emissions from sludge in industrial wastewater from "NE" to "NO" and provided additional information to justify this change. Sweden stated that no relevant activities, such as the anaerobic digestion of sludge from industrial wastewater, have been identified in the country. The ERT considered the additional information submitted by Sweden sufficient to justify the change of the notation key.

98. In its 2010 annual submission, Sweden reported CH_4 emissions from domestic and commercial wastewater and sludge as "NE" for the entire time series. In response to the list of potential problems and further questions raised by the ERT, Sweden informed the ERT that it divides the calculation of CH_4 emissions from domestic and commercial wastewater treatment into three sections: large wastewater treatment plants (with treatment capacity of more than 2,000 people); small wastewater treatment plants (with treatment capacity of 25 to 2,000 people); and population not connected to wastewater discharge systems. In Sweden, all large wastewater treatment plants use aerobic processes, whereby no CH_4 emissions are generated. For small wastewater treatment plants and population not connected to wastewater discharge systems, Sweden used the check method from the IPCC good practice guidance and reported, in the revised CRF tables submitted on 26 January 2011 an estimate of CH_4 emissions from domestic and commercial wastewater of 10.51 Gg CH_4 for 2008. Regarding CH_4 emissions from sludge, Sweden informed the ERT that, on the basis of a study on gas leakage at two wastewater treatment plants in Stockholm, the leakage of CH_4 is estimated at 4 to 7 per cent of these plants' gas production. Using these data, and assuming that the data are representative of all anaerobic wastewater treatment plants in Sweden, the Party calculated an estimate of CH_4 emissions from sludge in domestic and commercial wastewater of 3.27 Gg CH_4 for 2008. Sweden reported an overall estimate of CH_4 emissions from both wastewater and sludge in domestic and commercial wastewater of 13.78 Gg CH_4 for 2008. The ERT agreed with these emission estimates. In addition, Sweden changed the notation key used to report energy recovery from domestic and commercial wastewater treatment from "NE" to "NO".

99. The ERT recommends that Sweden continue to estimate and report the CH_4 emissions from industrial, domestic and commercial wastewater and sludge, ensure consistency between the information reported in the NIR and that in the CRF tables and include all necessary information (e.g. category description, methodological issues, uncertainty and time-series consistency, recalculations and planned improvements) in order to improve the transparency of its reporting in its next annual submission. The ERT also recommends that Sweden provide information on the rationale for using the notation keys to report on wastewater handling in its next annual submission.

Wastewater handling – N_2O

100. In its 2010 annual submission, Sweden performed recalculations of its estimates of N_2O emissions from human sewage. For its previous annual submission, Sweden estimated the number of people residing in rural areas not connected to municipal wastewater treatment systems at 1 million and used these data for its calculations. After the new data were published, this figure was increased to 1.3 million people. The impact of the recalculations on the estimated N_2O emissions was an increase by 3.7 per cent for 1990 and by 6.3 per cent for 2007. The estimation method and EFs used are in accordance with the IPCC good practice guidance. The Party used a constant value for the annual protein consumption per capita for the entire time series. The ERT recommends that Sweden consider using time-dependent AD on protein consumption (e.g. statistics from the Food

and Agriculture Organization of the United Nations) to further improve the accuracy of its reporting in its next annual submission.

101. The ERT noted that the background data on wastewater handling presented in the CRF tables are not fully transparent. The Party did not include additional information on wastewater handling in CRF table 6.B. The ERT encourages the Party to further improve the transparency of its reporting by providing fully transparent information on the AD and EFs used to estimate N_2O emissions from wastewater handling 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

102. Sweden has provided all mandatory information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol following the requirements outlined in paragraphs 5 to 9 of the annex to decision 15/CMP.1. The information was reported in the NIR and the CRF tables. 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. For the identification of the land area subject to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, Sweden used the same methodologies used for its reporting of LULUCF under the Convention, based on the permanent sampling plots. Sweden identified its national boundary as a geographical boundary encompassing units of land (reporting method 1) and adopted approach 3 for reporting emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. The definition of forest and the land identification system used to identify the area subject to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol are in accordance with the IPCC good practice guidelines for LULUCF.

103. In its key category analysis, Sweden identified only forest management as a key category, while the secretariat identified afforestation/reforestation, deforestation and forest management as key categories. In its comments to the previous stages of the review, Sweden explained that it plans either to improve the key category analysis or alternatively to consider all activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol as key categories in its next annual submission.

104. Sweden performed a qualitative uncertainty assessment in relation to the activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. The ERT encourages the Party to apply a quantitative uncertainty assessment for its next annual submission, taking special consideration to the AD used to estimate the emissions from these activities.

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

Afforestation and reforestation – CO_2

105. Sweden has provided estimates for each of the five carbon pools, namely above-ground biomass, below-ground biomass, deadwood, litter and soil organic carbon. Carbon stock changes were estimated using a tier 3 approach and country-specific EFs in accordance with the IPCC good practice guidance for LULUCF.

106. Units of land harvested since the beginning of the commitment period were reported as "NO", since land subject to afforestation and reforestation was not considered harvested during the commitment period, owing to the slow growth rate of boreal forests. The emissions from all the activities were reported as "NO", as the harvesting practice was not observed in the juvenile forest.

Deforestation – CO_2 and N_2O

107. Sweden has provided estimates of carbon stock changes for all five carbon pools for this activity. A tier 3 approach was applied for calculating the estimates, in accordance with the IPCC good practice guidance for LULUCF. Most of EFs and parameters used were country-specific and appropriately selected. In addition, N_2O emissions from disturbance associated with land-use conversion to cropland have also been estimated under this activity using the tier 1 approach in accordance with the IPCC good practice guidance for LULUCF.

108. In order to distinguish the normal harvesting or forest disturbance from the deforestation activities, Sweden continuously monitors the land which loses forest land-cover using its five-year cycle sampling method. In case if another land use activity was observed in the land in the next consecutive inventory, it was confirmed as deforestation. Then, the year of deforestation is revised and recalculation is applied. This approach is in line with the IPCC good practice guidance for LULUCF. The ERT commends Sweden's effort for taking this elaborated approach.

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

Forest management – CO_2, CH_4 and N_2O

109. Sweden adopted a broad interpretation of definition of forest management and identified the entire managed forest area, excluding area subjected to afforestation and reforestation under Article 3, paragraph 3, of the Kyoto Protocol, as area subject to human-induced forest management activities. Harmonized with the reporting under the Convention, carbon stock changes in all of the five carbon pools were estimated applying a tier 3 approach in line with the IPCC good practice guidance for LULUCF. Most of EFs and parameters used were country-specific and appropriately selected.

110. N_2O emissions from fertilization and non-CO_2 emissions from biomass burning were also estimated, using a tier 1 approach. Liming was reported as "NO" as lime application in forest was not observed in Sweden. Non-CO_2 emissions from drainage of soils under forest management were not estimated, as a relevant IPCC methodology is not available.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

111. 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.[6] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterated the main findings contained in the SIAR.

[6] The SEF comparison report is prepared by the ITL 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.

112. 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 (CDM) 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.

National registry

113. 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 took further note of the SIAR and its findings 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. The national registry has adequate procedures in place to minimize discrepancies.

Calculation of the commitment period reserve

114. In its 2010 annual submission, Sweden has reported its commitment period reserve to be 319,814,750 t CO_2 eq based on the national emissions in its most recently reviewed inventory (2008). The ERT disagreed with this figure, as this calculation was based on a wrong number for the total national emissions; the commitment period reserve should be equal to 319,815,475 t CO_2 eq based on the national emissions in the 2008 inventory (63,963.10 Gg CO_2 eq). In response to the list of potential problems and further questions raised by the ERT, on 17 December 2010 Sweden reported its commitment period reserve to be 320,294,298 t CO_2 eq based on the national emissions in its 2008 revised inventory (64,058.86 Gg CO_2 eq). Later, after submission of a new set of revised CRF tables on 26 January 2011, Sweden reported its commitment period reserve to be 321,354,810 t CO_2 eq based on the national emissions in its revised inventory for 2008 (64,270.96 Gg CO_2 eq). The ERT agrees with this figure.

3. Changes to the national system

115. Sweden has reported that there has been no change in its national system since its previous annual submission. The ERT concluded that Sweden'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

116. Sweden has reported in its NIR that there have been changes in its national registry since its previous annual submission. Sweden reported the following changes: a new name and contact information for the registry administrator, and a change of the IT supplier from Siemens Services and Solutions Ltd. to SFW Ltd. for the registries using the GRETA software. The ERT concluded that the Party'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 decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

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

117. Sweden has reported information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as requested in chapter I.H of the annex to decision 15/CMP.1, in its 2010 annual submission. The reported information is considered complete and transparent.

118. In annex 6.9 to the NIR, Sweden has provided comprehensive information on its activities under Article 3, paragraph 14, of the Kyoto Protocol. It has reformed its energy markets so that the energy price is regulated by supply and demand; fossil fuels used outside the EU ETS are subject to taxation; emissions taxes have been imposed on environmentally harmful technologies; priority is given to the development of virtually fossil-free heat- and power-production technologies; and there are research programmes in the area of hybrid technologies and recently in the area of carbon capture and storage technology. Sweden was also involved in the transfer of energy-efficient and renewable-energy technologies through the implementation of the CDM projects in the developing countries in Africa.

III. Conclusions and recommendations

119. Sweden made its annual submission on 14 April 2010. 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, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol; Kyoto Protocol units; changes to the national system and to the national registry; and minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. This is in general in accordance with decision 15/CMP.1. In response to the list of potential problems and further questions raised by the ERT, Sweden officially submitted revised CRF tables on 21 October 2010 and on 26 January 2011. On 26 January 2011 Sweden officially submitted its revised estimates of the commitment period reserve of its 2010 annual submission.

120. The ERT concludes that the inventory submission of Sweden has been prepared in accordance with the UNFCCC reporting guidelines. The inventory submission is generally complete in terms of categories and complete in terms of gases, geographical coverage, years and sectors. The Party has submitted a complete set of CRF tables for the period 1990–2008, with the exception of CRF table 7 (summary overview for key categories). Sweden reported some categories as "NE", such as CH_4 emissions from industrial wastewater and domestic and commercial wastewater in the waste sector. Sweden did not include the CO_2 emissions from crude oil transportation, even though the IPCC good practice guidance provides the CO_2 EF. Furthermore, Sweden did not include estimates of CO_2, CH_4 and N_2O emissions from civil aviation related to private aviation, educational training flights and military flights. The ERT noted that these activities do occur in the country and that methodologies and EFs for estimating these emissions are available in the IPCC good practice guidance and the Revised 1996 IPCC Guidelines. In response to the list of potential problems and further questions raised by the ERT during the review, Sweden provided the missing emission estimates in the revised CRF tables.

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

122. The ERT concludes that the 2010 annual submission of Sweden has been prepared and reported generally in line with the UNFCCC reporting guidelines, the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

123. Sweden has provided all mandatory information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol in its NIR and the CRF tables in accordance with the requirements outlined 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.

124. 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.

125. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1. However, the ERT identified a potential issue linked to the Government's call to reduce requests for statistical compilations and consequent inconveniences with obtaining data for estimating the emissions from some activities under civil aviation. This potential problem relates to the mandatory functions of the national system described in paragraph 14(c) of the annex to decision 19/CMP.1.

126. 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 decisions of the CMP.

127. Sweden has reported the information requested in 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 2010 annual submission. The information is complete and transparent.

128. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of the Party's 2010 annual submission. The key recommendations are that Sweden:

(a) Provide more extensive information on the national system, including a description of the specific responsibilities of the organizations participating in SMED and of the consultants assisting Swedish EPA in the inventory preparation process;

(b) Ensure that AD and emission estimates from civil aviation continue to be reported, following the recommendations provided by the ERT in the list of potential problems and unresolved questions;

(c) Provide estimates, in its next annual submission, for those categories that were reported as "NE" and for which IPCC methodologies and EFs are available, for example applying the approach used during the review**;**

(d) Perform the key category analysis at a more disaggregated level in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF, and pay special attention to the identification of key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;

(e) Provide information on summary overview for key categories in CRF table 7 (summary overview for key categories);

(f) Strengthen the QC procedures in relation to the key category analysis;

(g) Improve the QC procedures for the identification and correction of errors as observed in the estimation of CO_2 emissions from agriculture/forestry/fisheries in the energy sector;

(h) Provide information on the QA procedures applied in relation to the EU ETS data;

(i) Ensure a consistent use of the notation keys in the CRF tables for the energy, agriculture and waste sectors to improve the transparency of reporting.

IV. Questions of implementation

129. 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>.

Intergovernmental Panel on Climate Change. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*.
Available at <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*.
Available at <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

Intergovernmental Panel on Climate Change. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*.
Available at <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

"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>.

"Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention". FCCC/CP/2002/8.
Available at <http://unfccc.int/resource/docs/cop8/08.pdf>.

"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>.

"Guidelines for review under Article 8 of the Kyoto Protocol". Decision 22/CMP.1.
Available at <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=51>.

Status report for Sweden 2010.
Available at <http://unfccc.int/resource/docs/2010/asr/swe.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2010.
Available at <http://unfccc.int/resource/webdocs/sai/2010.pdf>.

FCCC/ARR/2009/SWE. Report of the individual review of the annual submission of Sweden submitted in 2009.
Available at <http://unfccc.int/resource/docs/2009/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>.

B. Additional information provided by the Party

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

H. Hedlund and M. Lidén, 2010 *Jämförelse av energirapportering till IEA och UNFCCC,* SCB. Swedish Environmental Protection Agency. 2010. *Sweden's Informative Inventory Report. In English:* H. Hedlund and M. Lidén, 2010. Comparison of energy reported to the IEA and UNFCCC. SMED Report 2020.

Statens energimyndighet (STEM), 2010 Produktion och användning av biogas 2008, ES2010:01. *In English:* The Swedish Energy Authority 2010. Production and use of biogas 2008, ES2010:01.

M. Ek and O. Westling, 2003 Dagsläget beträffande skogsindustrins avfall. IVL Swedish Environmental Research Institute Ltd. IVL report B 1482. *In English:* M. Ek and O. Westling, 2003. The state of forest industy waste. IVL Swedish Environmental Research Institute Ltd. IVL report B 1482.

K. Starberg and A.Welin, 2004. "Metanförluster vid avloppsreningsverken i Henriksdal och Bromma"Stockholm Vatten. UPPdragsnummer 1833 042 000. *In English:* K. Starberg and A.Welin, 2004. Methane losses in sewage treatment plants in Henriksdal and Bromma. The Stockholm Water Company, Nr 1833 042 000.

[1] Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AD	activity data
CH_4	methane
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CKD	cement kiln dust
CRF	common reporting format
DOM	dead organic matter
EF	emission factor
EPA	Environmental Protection Agency
ERT	expert review team
EU ETS	European Union emissions trading scheme
Gg	gigagram
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
HFCs	hydrofluorocarbons
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
kg	kilogram (1 kg = 1,000 grams)
KP	Kyoto Protocol
LULUCF	land use, land-use change and forestry
N	nitrogen
NA	not applicable
NCV	net calorific value
NE	not estimated
NH_3	ammonia
NIR	national inventory report
NO	not occurring
NO_x	nitrogen oxide
N_2O	nitrous oxide
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
SCAA	Swedish Civil Aviation Authority
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
SLU	Swedish University of Agricultural Sciences
SMED	Swedish Environmental Emissions Data
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change