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Report of the individual review of the annual submission of Finland submitted in 2012*

* In the symbol for this document, 2012 refers to the year in which the inventory was submitted, and not to the year of publication.

Contents

I. Introduction and summary

1. This report covers the in-country review of the 2012 annual submission of Finland, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 1 to 6 October 2012 in Helsinki, Finland, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Mr. Manfred Ritter (Austria); energy – Mr. Ole-Kenneth Nielsen (Denmark); industrial processes – Ms. Natalya Parasyuk (Ukraine); agriculture – Mr. Marcelo Theoto Rocha (Brazil); land use, land-use change and forestry (LULUCF) – Mr. Nagmeldin Elhassan (Sudan); and waste – Ms. Sirintornthep Towprayoon (Thailand). Mr. Nielsen and Mr. Rocha were the lead reviewers. The review was coordinated by Ms. Sylvie Marchand and Mr. Javier Hanna (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 Finland, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

3. In 2010, the main greenhouse gas (GHG) in Finland was carbon dioxide (CO_2), accounting for 85.4 per cent of total GHG emissions[1] expressed in CO2 eq, followed by nitrous oxide (N_2O) (7.2 per cent) and methane (CH_4) (5.8 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 1.6 per cent of the overall GHG emissions in the country. The energy sector accounted for 81.3 per cent of total GHG emissions, followed by the agriculture sector (7.9 per cent), the industrial processes sector (7.7 per cent) and the waste sector (2.9 per cent). Total GHG emissions amounted to 74,555.64 Gg CO_2 eq and increased by 5.9 per cent between the base year[2] and 2010.

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

5. Tables 3–5 provide 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[a] to 2010

			Gg CO_2 eq								*Change (%)*
		Greenhouse gas	*Base year[a]*	*1990*	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*Base year–2010*
Annex A sources		CO_2	56 633.32	56 633.32	57 885.12	56 814.44	56 520.15	58 102.60	55 192.12	63 688.56	12.5
		CH_4	6 315.21	6 315.21	6 104.01	5 405.90	4 527.30	4 358.75	4 282.11	4 327.14	–31.5
		N_2O	7 322.36	7 322.36	6 728.94	6 452.96	6 666.92	6 736.72	5 705.02	5 343.98	–27.0
		HFCs	29.33	0.02	29.33	491.76	863.45	993.19	888.83	1 163.96	3 868.7
		PFCs	0.14	0.07	0.14	22.46	9.88	11.23	9.32	0.75	435.5
		SF_6	68.53	94.38	68.53	51.49	34.83	40.36	41.34	31.24	–54.4
KP-LULUCF	Article 3.3[b]	CO_2						3 984.37	3 988.57	3 994.24	
		CH_4						0.001	0.001	0.001	
		N_2O						0.25	0.24	0.32	
	Article 3.4[c]	CO_2	NA					–36 431.84	–47 303.56	–31 858.89	NA
		CH_4	NA					1.26	1.11	0.67	NA
		N_2O	NA					35.47	24.91	22.70	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.

[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[a] to 2010

			Gg CO_2 eq							*Change (%)*
		Sector	*Base year[a]*	*1990*	*1995*	*2000*	*2005*	*2008*	*2009*	*2010*	*Base year–2010*
Annex A		Energy	54 494.70	54 494.70	56 049.23	54 429.38	53 995.10	54 851.23	52 808.62	60 649.16	11.3
		Industrial processes	5 103.25	5 099.72	4 685.87	5 568.87	6 330.77	7 149.07	5 335.94	5 765.86	13.0
		Solvent and other product use	178.37	178.37	142.77	124.71	106.39	86.59	72.27	73.43	–58.8
		Agriculture	6 617.97	6 617.97	6 027.14	5 844.88	5 785.58	5 872.69	5 715.44	5 881.53	–11.1
		Waste	3 974.60	3 974.60	3 911.06	3 271.16	2 404.68	2 283.26	2 186.45	2 185.65	–45.0
		LULUCF	NA	–15 718.20	–14 529.00	–20 079.28	–28 611.08	–26 581.06	–36 091.74	–22 081.70	NA
		Total (with LULUCF)	**NA**	**54 647.16**	**56 287.07**	**49 159.72**	**40 011.45**	**43 661.79**	**30 026.99**	**52 473.93**	**NA**
		Total (without LULUCF)	**70 368.89**	**70 365.36**	**70 816.07**	**69 239.00**	**68 622.53**	**70 242.85**	**66 118.73**	**74 555.64**	**5.9**
		Other[b]	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
KP-LULUCF	Article 3.3[c]	Afforestation and reforestation						409.19	411.48	362.98	
		Deforestation						3 575.43	3 577.33	3 631.58	
		Total (3.3)						**3 984.63**	**3 988.81**	**3 994.56**	
	Article 3.4[d]	Forest management						–36 395.11	–47 277.54	–31 835.52	
		Cropland management	NA					NA	NA	NA	NA
		Grazing land management	NA					NA	NA	NA	NA
		Revegetation	NA					NA	NA	NA	NA
		Total (3.4)	**NA**					**–36 395.11**	**–47 277.54**	**–31 835.52**	**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] Emissions/removals reported in the sector other (sector 7) are not included in Annex A to the Kyoto Protocol and are therefore not included in national totals.

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

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

Table 3
Information to be included in the compilation and accounting database in t CO_2 eq for the year 2010, including the commitment period reserve

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Commitment period reserve	319 515 790			319 515 791
Annex A emissions for current inventory year				
CO_2	63 688 564			63 688 564
CH_4	4 327 136			4 327 136
N_2O	5 343 983			5 343 983
HFCs	1 163 958			1 163 958
PFCs	750			750
SF_6	31 244			31 244
Total Annex A sources	**74 555 635**			**74 555 635**
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	362 983			362 983
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported	NA			NA
3.3 Deforestation for current year of commitment period as reported	3 631 576			3 631 576
Activities under Article 3, paragraph 4, for current inventory year[c]				
3.4 Forest management for current year of commitment period	–31 835 524			–31 835 524
3.4 Cropland management for current year of commitment period				
3.4 Cropland management for base year				
3.4 Grazing land management for current year of commitment period				
3.4 Grazing land management for base year				
3.4 Revegetation for current year of commitment period				
3.4 Revegetation in base year				

Abbreviation: NA = not applicable.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 4
Information to be included in the compilation and accounting database in t CO_2 eq for the year 2009

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2009				
CO_2	55 192 124			55 192 124
CH_4	4 282 110			4 282 110
N_2O	5 705 017			5 705 017
HFCs	888 831			888 831
PFCs	9 317			9 317
SF_6	41 335			41 335
Total Annex A sources	**66 118 734**			**66 118 734**
Activities under Article 3, paragraph 3, for 2009				
3.3 Afforestation and reforestation on non-harvested land for 2009 as reported	411 482			411 482
3.3 Afforestation and reforestation on harvested land for 2009 as reported	NA			NA
3.3 Deforestation for 2009 as reported	3 577 331			3 577 331
Activities under Article 3, paragraph 4, for 2009[c]				
3.4 Forest management for 2009	–47 277 539			–47 277 539
3.4 Cropland management for 2009				
3.4 Cropland management for base year				
3.4 Grazing land management for 2009				
3.4 Grazing land management for base year				
3.4 Revegetation for 2009				
3.4 Revegetation in base year				

Abbreviation: NA = not applicable.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

Table 5
Information to be included in the compilation and accounting database in t CO_2 eq for the year 2008

	As reported	*Revised estimates*	*Adjustment*[a]	*Final*[b]
Annex A emissions for 2008				
CO_2	58 102 598			58 102 598
CH_4	4 358 755			4 358 755
N_2O	6 736 721			6 736 721
HFCs	993 190			993 190
PFCs	11 231			11 231
SF_6	40 355			40 355
Total Annex A sources	**70 242 850**			**70 242 850**
Activities under Article 3, paragraph 3, for 2008				
3.3 Afforestation and reforestation on non-harvested land for 2008 as reported	409 193			409 193
3.3 Afforestation and reforestation on harvested land for 2008 as reported	NA			NA
3.3 Deforestation for 2008 as reported	3 575 433			3 575 433
Activities under Article 3, paragraph 4, for 2008[c]				
3.4 Forest management for 2008	–36 395 111			–36 395 111
3.4 Cropland management for 2008				
3.4 Cropland management for base year				
3.4 Grazing land management for 2008				
3.4 Grazing land management for base year				
3.4 Revegetation for 2008				
3.4 Revegetation in base year				

Abbreviation: NA = not applicable.
[a] "Adjustment" is relevant only for Parties for which the expert review team has calculated one or more adjustment(s).
[b] "Final" includes revised estimates, if any, and/or adjustments, if any.
[c] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2012 annual inventory submission was submitted on 12 April 2012 (common reporting format (CRF) tables) and 14 April 2012 (national inventory report (NIR)); it contains a complete set of CRF tables for the period 1990–2010 and an NIR. Finland also submitted information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 16 February 2012. The annual submission was submitted in accordance with decision 15/CMP.1.

7. The expert review team (ERT) also used the previous year's submission during the review. In addition, the ERT used the standard independent assessment report (SIAR), parts I and II, to review information on the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and on the national registry.[3]

8. During the review, Finland provided the ERT with additional information. The documents concerned are not part of the annual submission but are in many cases referenced in the NIR. The full list of materials used during the review is provided in annex I to this report.

Completeness of inventory

9. The inventory generally covers all mandatory[4] source and sink categories for the period 1990–2010 and is complete in terms of years and geographical coverage. The ERT noted that a number of mandatory and non-mandatory categories for the LULUCF sector have been reported as "not estimated" ("NE"), referring to the lack of data or the lack of available IPCC methods (see para. 86 below).

10. In addition, N_2O emissions from industrial, and domestic and commercial wastewater (without human sewage) have been reported as "NE" in the waste sector, referring to the lack of available IPCC methodologies for these categories.

11. The ERT recommends that Finland estimate mandatory pools and related emissions and removals in its next annual submission. Furthermore, the ERT encourages Finland to

[3] The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5(a), and 6(c) and (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.

[4] Mandatory source and sink categories under the Kyoto Protocol are all source and sink categories for which the Intergovernmental Panel on Climate Change (IPCC) *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) provide methodologies and/or emission factors to estimate GHG emissions.

further investigate possibilities to estimate the emissions from the non-mandatory categories 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

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

Inventory planning

13. During the in-country visit, Finland explained the national system for the preparation of the inventory. Statistics Finland was appointed as the single national entity with overall responsibility for Finland's GHG emissions inventory at the beginning of 2005. In addition to being responsible for the preparation of most parts of the inventory, Statistics Finland is also responsible for the Party's annual submission under the Convention and the Kyoto Protocol.

14. The Finnish national system is defined in a report published by Statistics Finland in 2005 and is supplemented by agreements (reporting protocols) with expert organizations that are part of the national system (see para. 15 below), as well as by cooperation between the responsible ministries. An advisory board, set up by Statistics Finland and including relevant ministries and contributing expert organizations, approves changes in the division of tasks between the expert organizations and oversees overall quality assurance.

15. The NIR and additional information submitted by Finland in response to questions raised by the ERT during the review also describe the national system for the preparation of the inventory. The expert organizations involved in the preparation of the inventory at the sectoral level are: the Finnish Environment Institute (SYKE), responsible for reporting on emissions from the waste sector and on fluorinated gases; MTT Agrifood Research Finland (MTT) and the Finnish Forest Research Institute (Metla), responsible for reporting on emissions from the agriculture and LULUCF sectors; and VTT Technical Research Centre of Finland, responsible for reporting on emissions from transport. Responsibility for the preparation of emissions from the energy and industrial processes sectors of the inventory resides with Statistics Finland.

16. All of the organizations involved in the preparation of the inventory are represented in an inventory working group, which was established to support the process of producing the annual inventory and fulfilling the Party's reporting requirements. The working group supports the collaboration and communication between the inventory unit and the experts in charge of the different inventory categories. Finland has also set up an advisory board, which functions as a higher-level forum for collaboration and communication with the parties involved in the national system.

17. The VAHTI compliance monitoring data (VAHTI) system is a tool for processing and monitoring environmental permits and contains information on how installations comply with environmental regulations. It holds information on the environmental permits of clients and on their waste generated, discharges into water and emissions to air. There are approximately 4,000 industrial installations that have already submitted electronic reports to VAHTI, which is an important resource used by administrative bodies in Finland for environmental management.

18. During the review week, Finland supplied copies of the agreements referred to in paragraph 14 above (reporting protocols) to the ERT. The national system demonstrated its

functionality during the review and Finland responded to all requests for further information during the review in a very cooperative, comprehensive and timely manner.

19. During the review, Finland explained that, until 2009, the former Civil Aviation Administration (Finavia) was responsible for providing Statistics Finland with estimates of GHG emissions from aviation. However, since 2010 the final responsibility for the calculation of estimates of emissions from aviation has rested with Statistics Finland. The aim is to obtain aviation data and emission estimates from EUROCONTROL (European Organisation for the Safety of Air Navigation) once its new data portal project has become operational. For the Party's 2012 annual submission, Statistics Finland calculated the GHG emission estimates for aviation on the basis of data provided by Finavia, which is still contributing activity data (AD) and advice during the transition period. Those data were supplemented by data from the Finnish Transport Safety Agency, the competent authority for the national implementation of the European Union emissions trading system (EU ETS) for aviation in Finland.

20. The ERT recommends that Finland report in its next annual submission on the progress made in operationalizing the upcoming data portal (see para. 19 above) and provide a date for when Finland expects to be able to use the EUROCONTROL data in its inventory. The ERT also recommends that Finland report in its next annual submission on the institutional responsibilities presently in place at all stages of the process of the calculation of the emissions from aviation.

Inventory preparation

Key categories

21. Finland has reported tier 1 and tier 2 key category analyses, both level and trend assessment, as part of its 2012 annual submission. The more detailed tier 1 key category analysis performed by Finland and that performed by the secretariat[5] produced different results, owing to the different levels of aggregation used. Finland has included the LULUCF sector in its key category analysis, which was performed in accordance with the IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF).

22. In response to a recommendation made in the 2011 annual review report,[6] the NIR of the Party's 2012 annual submission includes the detailed results of the key category analyses in an annex and a confirmation that the analyses are used to prioritize the development and improvement of the inventory.

23. Finland has identified key categories for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol for 2008–2010.

[5] 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 LULUCF. 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.

[6] FCCC/ARR/2011/FIN, paragraph 15.

Uncertainties

24. In response to a recommendation made in the previous review report, Finland has reported improved tier 1 and tier 2 uncertainty analyses, both at the summary level and at the individual category level, in its 2012 annual submission. Category-specific descriptions of the analyses have been provided in the sectoral chapters of the NIR. The ERT noted that the total level uncertainty (excluding LULUCF) for 2010 was 5 per cent and the total trend uncertainty (excluding LULUCF) was 6 per cent. The ERT further noted that the total level uncertainty (including LULUCF) for 2010 is 24 per cent, which is considerably lower than the value for 2009 reported in the previous annual submission (59 per cent). The estimate of the overall trend uncertainty (including LULUCF) for 2010 is 32 per cent, which is also lower than that reported for 2009 in the previous annual submission (39 per cent). Finland explained during the review that the changes are due to the use of revised parameters to calculate the LULUCF uncertainty estimate, in particular for the subcategories land converted to settlements and land converted to forest land. However, Finland has provided few details in its 2012 annual submission on the specific parameter modifications, which makes it difficult to understand why the total level uncertainty dropped from 59 per cent to 24 per cent from 2009 to 2010. The ERT recommends that Finland document in more detail the revisions to the uncertainty parameters and methodology used for the LULUCF sector in its next annual submission.

25. The ERT noted that Finland applied the formula provided in the IPCC good practice guidance (chapter 6, page 6.12, equation 6.3) for the calculation of the overall inventory uncertainty. However, the denominator in that formula sums emissions and removals before determining the absolute value, which is incorrect. As a result, the overall uncertainty associated with the Party's total inventory emissions including LULUCF is not correctly calculated. The ERT recommends that Finland use, for its next annual submission, the correct formula for combining uncertainty estimates in the calculation of the overall uncertainty of the total inventory emissions including LULUCF by taking the absolute value of each emissions and removals term in the denominator before adding them up. In response to the draft review report Finland informed the ERT that the uncertainty analysis had been revised to use the correct formula.

Recalculations and time-series consistency

26. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. The ERT noted that recalculations reported by Finland of the time series 1990–2009 have been undertaken to take into account the continuous improvements and the correction of errors in estimations. The recalculations led to no major changes, their total effect being a 0.3 per cent decrease in the estimate of total GHG emissions (without LULUCF) for 2009 and a decrease in the corresponding estimate for 1990 of below 0.00 per cent. The rationale for the recalculations is provided in the NIR and in CRF table 8(b).

Verification and quality assurance/quality control approaches

27. Statistics Finland has overall responsibility for the Party's quality assurance/quality control (QA/QC) procedures. The other institutions involved in the QA/QC procedures are represented in the inventory working group, which meets three to seven times a year and takes part, once a year, in the bilateral quality meetings between the inventory unit and the expert organizations, where issues concerning the quality of the inventory and the need for improvements are discussed.

28. The NIR presents an extensive description of the Party's quality objectives and the QA/QC plan and how it is implemented. The category-specific QA/QC procedures are discussed in the sectoral chapters of the NIR, with a focus on QC rather than QA.

Information on QA is included in the general chapter on QA/QC in the NIR, but there is little or no information on category-specific QA or verification in the category-specific chapters of the NIR. The ERT encourages Finland to include category-specific information on QA in each sector-specific QA/QC section of the NIR, in order to increase transparency and improve the overall understanding of the whole QA/QC process by sector, in its next annual submission.

29. Statistics Finland compiles an inventory improvement plan annually, from which a summary list of category-specific improvements to Finland's national inventory is drawn and included in chapter 10 of the NIR. The full inventory improvement plan is discussed by the advisory board set up by Statistics Finland before starting the next cycle of inventory preparation. The category-specific planned improvements summarized in chapter 10 of the NIR include a time frame for their implementation. Furthermore, additional category-specific improvements are mentioned in the sectoral chapters of the NIR, but the ERT noted that some of them lack timelines for their implementation. Although the ERT greatly appreciates the additional information, its relationship with the list of planned improvements in chapter 10 of the NIR is unclear. The ERT recommends that Finland explain, in its next annual submission, the relationship between the list of planned improvements given in chapter 10 and each of the category-specific planned improvements provided in the respective sectoral chapters of the NIR. Moreover, the ERT encourages Finland to provide an indicative time frame for the implementation of the sector-specific improvements.

Transparency

30. The ERT considers the information provided in the NIR and CRF tables of Finland's 2012 annual submission to be transparent. The NIR includes information on key categories, methods, data sources and uncertainty estimates, as well as a description of the QA/QC procedures and verification activities used in the preparation of the inventory. The sectoral chapters of the NIR include information on methodological issues, AD and emission factors (EFs), together with information on category-specific uncertainty assessments, category-specific QA/QC procedures and verification activities, recalculations and planned improvements. The information provided in the CRF tables and in the NIR is consistent.

31. In spite of the overall high transparency of Finland's 2012 annual submission, the ERT noted some transparency issues in the sector-specific chapters of the NIR: in the chapter on the energy sector, concerning the aggregated reporting of AD (see para. 40 below); in the chapter on the LULUCF sector, concerning the reporting on the identification of areas of land use and land-use change (see para. 85 below); and, in the chapter on the waste sector, concerning the reporting on hospital waste disposal (see para. 103 below). The ERT encourages Finland to address these issues and to continue to improve the transparency of the information provided in the sectoral chapters of the NIR for its next annual submission.

Inventory management

32. Finland has a centralized archiving system, which is linked to the archiving systems of the expert organizations responsible for the sectoral emission calculations. The centralized archiving system at Statistics Finland includes the archiving of disaggregated EFs and AD and documentation on how they 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 planned inventory improvements. During the review, Statistics Finland was able to quickly retrieve the archived information requested by the ERT.

3. Follow-up to previous reviews

33. In its 2012 annual submission, Finland has made improvements in comparison with its 2011 annual submission by implementing many of the recommendations made in previous review reports. Finland has continued to improve the transparency of the NIR and included more information on internal audits and on the implementation of its commitments under Article 3, paragraph 14, of the Kyoto Protocol. Information on the implementation of recommendations made in the 2011 review report has been included in the improvement section of chapter 10 of the NIR. The ERT commends Finland for this transparent approach.

4. Areas for further improvement identified by the expert review team

34. During the review, the ERT identified some areas for improvement. These are listed in table 6 below. The ERT notes that the draft review report was significantly delayed and that Finland therefore did not have time to implement all recommendations in the 2013 annual submission.

35. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report and in table 6 below.

B. Energy

1. Sector overview

36. The energy sector is the main sector in the GHG inventory of Finland. In 2010, emissions from the energy sector amounted to 60,649.16 Gg CO_2 eq, or 81.3 per cent of total GHG emissions. Since 1990, emissions have increased by 11.3 per cent. Owing to the structure of the Nordic electricity market, the level of emissions from public electricity and heat production in Finland fluctuates significantly, mainly as a consequence of the fluctuations in hydropower production in Sweden and Norway. The key driver for the rise in emissions from the energy sector is the increase in emissions from energy industries, which is due to the increased fuel consumption for public electricity and heat production, caused by less hydropower production in Scandinavia in 2010. The emission increase has been significant for all major fuel groups (i.e. solid fuels (mainly coal), gaseous fuels (natural gas) and other fuels (mainly peat)). Within the energy sector, 50.4 per cent of the emissions were from energy industries, followed by 22.4 per cent from transport, 16.3 per cent from manufacturing industries and construction and 8.4 per cent from other sectors. The category other (energy) accounted for 2.2 per cent of the total sectoral emissions and oil and natural gas for the remaining 0.3 per cent.

37. Finland has made recalculations for all years for the energy sector between its 2011 and 2012 annual submissions in response to the 2011 review report, following the update of AD and EFs and in order to rectify identified errors (e.g. the inclusion of biogas plants that had been omitted from the previous inventory). The largest recalculation stems from the methodological updates made to the space heating model applied to estimate emissions from other sectors, while the overall impact of the recalculations made in relation to the rest of the energy sector is small. The impact of the recalculations on the energy sector is a decrease in the estimate of emissions for 2009 of 0.6 per cent and an increase in the estimate of emissions for 1990 of 0.02 per cent. The main recalculations for 2009 took place in the following categories:

(a) Energy industries (decrease in the emission estimate by 199.22 Gg CO_2 eq or 0.8 per cent), owing to updated AD and EFs. The recalculations affected all gases, with the largest impact observed on the estimates of CO_2;

(b) Other sectors (decrease in the emission estimate by 375.89 Gg CO_2 eq or 7.3 per cent), owing to an updated methodology, AD and EFs. The recalculations affected all gases, with the largest impact observed on the estimates of CO_2;

(c) Other (increase in the emission estimate by 174.14 Gg CO_2 eq or 15.4 per cent), owing to an updated methodology, AD and EFs and the correction of errors. The recalculations affected all gases, with the largest impact observed on the estimates of CO_2.

38. The ERT noted that Finland has reported in a very transparent manner on the follow-up to previous review reports in chapter 10 of the NIR. In its 2012 annual submission, Finland has addressed all recommendations and also several encouragements made in the 2011 review report in relation to the energy sector (e.g. by providing more detailed information on the energy balance in the NIR). The ERT commends Finland for its transparent reporting on the actions taken in response to previous recommendations and for the fast and comprehensive implementation of the recommendations.

39. Finland's reporting on the energy sector is generally transparent regarding methodological descriptions, AD and EFs. However, one area for further improvement was identified by the ERT (see para. 40 below).

40. During the review, the ERT noted that the AD in the energy sector presented in the NIR are aggregated both in terms of categories and fuels (e.g. there is no further breakdown of energy industries and significant fuel consumption has been reported in the NIR under other liquid fuels, other solid fuels, etc.) This makes it difficult to interpret the fluctuations in the time series of implied emission factors (IEFs) and consequently causes the same questions to arise regularly during reviews. In response to questions raised by the present ERT during the review, Finland explained that, owing to issues of confidentiality, it is not possible to provide fully disaggregated information on single fuels and subcategories. While the ERT acknowledges the issue of confidentiality, it believes that more information could be provided without compromising the protection of confidential data. Finland agreed during the review to explore the possibility of reporting more disaggregated AD for the energy sector in the NIR of its future annual submissions. The ERT recommends that Finland improve the transparency of its next annual submission by including more disaggregated information in the NIR on the AD used for the energy sector, either by further disaggregating the AD by subcategory and/or by using a more disaggregated fuel list. If data are still presented in an aggregated manner, then the ERT recommends that qualitative information be provided on which fuels are included.

41. The QC for the energy sector is carried out in accordance with the overall QC plan for the inventory. The QC activities are well documented in the NIR and include both general tier 1 checks and category-specific checks. There is little information in the NIR on sector-specific QA activities carried out by experts not involved in the preparation of the inventory. In the past, Finland has had projects with Sweden and Germany, reviewing each other's inventories. The ERT considers that, because many aspects of the energy sector are specific to Finland, it would bring added value if experts with in-depth knowledge of Finland's national circumstances could perform QA for the energy sector or parts thereof. The ERT acknowledges that it can be difficult to find qualified national experts not already involved directly or indirectly in the preparation of the inventory. However, the ERT encourages Finland to explore the possibility of having a review of the energy sector inventory, or parts thereof, performed by an expert with in-depth knowledge of Finland's energy sector; for example, reviewers could be invited from universities, research institutions, companies, industrial associations, etc.

42. Finland performed both tier 1 and tier 2 uncertainty analyses. The input parameters used for the uncertainty estimation are clearly documented in the NIR.

43. The ERT noted that Finland has listed a number of planned sectoral improvements in its NIR both in the energy sector chapter and in chapter 10. The improvements include, for example, the improvement of the models used to calculate emissions from leisure boats and from space heating in other sectors. The ERT commends Finland for identifying planned improvements in a very transparent manner. The ERT noted that a few of the planned improvements listed in the energy sector chapter are not included in the list of planned improvements in chapter 10 of the NIR (e.g. the improvement of the mileage data for road transportation using vehicle inspection data and adjusting for the share of biofuel when calculating indirect CO_2 emissions). The ERT encourages Finland to describe in the NIR of its next annual submission what the implications are of the planned improvements included in the energy sector chapter that are not reported in chapter 10 of the NIR.

2. Reference and sectoral approaches

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

44. Finland estimated CO_2 emissions from fossil fuel combustion using the reference approach and the sectoral approach for all years of the time series. For 2010, the CO_2 emissions estimated using the sectoral approach were 0.3 per cent lower than those estimated using the reference approach. The estimates for the early years of the time series exhibit the largest differences, especially those for 1992 and 1993 (difference of –8.4 per cent and –6.4 per cent, respectively). The ERT noted and agrees with the explanations provided by Finland in the NIR in response to recommendations made in previous review reports. It also agrees that dedicating significant resources to exploring the reason for and trying to reduce the difference between the estimates for 1992 and 1993 calculated using the two approaches should not be prioritized over more important planned improvements. When compared, the International Energy Agency data and the data reported by Finland are largely consistent.

International bunker fuels

45. Finland estimated emissions from international bunker fuels on the basis of fuel sales using country-specific CO_2 EFs and CH_4 and N_2O EFs from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines). As noted in previous review reports, including the initial review report under the Kyoto Protocol, the definition used by Finland for splitting domestic and international navigation is in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. The ERT noted that in the 2011 annual review report an issue was identified relating to a possible double counting of the emissions associated with navigation to the Finnish island of Åland. In response to the related recommendation made in the previous review report, Finland investigated the issue and made a recalculation, which led to a change of less than 0.1 per cent in 2009 and resolved the double counting. The ERT commends Finland for this improvement.

46. The ERT noted that in the previous review report it was identified that Finland had not split lubricant use between domestic and international navigation. In response to the related recommendation made in the previous review report, Finland estimated the split in lubricant use between domestic and international navigation. The assumptions and methodology used for splitting the use of lubricants between domestic and international navigation are now clearly described in the NIR. The ERT commends Finland for implementing this recommendation.

Feedstocks and non-energy use of fuels

47. Finland has reported information on the non-energy use of fuels in the subcategory feedstocks and non-energy use of fuels (CRF table 1.A(d)). However, the additional information part of the CRF table is not complete. For example, the table provides references to the relevant category under the industrial processes sector in which the associated CO_2 emissions have been reported only for coke and residual fuel oil. For other fuels with a large non-energy consumption, for example naphtha, natural gas, liquefied petroleum gas and other petroleum products, no additional information has been provided in CRF table 1.A(d) on the categories in which the associated CO_2 emissions have been reported. The ERT encourages Finland to complete the additional information part of CRF table 1.A(d) on feedstocks and non-energy use of fuels in its next annual submission.

48. The ERT noted that for lubricants and coke the fraction of carbon stored has been reported as 0.33 and 0.46, respectively, with the indication that the remaining carbon has been included in the reporting on fuel combustion. However, it was not completely clear from the CRF and NIR how the emissions were handled. In response Finland provided detailed information on the assumptions and allocation of emissions related to the use of lubricants. The ERT recommends that Finland include this information in its next annual submission.

Country-specific issues

49. Finland has reported negative CO_2 emissions (197.46 Gg) in the subcategory transferred CO_2 (other, manufacturing industries and construction). In its NIR, Finland has explained that these emissions consist of CO_2 from energy production, which is captured in the production of precipitated calcium carbonate (PCC). PCC is widely used in different kinds of paper and paperboard production as a filling or coating material and the CO_2 is considered to be stored over the long term, which is the main criterion used for the inclusion of this CO_2 capture and storage in the inventory.

50. In response to recommendations made in previous review reports, Finland has greatly expanded the information on this country-specific issue provided in its NIR. The ERT finds that the reporting on this country-specific issue is now fully transparent and commends Finland for this improvement in transparency.

51. In connection with the matter of CO_2 capture from PCC production, the ERT specifically considered two issues: (a) the Party's assumption that PCC can be considered to store CO_2 over the long term; and (b) the allocation of the CO_2 captured. Finland has provided in the NIR documentation on the assumption of long-term CO_2 storage for the paper when landfilled or used for landscaping, and it accounts for the CO_2 as fossil for the part of the paper that is incinerated. On the basis of the documentation provided by Finland, the ERT agrees with the assumption of long-term storage of CO_2 captured in PCC. The Revised 1996 IPCC Guidelines and the IPCC good practice guidance do not contain any guidance on how to report CO_2 capture and storage. The avoided emissions would have been reported under the energy sector in the category manufacturing industries and construction and in general the principle is that emissions and recovery should be reported under the category where they occurred. On that basis, the ERT concludes that the allocation made by Finland is appropriate.

3. Key categories

Stationary combustion: solid, liquid, gaseous and other fuels – CO_2

52. The ERT noted that most of the country-specific CO_2 EFs used by Finland in its estimations for this category are constant throughout the time series, with the exception of fuels for which plant-specific data are available (e.g. coal, petroleum coke and refinery

gas). The majority of the country-specific CO_2 EFs were derived from studies conducted around 2005. No procedure is in place to periodically check whether those EFs are still applicable, with the exception of those for fuels for which there is a broad coverage of plant-specific data, as is the case for peat. For example, the Finnish oil company Neste is the source of many of the EFs for liquid fuels used in the inventory, but it has not been approached to review the validity of the EFs in recent years.

53. The ERT recommends that Finland establish a system that ensures that all country-specific CO_2 EFs are periodically reviewed, as part of the continuous improvement of the inventory, for its next annual submission. The ERT noted that priority should be given to the EFs for the fossil fuels that contribute the most to the CO_2 emissions (e.g. major liquid fuels). Furthermore, the ERT noted that, if CO_2 EFs are not published, the use of expert judgement should be documented, for example by using the procedures outlined in the IPCC good practice guidance.

54. The ERT noted that, for its 2012 annual submission, Finland has started to use plant-specific data on carbon contents, calorific values, etc. as a basis for the estimation of the CO_2 EF for coal used in public electricity and heat production. That CO_2 EF (94.00 t/TJ for 2008, 93.70 t/TJ for 2009 and 93.30 t/TJ for 2010), derived from plant-specific data covering all plants is somewhat lower than the country-specific EF used for the period 1990–2007 (94.60 t/TJ). Given the detailed data provided by the plants in accordance with the monitoring guidelines under the EU ETS, the ERT considers the plant-specific CO_2 EFs to be accurate and to have been prepared in accordance with the IPCC good practice guidance. However, the rapid decrease in the CO_2 EF could indicate that the emissions for 1990–2007 have been overestimated. The time-series consistency should be further investigated, for example by looking at whether there have been changes in the country of origin of the coal or if changes in the net calorific value of coal could explain the decrease in the CO_2 EF. Therefore, the ERT encourages Finland to continue to monitor and assess the time-series consistency of the CO_2 EF for coal and to report on the results in its next annual submission.

55. During the review, the ERT identified that the CO_2 IEF for gaseous fuels used in public electricity and heat production is slightly higher for 2000 and 2001 (54.81 t/TJ and 54.83 t/TJ, respectively) than for the rest of the time series (54.76 t/TJ). In response to a question raised by the ERT during the review, Finland explained that this resulted from the inclusion of emissions from gasified fossil waste with emissions from gaseous fuels. Finland informed the ERT that it is considering reallocating the emissions from gasified fossil waste to the subcategory other fuels, an improvement with which the ERT agrees. Therefore, the ERT recommends that Finland reallocate the reporting of emissions from gasified fossil waste to the subcategory other fuels in its next annual submission.

56. During the review, the ERT identified that the CO_2 IEF value for liquid fuels used in petroleum refining decreased significantly (by 8.1 per cent) between 2004 (74.14 t/TJ) and 2005 (68.16 t/TJ). As a result, the value of the CO_2 IEF for liquid fuels used in energy industries as a whole decreased by 5.4 per cent. For 2005 onward plant-specific data were used to calculate the CO_2 EF. For 1990–2004 information received from the plants in the late 1990s was used to calculate a CO_2 EF that was kept constant for that period. The ERT considers the plant-specific data to be accurate and to have been prepared in accordance with the IPCC good practice guidance. However, the large drop in the CO_2 IEF from 2004 to 2005 is not realistic and could infer an overestimation of emissions for the earlier part of the time series, including for 1990. The ERT noted that this is not a matter of urgency; however, it recommends that Finland include the improvement or revision of the time-series consistency of the CO_2 EF for liquid fuels used in petroleum refining in the inventory improvement plan and report on any relevant progress in its next annual submission.

4. Non-key categories

Civil aviation: liquid fuels – CO_2, CH_4 and N_2O

57. The ERT noted that in its 2011 annual submission Finland reported that it planned to start using AD available from the EUROCONTROL data portal for estimating emissions for this category for its 2012 annual submission onward (see paras. 19 and 20 above). However, in its 2012 annual submission Finland has indicated that the improvement was postponed, owing to the fact that EUROCONTROL did not provide the requested data. The ERT noted that the improvement is dependent upon when EUROCONTROL will provide access to the required data; nevertheless, it encourages Finland to continue reporting on the progress in the implementation of this planned improvement in its next annual submission.

C. Industrial processes and solvent and other product use

1. Sector overview

58. In 2010, emissions from the industrial processes sector amounted to 5,765.86 Gg CO_2 eq, or 7.7 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 73.43 Gg CO_2 eq, or 0.1 per cent of total GHG emissions. Since the base year, emissions have increased by 13.0 per cent in the industrial processes sector and decreased by 58.8 per cent in the solvent and other product use sector. The main contributors to the rise in emissions in the industrial processes sector are CO_2 emissions from phosphoric acid production, CO_2 emissions from a new hydrogen plant and CO_2 emissions from new users of limestone and dolomite. Within the industrial processes sector, 41.9 per cent of the emissions were from metal production, followed by 20.9 per cent from mineral products, 20.7 per cent from consumption of halocarbons and SF_6 and 16.4 per cent from chemical industry.

59. Finland has made recalculations for the industrial processes sector between its 2011 and 2012 annual submissions following changes in AD and EFs. The impact of these recalculations on the industrial processes sector is a decrease in the estimate of emissions for 2009 of 84.87 Gg CO_2 eq or 1.6 per cent. The main recalculations for 2009 took place in the following categories:

(a) Mineral products (increase in the emission estimate by 38.29 Gg CO_2 eq or 4.3 per cent);

(b) Chemical industry (increase in the emission estimate by 42.9 Gg CO_2 eq or 2.9 per cent).

60. Finland has made recalculations for the solvent and other product use sector between its 2011 and 2012 annual submissions following changes in the data on non-methane volatile organic compound (NMVOC) emissions in the VAHTI system and changes due to the use of updated statistics as AD in the calculation of NMVOC emissions from the use of fat and the extraction of edible and non-edible oil. The impact of these recalculations on the solvent and other product use sector is an increase in the estimate of emissions for 2009 of 2.5 per cent. The main recalculations took place in the preservation of wood[7] and paint application subcategories.

61. Finland's inventory for the industrial processes and solvent and other product use sectors is complete, including emission estimates for all relevant categories, gases and years, and is also complete in terms of geographical coverage. The reporting is transparent regarding the sources of data and EFs and the methods and assumptions used for the entire

[7] Reported under other (solvent and other product use).

time series. Finland has provided a full explanation of the uncertainty estimates and QA/QC procedures for all categories, including the verification of emission estimates by comparing them with emission estimates reported under the EU ETS. Finland is planning to improve its calculations for fertilizer production, for refrigeration and air conditioning and for SF_6 from electrical equipment. In addition, an internet-based electronic data collection system with electronic questionnaires will be established to improve the QA/QC for the paint application and other (solvent and other product use) subcategories.

62. The ERT noted that Finland has implemented all of the recommendations related to the industrial processes and solvent and product use sectors made in the 2011 annual review report.

2. Key categories

Nitric acid production – N_2O

63. The ERT noted that the estimate of N_2O emissions from nitric acid production for 2010 (166.58 Gg CO_2 eq) shows a decrease of 79.0 per cent when compared with that for 2009 (792.99 Gg CO_2 eq), owing to the installation of a new abatement technology (pelleted catalysts) in the three existing nitric acid production plants. In the NIR of its 2012 annual submission, Finland has reported that the new pelleted catalysts were installed directly underneath the existing ammonia (NH_3) oxidation catalysts. In addition, the NIR includes detailed information on the EFs as well as the methodology used for estimating the N_2O emissions, which are expected to decrease by about 90 per cent owing to the new abatement technology. The ERT noted that, as part of its planned improvements, Finland intends to identify and report separately the N_2O emissions from fertilizer production, which are currently reported within the total emissions for this category for confidentiality reasons. The ERT commends Finland for this planned improvement.

Other (industrial processes) – CO_2

64. In this category, Finland has reported emissions from hydrogen production, for which stoichiometric EFs for the different feedstocks were used since no default method or EFs for hydrogen production are available in the Revised 1996 IPCC Guidelines. The ERT noted that Finland applied a correction factor (0.94) to the EFs when off-gases were used only for preheating the processes involved in hydrogen production. If off-gases are recycled and combusted, no correction factor is used, and the carbon content of the off-gases is not reported as emissions from the energy sector if it is already accounted for in the emissions from hydrogen production (to avoid the double counting of emissions). The correction factor is based on the information reported by one producer of hydrogen and is based on the percentage of feedstock that is actually converted to hydrogen and CO_2. In the NIR of its 2012 annual submission, Finland has indicated that the CO_2 emissions from hydrogen production were calculated using the composition of the off-gas to determine the EF. The ERT considers the approach taken by Finland to be appropriate. However, in response to questions raised by the ERT during the review, Finland informed the ERT that for one hydrogen producer it is not known whether all of the off-gases are recycled and combusted during the technological process. The ERT recommends that Finland confirm the AD, EFs and correction factor used with that hydrogen producer, review and update the corresponding emission estimates where necessary and include relevant information thereon in its next annual submission.

3. Non-key categories

Lime production – CO_2

65. Following the recommendation made in the previous review report, all AD prior to 2005 for this category were recalculated. The ERT noted that it has been reported in the NIR that the AD for 2005 onward were received from the Energy Market Authority, which grants emission permits to companies for the EU ETS and supervises the monitoring and reporting of emissions and production data. The data received were compared with the data from industrial statistics and the VAHTI system. On the basis of the finding that only 94 per cent of the lime consisted of pure calcium oxide and magnesium oxide (i.e. 6 per cent impurities), the AD for activities that took place before the implementation of the EU ETS in 2005 were multiplied by 0.94. Overall, the estimates of CO_2 emissions from lime production for the period 1990–2004 were unchanged (the EFs were also recalculated after the exclusion of the impurities in the produced lime for the whole time series). The ERT commends Finland for these improvements.

Limestone and dolomite use – CO_2

66. Following the recommendation made in the previous review report, Finland has provided in the NIR more information to verify the assumptions made in establishing the correction factors for the carbonate content of limestone and dolomite. The calculated CO_2 emission data for 19 plants (out of 26) were verified using EU ETS data and the emission estimates were found to be almost equal. In some cases the EU ETS emission data were higher, because EU ETS companies calculate CO_2 emissions using default IPCC EFs, while for the Finnish inventory the country-specific EFs used are based on the finding that not all limestone and dolomite are calcinated in the various processes where they are used. In addition, the EF for power plants using calcium carbonate for flue gas desulphurization was corrected for the period 1999–2001 and, as a result, the estimates of the resulting CO_2 emissions increased slightly. Furthermore, the estimate of CO_2 emissions from limestone and dolomite use for 2009 (114.33 Gg CO_2 eq) in the 2011 annual submission was recalculated owing to the introduction of a new limestone-using plant that became operational in 2009. CO_2 emissions from 2009 increased by 17.80 Gg to 132.13 Gg CO_2 eq for 2009. The ERT commends Finland for these improvements.

Other (chemical industry) – CO_2

67. In the NIR of its 2012 annual submission, Finland has reported for the first time emissions from phosphoric acid production in the subcategory other (chemical industry). EFs and AD were received from the phosphoric acid producing company and are confidential. The EFs for apatite and calcite were defined as a yearly average of daily samples and the AD were determined by the amount of apatite and calcite used. In response to questions raised by the ERT during the review, Finland provided the ERT with the opportunity to examine the model used for the calculation of CO_2 emissions from phosphoric acid production. The ERT considers the approach taken by Finland for the estimation of CO_2 emissions from phosphoric acid production to be appropriate.

Electrical equipment – SF_6

68. In the NIR of its 2012 annual submission, Finland has provided additional information on the status of its effort to ensure the time-series consistency of the estimates of SF_6 emissions from electrical equipment, as recommended in the previous review report. Finland has reported that the recalculation of the estimates of SF_6 emissions from electrical equipment for 2009 (based on AD for a five-year period) improved the time-series consistency for the years 2003–2007 compared with the previous calculations, which used

one- and three-year periods of AD. Finland has also reported that the time-series consistency will be further examined, since consistent results could not be obtained when using the tier 2 estimation method for the period 1990–2002 and the tier 3c estimation method for the period 2003–2010. Owing to staff changes that prevented a full cycle of QC procedures, the updated time series of emission estimates for 1990–2010 has not been reported in the NIR of the Party's 2012 annual submission. Finland anticipates that the planned improvements will be implemented for its 2013 annual submission. The ERT recommends that Finland achieve concrete results from its effort to ensure the time-series consistency of the estimates of SF_6 emissions from electrical equipment and report thereon in its next annual submission. In response to the draft review report, Finland informed the ERT that the time series has been updated in the 2013 annual submission.

D. Agriculture

1. Sector overview

69. In 2010, emissions from the agriculture sector amounted to 5,881.53 Gg CO_2 eq, or 7.9 per cent of total GHG emissions. Since 1990, emissions have decreased by 11.1 per cent. The key drivers for the fall in emissions are: the reduction in the total livestock population; the reduced use of nitrogen (N) fertilizers; and improved manure management resulting from the measures taken by farmers as part of an agri-environmental programme (started in 1995) aiming to minimize nutrient loading to water. Within the sector, 60.3 per cent of the emissions were from agricultural soils, followed by 27.3 per cent from enteric fermentation, 12.4 per cent from manure management and 0.01 per cent from field burning of agricultural residues.

70. Finland has made recalculations for the agriculture sector between its 2011 and 2012 annual submissions following changes in AD (i.e. the updated number of fur animals for 2008 and 2009 and the updated area of cultivated organic soils for the period 1990–2009) and in order to rectify identified errors (i.e. the inconsistency between the animal numbers and the amount of N applied to soils for the period 1990–2009). The impact of these recalculations on the agriculture sector is a decrease in the estimate of emissions for 2009 of 5.91 Gg CO_2 eq or 0.1 per cent and a decrease in the estimate for 1990 of 40.48 Gg CO_2 eq or 0.6 per cent. The main recalculations for 2009 took place in the following categories:

(a) Enteric fermentation (increase in the emission estimate by 1.56 Gg CO_2 eq or 0.1 per cent), owing to the updated number of fur animals;

(b) Manure management (increase in the emission estimate by 20.98 Gg CO_2 eq or 3.0 per cent), owing to the updated number of fur animals;

(c) Agricultural soils (decrease in the emission estimate by 28.46 Gg CO_2 eq or 0.8 per cent), owing to the update of the area of cultivated organic soils and the correction of the inconsistency between the animal numbers and the amount of N applied to soils.

71. The ERT noted that combined uncertainties for each subcategory have been presented in the agriculture sector chapter of and in annex 6 to the NIR. Finland estimated uncertainties using country-specific values for key categories (enteric fermentation for cattle, N_2O emissions from manure management, and agriculture soils); IPCC default values (enteric fermentation for species other than cattle); and other countries' values (CH_4 emissions from manure management for all species). The ERT also noted that, in annex 6 to the NIR, the EF uncertainties for 2010 for all subcategories except field burning of agricultural residues have been reported as zero. In response to questions raised by the ERT during the review, Finland explained that only the combined emission uncertainties for the agriculture sector reported in annex 6 are valid and that the EF uncertainties reported as zero should not be considered. The ERT recommends that Finland correct the presentation

of the uncertainties in annex 6 to the NIR in its next annual submission, either by explaining that the reported uncertainties for the agriculture sector are the combined ones or by disaggregating them into AD and EF uncertainties.

72. In relation to the QA/QC procedures applied for the agriculture sector, the NIR includes a brief description of the QC (tier 1) and verification procedures specific to the sector but no specific information on QA procedures. In response to questions raised by the ERT during the review, Finland explained that the QA procedures for the sector are performed by inventory staff from Statistics Finland not directly involved in the estimation of emissions from the agriculture sector. In addition, Finland indicated that it might revise the agriculture category-specific sections of the NIR to better explain the QA procedures applied. The ERT recommends that Finland, in its next annual submission, include more information on the specific QA procedures undertaken for the agriculture sector, and it also encourages the Party to explore the possibility of developing a new peer review system for the agriculture sector using reviewers not involved in the preparation of the inventory, who could come from universities or other research organizations, companies, agricultural associations, etc.

2. Key categories

Enteric fermentation – CH_4

73. For the cattle subcategory, Finland used a tier 2 approach for estimating CH_4 emissions from enteric fermentation, in line with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance, with country-specific EFs (divided into the subcategories dairy cows, suckler cows, bulls, heifers and calves) based on national data for the following parameters: weight, weight gain, milk production, milk fat, pasturing and digestible energy. These EFs are transparently described in the NIR. For other animal subcategories, a tier 1 approach and IPCC default EFs were used, with the exception of sheep and reindeer, for which a tier 2 approach was used. In the case of fur animals, Finland used an EF taken from Norway's inventory (0.1 kg/animal/year). With regard to the development of a country-specific EF for fur animals, Finland has indicated in its NIR that there are no plans to do so in the near future, owing to the small contribution of CH_4 emissions from fur animals to the total emissions from the agriculture sector (0.1 per cent in 2010).

74. Responding to an encouragement in the previous review report for it to revise the EF for piglets, Finland has reiterated in its 2012 annual submission that although the EF for piglets is currently assumed to be the same as that used for other, much larger, pigs, this issue needs to be studied further and that the EF for piglets may be revised in the future. In response to questions raised by the ERT during the review, Finland indicated that the background data for the estimation of the EF for piglets had been collected and that the revised EF will be reported in the Party's 2013 or 2014 annual submission. The ERT welcomes Finland's efforts in this regard and encourages Finland to report on the progress made in its next annual submission.

Manure management – N_2O

75. During the review, Finland presented the model used for the calculation of ammonia (NH_3) and N_2O emissions from agriculture, including manure management. The model takes into consideration the percentage of farms that apply different emission abatement measures and their respective emission reductions for each animal waste management system (AWMS). The model is maintained and updated by SYKE and MTT. SYKE is responsible for the technical updates of the model, as well as for providing animal population data. MTT is responsible for estimating nitrogen excretion values. Otherwise, both institutes are involved in other areas of the estimation process (manure management

data and EFs). During the review, the ERT found an error in the N model in the sheets used for estimating the emission projections. However, this did not influence the final N_2O inventory emission estimates. Finland confirmed that this error was corrected. The ERT welcomes the use of the nitrogen model and recommends that Finland keep regular QC checks of the model to avoid any future error in the model.

76. In addition, in response to questions raised by the ERT during the review, Finland explained how the AWMS distribution was estimated and it recognized the need to regularly update the data on the manure management systems. However, Finland indicated the difficulties involved in producing regular updates compared with the potential benefits for the estimation of total emissions, and so there is no time frame defined as yet for this improvement. The ERT encourages Finland to continue to evaluate the possibility of updating the AWMS distribution and to report back on updates, if any, in its next annual submission.

77. Responding to an encouragement in the previous review report, Finland has improved the information in the NIR related to the manure management systems that separate the solid and urine portions of manure. Thanks to the new information, the reason why the N_2O IEF (0.015–0.016 kg N_2O-N/kg N) for the solid part of manure is lower than the IPCC default value (0.020 kg N_2O-N/kg N) is much more transparent. The ERT welcomes this improvement.

Direct soil emissions – N_2O

78. When discussing the NH_3 and N_2O emission estimation model during the review, Finland explained that, because the available methods of manure application and emission abatement vary in their efficiency in reducing emissions, it was assessed that placement fertilization reduces NH_3 volatilization by 50 per cent compared with the surface application of mineral fertilizers. Thus, the EFs for arable land were subject to a correction factor of 0.5, except for where nitrogen solutions are applied to soils, for which placement fertilization is not used. The ERT welcomes this explanation and considers the assumption used to be appropriate. It therefore recommends that the Party provide, in its next annual submission, this explanation of why the EFs for arable land were subject to a correction factor of 0.5.

79. In addition, Finland informed the ERT during the review that it has decided to no longer subtract the volatilization of NH_3 before estimating the emissions from pasture, range and paddock manure. Therefore, Finland plans to recalculate the entire time series for its next annual submission. Preliminary results show that the recalculations result in estimates of NH_3 emissions in the range of 7.8 to 8.2 Gg CO_2 eq for the years 2008–2010. The ERT agrees with such an approach and recommends that Finland report and explain the recalculations in its next annual submission.

80. Responding to an encouragement in the previous review report, Finland has improved the information provided on the changes in the annual N_2O IEF (for 1990 to 2009) for cultivated histosols. In response to questions raised by the ERT during the review, Finland explained that cultivated histosols are divided into grasses and annual crops, and that the proportion of grasses in the total area has decreased by 0.5 per cent annually (since 1990), while the proportion of annual crops in the total area has increased accordingly. The annual IEF has changed because the EF for grasses is lower than that for annual crops (with the EF for grasses being 4.0 kg N_2O-N/ha/year and the EF for annual crops being 11.7 kg N_2O-N/ha/year) and also a portion of the organic soils used for grass production has been converted to be used for crop production. Thanks to this new information, the reasons for the changes in the annual IEF are much more transparent. The ERT welcomes this improvement and recommends that Finland include the information explaining why the annual N_2O IEF has changed in its next annual submission.

3. Non-key categories

Field burning of agricultural residues – CH_4 and N_2O

81. Finland has reported in the NIR that field burning of crop residues has to be avoided in the country and that it is allowed only if it is necessary for successful sowing or to prevent weeds or pests. According to several agricultural experts, field burning of agricultural residues occurs only on a small scale in Finland and is becoming increasingly rare.

82. The estimate of total emissions from field burning of agricultural residues for 2010 was 0.59 Gg CO_2 eq (0.01 per cent of the emissions from the agriculture sector), calculated in accordance with the Revised 1996 IPCC Guidelines.

E. Land use, land-use change and forestry

1. Sector overview

83. In 2010, net removals from the LULUCF sector amounted to 22,081.70 Gg CO_2 eq, offsetting an equivalent amount (about 29.6 per cent) of the country's total emissions in the same year. Since 1990, net removals have increased by 40.5 per cent. The key driver for the rise in removals is the increase in the annual increment in the carbon stock in living biomass for forest land remaining forest land. The net removals trend shows a high level of fluctuation in the net biomass removals from forest land during the period 1990–2010, mainly caused by changes in the international market for forest products, which affected the amount of domestic commercial roundwood fellings. Finland has explained in the NIR that the annual variation in the total drain, including both annual harvest and natural losses of wood, is considerably large. Within the sector, forest land accounted for all of the removals, amounting to a net sink of 32,768.28 Gg CO_2 eq. All other categories were net sources of emissions, with the following contributions: 5,752.22 Gg CO_2 eq from cropland, 2,108.48 Gg CO_2 eq from wetlands, 1,759.31 Gg CO_2 eq from settlements and 656.31 Gg CO_2 eq from grassland. The remaining 410.26 Gg CO_2 eq were from harvested wood products (HWPs) in the category other (LULUCF).

84. Finland has made recalculations for the LULUCF sector for the categories forest land, cropland, grassland, wetlands, settlements and other (LULUCF) between its 2011 and 2012 annual submissions for all years of the time series. Recalculations were performed because new data on areas of land use and land-use change and on changes in biomass became available for the years 2009 and 2010 from the Party's 11th National Forest Inventory (NFI11).[8] Accordingly, in response to the recommendation made in the previous review report, annual areas of land-use change have been reported instead of average areas. In addition, several additional updates led to recalculations, including the area of peat extraction fields, which was recalculated using the same updated data from NFI11. All NFI10 plots measured in 2005–2008 were checked for land-use change; part of the plots were checked in more detail using remote sensing data. The Yasso07 soil carbon model was applied for estimating emissions from forest land remaining forest land, with the mean weather period changed from 1970–2009 to 1970–2010. The new biomass data for 2009 and 2010 implied changes in the interpolated values of the biomass increment for all years. The area data and EFs for land converted to cropland and grassland were updated and some of the emissions from liming were reallocated from cropland to grassland. The impact of these recalculations on the LULUCF sector is a decrease in the estimate of removals from

[8] The NFI is a sample-based forest inventory, which has been carried out since the 1920s, covers all land uses and includes data on land uses and land-use changes, in addition to data on tree biomass and dead wood.

the sector for 2009 of 4,466.68 Gg CO_2 eq, or 11.0 per cent, and an increase in the estimate for 1990 of 680.02 Gg CO_2 eq, or 4.5 per cent. The main recalculations for 2009 took place in the following categories:

(a) Forest land (increase in the removal estimate by 960.29 Gg CO_2 eq or 2.0 per cent), owing to updated AD on area and biomass stock from NFI11 and changes in the method used to estimate area, with the main impact being on the estimated CO_2 removals;

(b) Cropland (decrease in the emission estimate by 730.02 Gg CO_2 eq or 11.1 per cent), owing to updated AD on area, a corrected estimate for mineral soils and the reallocation of living biomass from forest land and liming to grassland with the main impact being on the estimated CO_2 emissions;

(c) Grassland (increase in the emission estimate by 176.85 Gg CO_2 eq or 35.5 per cent), owing to the update of the estimates of area and changes in the estimates for liming, with the main impact being on the estimated CO_2 emissions;

(d) Wetlands (increase in the emission estimate by 696.87 Gg CO_2 eq or 53.8 per cent), owing to changes in the estimated areas of peat extraction fields and other wetlands based on data from NFI11, with the main impact being on the estimated CO_2 emissions;

(e) Settlements (increase in the emission estimate by 1,810.32 Gg CO_2), because no separate emission estimates were provided in the Party's 2011 annual submission and all pools for settlements were reported as "NE". Only CO_2 emissions were reported in the 2012 annual submission;

(f) Other (LULUCF) (increase in the emission estimate by 3,472.94 Gg CO_2 eq or 203.1 per cent for HWPs), owing to updated data on the trade in forest products and consumption statistics from the Food and Agriculture Organization of the United Nations Statistical Databases (2011) and the Finnish Forest Research Institute. The recalculation only impacts CO_2 emissions.

85. The ERT noted that the identification of areas of land use and land-use change as presented in the NIR is not fully transparent and needs to be further clarified. From the information reported in the NIR of the Party's 2012 annual submission, it is not clear how the two databases (the NFI and the Official Land Survey of Finland (from 1 January 2009), which is published annually by the National Land Survey of Finland) were used in the estimation of areas of land use and land-use change. The rationale for using the moving average method to identify land-use changes and the areas thereof is not clear, despite the high quality of the NFI data and the other supplementary sources of information used by Finland (satellites images and aerial photos). The logic, steps and assumptions used in the application of the moving average method are also not very clear. For example, it is not clear why the year 2002 was chosen as a fixed point to estimate areas of land-use for other years. The presentation and the additional information received during the review in response to questions raised by the ERT provided more clarity on the rationale for and application of the methods used to identify areas of land-use for the whole time series (1990–2010). However, the issue still needs to be further clarified; therefore, the ERT recommends that Finland improve the transparency of its reporting on the identification of areas of land use and land-use change by providing clear descriptions of the rationale for using the moving average method, of the logic and the stepwise approach followed in the application of the method, and of the data used, including the use of NFI and Official Land Survey data, in its next annual submission.

86. Finland's reporting on the LULUCF sector is complete in terms of geographical coverage, gases and years. Emissions and removals from the LULUCF sector have been reported and documented in accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC

reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines). However, the ERT noted that a number of categories in the sector have been reported as "NE" as part of the information on the notation keys used in CRF table 9(a): grassland converted to cropland (the dead organic matter (DOM) pool and losses in living biomass), wetlands converted to cropland (the DOM and mineral soil pools and losses in living biomass) and all pools for settlements converted to cropland and other land converted to cropland; living biomass pool for grassland remaining grassland, cropland converted to grassland (the DOM pool and losses in living biomass), wetlands converted to grassland (the DOM pool and losses in living biomass) and all pools for settlements converted to grassland; grassland and settlements converted to wetlands (living biomass and soil pools); and forest land converted to settlements (soil pool and gains in living biomass) and cropland, grassland, wetlands and other land converted to settlements (living biomass pool). The reporting of all of these subcategories is mandatory; therefore, the ERT recommends that Finland report estimates for the mandatory pools currently reported as "NE" as soon as possible. In addition, the ERT encourages Finland, if possible, to make further efforts to report estimates for non-mandatory categories, such as the DOM pool for cropland remaining cropland and all pools for wetlands remaining wetlands and settlements remaining settlements.

87. The ERT commends Finland for its commitment to improving its reporting under the Convention. Finland has identified a number of future improvements in its 2012 NIR in relation to its reporting on the LULUCF sector relevant to the Convention reporting requirements and the ERT encourages Finland to implement such improvements as soon as possible and to continue to identify and implement further improvements.

2. Key categories

Forest land remaining forest land – CO_2

88. Finland has provided complete estimates for all pools in this category. It applied the tier 3 method from the IPCC good practice guidance for LULUCF using national data and parameters based on the NFI data (NFI7 to NFI11). The biomass increment was estimated using the biomass models (Repola and Marklund). Following a recommendation made in the previous review report, Finland provided the description of these two models in appendix 7c to the NIR. Finland has also provided a detailed description of how biomass losses were estimated using reliable national data (e.g. the Finnish Statistical Yearbook of Forestry 2010). To estimate emissions from soils, Finland used a method combining NFI data, biomass models, litter turnover rates and the Yasso07 soil carbon model, a description of which has been provided in the NIR. The Yasso07 soil carbon model gives aggregated estimates of litter, dead wood and soil organic matter (SOM), and this fact has been reflected in CRF table 5.A, where DOM has been reported as included elsewhere ("IE")". The methods and data used are in line with the IPCC good practice guidance for LULUCF.

89. The estimates of the area of forest land remaining forest land were updated on the basis of new data for 2009 and 2010 from NFI11. Finland classifies areas of forest land remaining forest land into mineral and organic soils and the latter is further divided into undrained and drained soils for five site types on the basis of the fertility of the soil. The ERT commends Finland for continuing to update the national data and parameters used in order to improve the estimates of CO_2 emissions from forest land remaining forest land.

Land converted to forest land – CO_2

90. The IPCC tier 2 level method from the IPCC good practice guidance for LULUCF (equation 3.2.25, page 3.53) was used to estimate carbon stock changes for this category. The mean annual increment in carbon stock per unit of area was estimated separately for

each type of land (e.g. cropland and grassland) converted to forest land. The mean increments were computed using data from NFI10 on sample plots located on each type of the land converted to forest land and the same mean increments were applied throughout the entire time series. The annual increment in carbon stock was then obtained by multiplying the mean increments by the area converted to forest land.

91. The losses in carbon stock in living biomass for all types of land converted to forest land were estimated as part of the estimation of changes in carbon stock in living biomass for the forest land remaining forest land category and have been reported under land converted to forest land using the notation key "IE" because the method used does not allow for separate reporting. The data and parameters used are in line with the IPCC good practice guidance for LULUCF; however, the method used to estimate losses in carbon stock is not sufficiently described in the NIR, especially the reason why it does not allow for the separate reporting of carbon stock losses for land converted to forest land. The ERT recommends Finland to provide a more detailed description of the method used for estimating and reporting losses in carbon stock in living biomass for all types of land converted to forest land in its next annual submission.

Cropland remaining cropland – CO_2

92. In 2010, cropland remaining cropland was a net source of emissions, including emissions from carbon stock changes in soils (both mineral and organic) and living biomass. The methods used for the estimation of carbon stock changes in pools for this category were IPCC tier 2 for living biomass and IPCC tier 1 for soils. National data from the Party's NFIs (NFI7 to NFI11), the Yearbook of Farm Statistics and other national sources were used for the estimations and in some cases expert judgement was used, for example for estimating cropland density, mature weight and dry matter. The data and parameters used for the reporting of this subcategory are in line with the IPCC good practice guidance for LULUCF.

93. The estimation of uncertainties for this category was based mainly on expert judgement (e.g. the uncertainty of the estimated emissions from mineral soils is about ±100 per cent). Finland informed the ERT, during the review, of its plans and ongoing work to improve the reporting of this subcategory, including the AD (e.g. using soil monitoring data) and the uncertainty estimates (see para. 87 above). The ERT welcomes Finland's ongoing work to improve the reporting of this subcategory, including improving the method for estimating uncertainty. The ERT encourages Finland to report on the progress made in updating its uncertainty analysis of the estimated CO_2 emissions from cropland remaining cropland in its next annual submission.

Land converted to cropland – CO_2

94. The estimated area of land converted to cropland was obtained from the Party's NFIs (NFI7 to NFI11), together with the use of the Finnish soil database, and divided into mineral and organic soils. The Finnish soil database includes a soil map at a scale of 1:250,000 and the properties of the soil. The soil database is produced by MTT, Metla and the Geological Survey of Finland. The IPCC tier 1 method and default IPCC values for carbon in crop biomass were used to estimate CO_2 emissions for this category. To estimate CO_2 emissions from mineral soils for forest land converted to cropland, the Yasso07 soil carbon model was applied. The data and parameters used for the reporting of this category are in line with the IPCC good practice guidance for LULUCF.

95. The uncertainty estimation of the CO_2 emissions from land converted to cropland was based mainly on expert judgement. Finland informed the ERT, during the review, of its plans and ongoing work to improve the reporting of this category, including the uncertainty estimation (see para. 87 above). The ERT reiterates its encouragement for Finland to report

on the progress made in updating its uncertainty estimation for this category in its next annual submission.

Grassland remaining grassland – CO_2

96. A tier 1 method was used to estimate CO_2 emissions from grassland remaining grassland, except in the case of organic soils, for which a tier 2 method and the Yasso07 model were used. National data from the NFI and farm statistics, as well as a country-specific EF (3.20 Mg C per hectare per annum) for CO_2 emissions from cultivated organic soils and IPCC default EFs, were used to estimate emissions and removals for this category. Finland's reporting is generally complete; however, living biomass, which is a mandatory element for which there is an IPCC method, has been reported as "NE". Finland has indicated that there are no national data available to estimate the emissions and removals from that pool. For this category, the reporting of emissions and removals in terms of methods, data and parameters used is in line with the IPCC good practice guidance for LULUCF. However, there is room for improvement through the use of higher-tier methods for pools currently reported using a tier 1 method. Therefore, the ERT recommends Finland to further improve the reporting of this category by reporting estimates for the living biomass pool. The ERT also encourages Finland to use higher-tier estimation methods (e.g. for mineral soils) for its next annual submission.

97. The estimated uncertainty for this category is high (e.g. for mineral soils it is ±100 per cent) and based mainly on expert judgement. In response to questions raised by the ERT during the review, Finland informed of its plan to improve its methods for estimating uncertainties for all land-use categories. The ERT recommends Finland report in its next annual submission on improvements made, if any, in estimating the uncertainties for CO_2 estimations in this category.

Land converted to wetlands – CO_2

98. Finland has reported on CO_2 emissions from forest land and peat extraction field conversion to wetlands in this category. The Party used country-specific tier 2 and 3 estimation methods with country-specific EFs (see table 7.5-3 of the 2012 NIR) and AD computed from the Party's NFIs (NFI9 to NFI11). However, living biomass and soil pools for the subcategories grassland converted to wetlands and settlements converted to wetlands have been reported as "NE" and Finland has indicated that there are no national data to estimate CO_2 emissions for those subcategories. The ERT considers the emissions reported for this category to be in line with the IPCC good practice guidance for LULUCF. However, the ERT recommends Finland obtain national data for the conversion of grassland and settlements into wetland in order to complete the reporting of the subcategories currently reported as "NE", or to report in its next annual submission on when such information will become available.

Land converted to settlements – CO_2

99. Finland has reported CO_2 emissions from forest land converted to settlements. When estimating the relevant carbon stock changes, Finland assumed that when forest land is converted to settlements all of the trees are usually removed, and that if trees are left to grow in the settlement area, the biomass gain is negligible. Emissions due to biomass losses when forest land is converted to settlements were estimated on the basis of the annual converted area and the mean biomass stock for forest land, while emissions due to losses in deadwood were estimated using country-specific EFs (see appendix 7j to the 2012 NIR). The ERT noted the Party's approach and acknowledges that the reporting of this category is in line with the IPCC good practice guidance for LULUCF.

Other (LULUCF) – CO_2

100. In 2010, HWPs reported in the category other (LULUCF), which includes the carbon balance of all wood products in use in Finland, were a net source of CO_2 emissions. The carbon balance was calculated using the stock-change approach from the IPCC good practice guidance for LULUCF. HWPs have generally been a sink for CO_2 emissions in Finland, except in 1991 and in the period 2008–2010. The method used to estimate the emissions and removals from HWPs is a country-specific tier 3 method, which is a combination of the first order decay (FOD) method (flux method) and a direct inventory of HWPs, as documented in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines). The methods used are well described in the NIR; area data and parameters from the Food and Agriculture Organization of the United Nations and the IPCC were used and have also been documented in the NIR. The reporting of this category is in line with the IPCC good practice guidance for LULUCF.

F. Waste

1. Sector overview

101. In 2010, emissions from the waste sector amounted to 2,185.65 Gg CO_2 eq, or 2.9 per cent of total GHG emissions. Since 1990, emissions have decreased by 45.0 per cent. The key drivers for the fall in emissions from solid waste disposal on land are the implementation of the new Waste Act (1994) and the European Union (EU) landfill directive (directive 1999/31/EC), which endorsed the minimization of waste generation, the recycling and reuse of waste materials, landfill gas recovery and alternative waste treatment methods for landfills. The key driver for the fall in emissions from wastewater handling is the downward trend in uncollected domestic wastewater and the introduction of nitrogen purification technologies at wastewater treatment plants. The category other (waste) displays the only upward trend in emissions, which is due to the increased recovery of organic waste resulting from the implementation of the EU landfill directive. Within the sector, 84.3 per cent of the emissions were from solid waste disposal on land, followed by 9.9 per cent from wastewater handling and 5.7 per cent from composting. Emissions from waste incineration have been reported as "IE".

102. Finland has made recalculations for the waste sector between its 2011 and 2012 annual submissions for 2006 and 2009. The effect of these recalculations on the waste sector is a decrease in the estimate of emissions for 2009 of 2.36 Gg CO_2 eq or 0.1 per cent. The main recalculations for 2009 took place in the following categories:

(a) Wastewater handling: A decrease in the estimate of CH_4 and N_2O emissions by 1.57 Gg CO_2 eq or 0. 7 per cent, owing to the correction of the data on the population not connected to public wastewater treatment plants and improved data on protein consumption;

(b) Other (waste): a decrease in the estimate of CH_4 and N_2O emissions from composting by 0.79 Gg CO_2 eq or 0.1, owing to the update of AD and composting codes from the VAHTI system (for the period 2007–2009).

103. The ERT noted that the reporting of emissions from the waste sector in both the NIR and the CRF tables is complete in terms of years, geographical coverage, categories and gases. In general, the methods and data used have been described in the NIR in a transparent manner and are considered to be accurate. The ERT found that the disposal of hospital waste has not been described in the NIR. During the review, Finland informed the ERT that hospital waste is mainly landfilled in the country and that the associated CH_4

emissions were estimated using data from the VAHTI system and reported with emissions from industrial solid waste.

104. In its NIR, Finland has reported that the uncertainty of the AD for solid waste disposal on land is 43 per cent (owing specifically to the uncertainty of the historical AD originating from different statistical database systems), which the ERT considers high. The uncertainties of the EFs for solid waste disposal on land are IPCC default values. In response to questions raised by the ERT during the review, Finland mentioned that it plans to work on reducing the uncertainty of its composting AD and the waste composition data for solid waste disposed on land by improving the data on paper and board. The ERT welcomes Finland's plan to improve its AD for composting and its waste composition data in order to reduce the uncertainty of its estimates, and recommends Finland to report on progress made in its next annual submission.

105. The ERT acknowledges the ongoing improvement plan carried forward from the previous annual submission for the re-evaluation of the composition of the domestically consumed paper and cardboard in municipal solid waste (MSW), in particular for 2006 and onward, and the plan to cross-check data on uncollected wastewater from the VAHTI system with another database (Velvet) and another project (TIVA2). The ERT welcomes Finland's plan to improve, by 2014, the data on the composition of mixed construction and demolition waste, as well as its plan to improve the AD for 2006 on composting in the VAHTI database, which is expected to be completed in time for the Party's next annual submission. The ERT recommends that Finland include a time frame for each individual element of the improvement plan for the waste sector and report on the progress made in implementing the plan in its next annual submission.

2. Key categories

Solid waste disposal on land – CH_4

106. The first order decay (FOD) method (tier 2 approach from the IPCC good practice guidance) was applied to estimate CH_4 emissions for this category. The types of waste disposed to landfill are classified in and derived from the VAHTI system. Food waste is the main component of Finland's MSW, with its steady share of 35–38 per cent of the total MSW during the 1990–2010 period. Finland used many default values from the 2006 IPCC Guidelines, which Finland justified better reflected national circumstances than the default values from the IPCC good practice guidance. For example, the ERT noted that Finland used the default k value of 0.185 for the generation rate of CH_4 from wet food waste from the 2006 IPCC Guidelines. The ERT considers the use of that default value to be appropriate for the estimation of emissions from wet food waste in MSW. However, the ERT encourages Finland to consider the possibility of deriving a country-specific value for the generation of CH_4 from wet food waste, in order to improve the accuracy of the associated CH_4 emission estimates. After reading the draft review report, Finland indicated that there is no plan to derive a country-specific k value for wet food waste in MSW. Food waste is increasingly treated biologically, leading to a decrease in CH_4 emissions, and improvements in accuracy as a result of implementing the recommendation would not be significant.

107. The AD for solid waste disposal on land were taken from four sources: a 2002 report by Tuhkanen,[9] with the AD based on population and gross domestic product (for the period 1900–1989); estimates published in relevant literature (for the early 1990s); the Landfill Registry (for the period 1992–1995), providing a rough waste classification and waste

[9] Tuhkanen, S. 2002. Mitigation of greenhouse gases from waste management in Finland. Methane (CH4) emissions from landfills and landfill gas recovery. Espoo 2002. VTT Research Notes 2142. P.46.

amounts in volume units; and the VAHTI database (for the period 1996–2010), where waste is registered according to the European Waste Catalogue classification code and mass units. During the review, Finland explained and demonstrated the VAHTI system to the ERT. The ERT commends the transparency of the VAHTI system, which reports data by site and by volume of waste with additional detailed information.

108. In its 2012 annual submission, Finland has provided, in appendix 8b to the NIR, data on landfill gas recovery by plant and by volume, which were obtained from the Finnish Biogas Plant Register from surveys of field measurements. The ERT noticed that for two plants (Kerava and Uusikaupunki) the volume of gas collected in 2010 has been reported as zero in appendix 8b to the NIR. In response to questions raised by the ERT during the review, Finland informed the ERT that landfill gas flaring could occur in some circumstances, which could generate CH_4 and N_2O emissions that are currently not accounted for in the inventory. The ERT recommends that Finland explain, in its next annual submission, why some plants reported a zero value for the volume of collected gas from landfills, as this could point to either a malfunction of the equipment or the closure of landfills.

Wastewater handling – CH_4 and N_2O

109. The ERT noted that N_2O emissions from domestic and commercial wastewater is a key category by level and trend, while CH_4 emissions from domestic and commercial wastewater is a key category by trend only. Finland used the methods available from the Revised 1996 IPCC Guidelines to estimate CH_4 and N_2O emissions from wastewater handling. IPCC default EFs were used in most cases and AD were taken mainly from the VAHTI system. The Check method was used to estimate CH_4 emissions from uncollected domestic wastewater.

110. Finland did not estimate N_2O emissions from industrial wastewater handling, owing to the fact that no relevant IPCC method is available, but it did estimate N_2O emissions from nitrogen input in the waterway, including nitrogen input from fish farms and industrial wastewater, and has reported the N_2O emissions in the subcategory other in CRF table 6.B.

3. Non-key categories

Other (waste) – CH_4 and N_2O

111. Emissions of CH_4 and N_2O from composting were estimated using the relevant methodology from the 2006 IPCC Guidelines. IPCC default EFs were used for both CH_4 and N_2O. The ERT noted that the emissions from composting have increased over time since 1990, except in 2009 and 2010, owing to the decreased volume of industrial sludge available for composting. The increase in emissions since 1990 is 83.36 Gg CO_2 eq (or 199.6 per cent). During the review, Finland mentioned that there are new incineration plants and new biogas plants in the country that use industrial sludge as their substrate, which explains the reduction in the industrial sludge available for composting in those years. Since the AD for composting originate from several sources of waste, including MSW, industrial solid waste and municipal and industrial sludge, which are related to AD for other categories, it is not clear how the final AD were derived for estimating emissions from composting specifically. The ERT encourages Finland to consider to report in its NIR, when anaerobic digestion of MSW becomes available, a waste flow diagram for municipal and industrial waste, as well as for municipal and industrial sludge, in order to increase the transparency of which specific AD were ultimately used for the emission calculations for composting and solid waste disposal on land.

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

112. Finland submitted the supplementary information required for the reporting on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, in accordance with decision 15/CMP.1, annex, paragraphs 5–9, and consistent with the relevant provisions of decision 16/CMP.1. Finland has decided to account for the emissions and removals under Article 3, paragraphs 3 and 4 at the end of the commitment period. The Party has reported on all activities under Article 3, paragraph 3, of the Kyoto Protocol (afforestation and reforestation, and deforestation) and on forest management, the only activity elected by Finland under Article 3, paragraph 4, of the Kyoto Protocol.

113. The information reported on units of land subject to afforestation, reforestation and deforestation activities and forest management activities is in line with decision 15/CMP.1, annex, paragraph 6(b). Finland has reported information on emissions and removals from land subject to afforestation and reforestation, deforestation and forest management using reporting method 1 from the IPCC good practice guidance for LULUCF for land identification, for all geographical areas (south Finland and north Finland), for the years 2008–2010 of the first commitment period. All KP-LULUCF activities were identified as key categories by Finland, following the methods outlined in the IPCC good practice guidance for LULUCF. The methods used for deriving the estimates of emissions by sources and removals by sinks are the same as those used by Finland for its reporting under the Convention and they are in line with the IPCC good practice guidance for LULUCF. Finland estimated the total biomass increment for forest management and afforestation and reforestation by multiplying the mean increment per area unit in the forest land category under the Convention by the forest area under the Kyoto Protocol. The AD and EFs used have been clearly explained in the reporting on forest land under the Convention in the 2012 NIR. All pools have been reported, except for the dead wood pool for afforestation and reforestation, which has been reported as not occurring ("NO") and is not considered by Finland to be a net source of emissions (see paras. 118–119 below).

114. The national system for reporting on KP-LULUCF activities is well established and functioning and involves relevant institutions, namely Metla and MTT, with well-defined responsibilities. Both Metla and MTT have established the required institutional arrangements with Statistics Finland, which is the single national entity with overall responsibility for the preparation of the inventory. The ERT noted that the national system has the required capacity to identify the areas of land subject to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

115. The Party has made recalculations for the KP-LULUCF activities between the 2011 and 2012 annual submissions, reflecting improvements in the estimation of emissions from areas of land-use change for all KP-LULUCF activities. For land converted from settlements to afforestation/reforestation land, an error was corrected and the high sink value associated with such land was reduced. For land converted from organic grassland to afforestation/reforestation land, the estimation method was changed (the initial biomass immediately after the conversion, previously assumed to be zero, is now estimated) and a national EF was applied for organic grassland. The AD for biomass burning have changed, owing to the update of the areas of forest management and afforestation and reforestation for all years of the time series. In order to incorporate all these changes, recalculations for all KP-LULUCF activities have been made between the Party's 2011 and 2012 annual

submissions for the entire time series. The impact of these recalculations on each KP-LULUCF activity for 2009 is as follows:

(a) Afforestation and reforestation: the estimate of net CO_2 emissions increased by 209.40 Gg CO_2 eq, or 103.6 per cent;

(b) Deforestation: the estimate of net CO_2 emissions decreased by 41.73 Gg CO_2 eq, or 1.2 per cent;

(c) Forest management: the estimate of net CO_2 removals increased by 3,001.85 Gg CO_2 eq, or 6.0 per cent.

116. The ERT noted that Finland has not reported information on uncertainty estimates for the KP-LULUCF activities separately from the uncertainty estimates for forest land under the Convention. This issue was also raised in the previous review report, where it was recommended that Finland implement its plan to further develop the uncertainty estimates for the KP-LULUCF activities for its 2012 and 2013 annual submissions. The ERT acknowledges Finland's plan to improve the uncertainty estimates for all land-use categories, which is expected to be fully implemented by 2013–2014, but recommends that Finland provide separate estimates of uncertainty for the KP-LULUCF activities in its next annual submission.

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

Afforestation and reforestation – CO_2

117. Finland defined areas of afforestation and reforestation using sample-based NFI data, in addition to using aerial photographs and satellite images to supplement and confirm land uses prior to 1 January 1990 on areas that have been afforested or reforested since 1990. As a result, harvesting and disturbance followed by the re-establishment of forest are reliably distinguished from deforestation in the NFI. No areas of afforestation and reforestation have been reported as harvested during the first commitment period.

118. The ERT noted that Finland has reported the dead wood pool for afforestation and reforestation using the notation key "NO" in CRF tables NIR–1 and 5(KP–I)A.1.1. Finland has indicated in the NIR and explained, in response to questions raised by the ERT during the review, that the accumulation of dead wood in areas of afforestation and reforestation was assumed to be marginal for the period 1990–2010. Finland also explained that the dead wood pool could not decrease with afforestation and reforestation activities on cropland, grassland, settlements and peat extraction sites, because there is no dead wood on such sites before the conversion to afforestation/reforestation land. Finland further explained that the accumulation of dead wood starts after natural mortality or thinning occur, and when the trees reach the dimensions set to define dead wood (10 cm diameter) according to the IPCC good practice guidance for LULUCF, which on average are reached at the stand age of 20 years in Finland. Therefore, the carbon stock change for dead wood is assumed to be zero and has been reported as "NO". During the review, a reference was provided to the ERT confirming that at the age class of around 20 years, trees in Finland can have a diameter of 9–12 cm, which is just equal to the diameter (10 cm) specified in the IPCC good practice guidance for LULUCF for defining dead wood.

119. The ERT is of the view that the information provided verifies the fact that trees on afforestation/reforestation land in Finland have just reached the diameter limit for dead wood, and that they are therefore unlikely to have accumulated a pool of dead wood that may have caused emissions during the past years of the commitment period. However, for the remaining years of the commitment period, the justification based on the diameter limit of dead wood would not be sufficient to justify Finland not accounting for the dead wood pool for afforestation and reforestation, since the trees have already started to exceed the

10 cm diameter limit. Therefore, the ERT recommends that Finland use the data on dead wood collected in the NFI to estimate the carbon stock change in dead wood for afforestation/reforestation land for its next annual submission.

120. Table 11.1–1 of the NIR shows that for afforestation and reforestation land the DOM and SOM pools, which include dead wood, were in fact sources of emissions from both mineral and organic soils in 2010. In response to questions raised by the ERT during the review, Finland explained that the emissions reported in table 11.1-1 of the NIR originate mainly from the soil and litter pools and it is unlikely that they would come from dead wood. The ERT considers this to be an inconsistency in the reporting of the dead wood pool for afforestation and reforestation activities. Therefore, it recommends that Finland address the inconsistency in the reporting of DOM, in order to ensure the consistent reporting of the dead wood pool for afforestation and reforestation activities, for its next annual submission.

Deforestation – CO_2

121. The reporting of deforestation is in line with decision 15/CMP.1, annex, paragraphs 5–8. The ERT noted that in table 11.1–1 of the NIR, under deforestation, Finland has included aggregated emissions for DOM and SOM for both mineral and organic soils. In the same table, Finland has also included separate estimates for emissions from the dead wood pool for deforestation. Since DOM includes dead wood, the ERT considered this to be an inconsistency in the reporting, which might have led to the overestimation of CO_2 emissions from deforestation. Finland explained that this is likely to have been a mistake in the accounting of emissions from dead wood and will be corrected. The ERT recommends that Finland address the mistake in the accounting of emissions from dead wood, and ensure that the estimation of emissions from deforestation is as accurate as possible, for its next annual submission.

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

Forest management – CO_2

122. The reporting of forest management is in line with decision 15/CMP.1, annex, paragraphs 5–7 and 9. The biomass carbon stock for forest management was derived from the difference between the total increment in areas of forest management and the increment in areas of afforestation and reforestation. The total biomass increment for all forests was obtained by multiplying the mean increment per area unit of forest land in the reporting under the Convention by the estimated area of all forests included under the Kyoto Protocol. The drain for forest management was obtained as the difference between the total drain and the drain related to deforestation. The ERT noted that the approach used to report the drain for forest management was based on the reporting on the LULUCF sector under the Convention. Estimates for all pools for forest management have been reported, with the litter and dead wood pools reported in CRF table 5(KP-I)B-1 using the notation key "IE". Finland explained that the Yasso07 model, which is used for the soil, litter and dead wood pools, provides only aggregated estimates for these pools. The ERT concludes that the reporting of this category is in line with the IPCC good practice guidance for LULUCF.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

123. Finland 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.[10] 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.

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

National registry

125. The ERT took note of the SIAR and its finding that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT further noted from the SIAR and its 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.

Calculation of the commitment period reserve

126. In its 2012 annual submission, Finland has reported its commitment period reserve to be 319,515,790 t CO_2 eq. The Party reported that its commitment period reserve has not changed since the initial review report, as it is based on the assigned amount and not on the most recently reviewed inventory. The ERT disagrees with this figure, as the calculation of the commitment period reserve in the initial review report is 319,515,791 t CO_2 eq. The ERT recommends that Finland include the correct value of its commitment period reserve in its next annual submission.

3. Changes to the national system

127. Finland reported that there have been no changes in its national system since the previous annual submission. The ERT concluded that Finland'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

128. Finland reported that there have been changes in its national registry since the previous annual submission. Finland has described the changes in its NIR, as follows: minor changes to the user interface; the repair of minor software bugs; the addition of a reporting service in order to receive up-to-date information on the total unit holding situation and to aid in tracking compliance with the Kyoto Protocol; minor configurational changes following a security audit of the system (including penetration testing) performed by a third party; minor security updates to the software following the security audit; and the

[10] 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.

development and implementation of a second two-factor authentication system, in order to further increase security. The ERT concluded that, taking into account the confirmed changes in the national registry, Finland'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

129. Finland reported that there has been no change in its reporting of the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol since the previous annual submission. The ERT concluded that the information provided continues to be complete and transparent.

130. Finland has reported that it strives to implement its commitments under the Kyoto Protocol in such a way as to minimize social, environmental and economic impacts on other Parties to the Kyoto Protocol, developing countries in particular. Finland has also reported that, up to the time of the preparation of its 2012 annual submission, no specific information on adverse impacts linked to Finnish policies had been identified by or received from other Parties, in particular developing country Parties. Finland stated that all of its major policies, such as the national Long-term Climate and Energy Strategy adopted in 2008, and activities undergo an environmental impact assessment, including their impacts on other countries.

131. In order to minimize the impacts of its climate change policies on developing countries, Finland has identified the energy sector of its Development Policy Programme as a sector where sustainable development can be promoted. The Party aims to support programmes and projects that focus on saving energy, increasing energy efficiency and promoting renewable energy production. Finland has mentioned in particular policy programmes related to the production of renewable energy as having a positive impact on developing countries and has described the procedures in place to ensure that the increase in the use of biofuels will not jeopardize social and ecological sustainability. Finland has reported on the support it provides to developing countries by helping them to build their capacity and develop their economic infrastructure, thus helping them to diversify their economies and energy production. Several projects are in place, especially in poor countries and regions (e.g. Cambodia, Lao People's Democratic Republic, Mozambique, Namibia, Nepal, Nicaragua, South Africa, United Republic of Tanzania and Zambia, as well as Latin America, the Mekong and sub-Saharan Africa regions).

III. Conclusions and recommendations

A. Conclusions

132. Finland made its annual submission on 12 April 2012 (CRF tables) and 14 April 2012 (NIR). The annual submission contains the GHG inventory (comprising the CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (information on: activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, Kyoto Protocol units, changes to the national system and the national registry, and the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

133. The ERT concludes that the inventory submission of Finland has been prepared and reported in accordance with the UNFCCC reporting guidelines. The inventory submission is complete and Finland has submitted a complete set of CRF tables for the years 1990–2010 and an NIR; these are complete in terms of geographical coverage, years and sectors, as well as generally complete in terms of categories and gases. Some mandatory categories in the LULUCF sector have been reported as NE (see para. 86 above)

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

135. Finland's inventory is in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The areas identified by the ERT for improvement are described in the sectoral chapters of this report.

136. Finland has made recalculations for the inventory between its 2011 and 2012 annual submissions following changes in methodologies, AD and EFs and reallocations and in order to rectify identified errors. The impact of these recalculations on the national total is a decrease in the estimate of emissions for 2009 of 0.3 per cent and a decrease in the estimate of emissions for 1990 of 0.005 per cent. The main recalculations took place in the following sectors/categories:

(a) CO_2, CH_4 and N_2O emissions from the energy sector, particularly for other sectors, energy industries and other (energy) (total decrease in the energy sector emission estimate for 2009 by 304.09 Gg CO_2 eq or 0.6 per cent);

(b) CO_2 emissions from industrial processes, particularly for chemical industry and mineral products (total increase in the industrial processes sector emission estimate for 2009 by 84.87 Gg CO_2 eq or 1.6 per cent);

(c) CH_4 and N_2O emissions from agriculture, particularly for agricultural soils and manure management (total decrease in the agriculture sector emission estimate for 2009 by 5.91 Gg CO_2 eq or 0.1 per cent);

(d) CO_2, CH_4 and N_2O emissions from LULUCF, particularly for other, settlements and forest land (total decrease in the LULUCF sector net removals emission estimate for 2009 by 4,466.68 Gg CO_2 eq or 11.0 per cent);

(e) CH_4 and N_2O emissions from waste, particularly for wastewater handling and other (total decrease in the waste sector emission estimate for 2009 by 2.36 Gg CO_2 eq or 0.1 per cent).

137. Finland submitted the supplementary information required for the reporting on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, in line with decision 15/CMP.1, annex, paragraphs 5–9, and consistent with the relevant provisions of decision 16/CMP.1. Finland has reported on afforestation and reforestation, and deforestation under Article 3, paragraph 3, of the Kyoto Protocol, and forest management under Article 3, paragraph 4, of the Kyoto Protocol, in accordance with the IPCC good practice guidance for LULUCF.

138. Finland has made recalculations for the KP-LULUCF activities between its 2011 and 2012 annual submissions following changes in methodologies, AD and EFs and in order to rectify identified errors. The impact of these recalculations on each KP-LULUCF activity for 2009 is as follows:

(a) Afforestation and reforestation: the estimate of net CO_2 emissions increased by 209.40 Gg CO_2 eq, or 103.6 per cent;

(b) Deforestation: the estimate of net CO_2 emissions decreased by 41.73 Gg CO_2 eq, or 1.15 per cent;

(c) Forest management: the estimate of net CO_2 removals increased by 3,001.85 Gg CO_2 eq, or 5.97 per cent.

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

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

141. 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.

142. Finland has reported information under decision 15/CMP.1, annex, chapter I.H, "Minimization of adverse impacts in accordance with Article 3, paragraph 14", as part of its 2012 annual submission. The ERT concluded that the information provided continues to be complete and transparent.

B. Recommendations

143. The ERT identifies issues for improvement as listed in table 6 below. All recommendations are for the next annual submission, unless otherwise specified.

Table 6
Recommendations identified by the expert review team

Sector	*Category*	*Recommendation*	*Paragraph reference*
General	Inventory planning	Report on the progress made in operationalizing the upcoming data portal and provide a date for when Finland expects to be able to use the European Organisation for the Safety of Air Navigation data in its inventory	20
	Inventory planning	Report on the institutional responsibilities presently in place at all stages of the process of the calculation of the emissions from aviation	20
	Uncertainty	Document in more detail the revisions to the uncertainty parameters and methodology used to estimate uncertainty for the land use, land-use change and forestry (LULUCF) sector	24
	Uncertainty	Use the correct formula for combining uncertainty estimates in the calculation of the overall uncertainty of the total inventory emissions including LULUCF, by taking the absolute value of each emissions and removals term in the denominator before adding them up	25
	Verification and quality assurance/quality control approaches	Explain the relationship between the list of planned improvements given in chapter 10 and each of the sector-specific planned improvements provided in the respective sectoral chapters of the national inventory report (NIR)	29
Energy	General	Improve the transparency by including more disaggregated information in the NIR on the activity data (AD) used for the energy sector, either by further disaggregating the AD by	40

Sector	*Category*	*Recommendation*	*Paragraph reference*
		subcategory or by using a more disaggregated fuel list. If data are still presented in an aggregated manner, then qualitative information should be provided on which fuels are included	
	Feedstocks and non-energy use of fuels	Include information on the assumptions and allocation of emissions related to the use of lubricants	48
	Stationary combustion: solid, liquid, gaseous and other fuels – carbon dioxide (CO_2)	Establish a system that ensures that all country-specific emissions factors (EFs) are periodically reviewed, as part of the continuous improvement of the inventory, for its next annual submission	53
	Stationary combustion: gaseous fuels	Reallocate the reporting of emissions from gasified fossil waste to the subcategory other fuels	55
	Stationary combustion: liquid fuels	Include the improvement or revision of the time-series consistency of the CO_2 EF for liquid fuels used in petroleum refining in the inventory improvement plan and report on any relevant progress	56
Industrial processes and solvent and other product use	Other (chemical industry)	Confirm the AD, EFs and correction factor used with that hydrogen producer, review and update the corresponding emission estimates where necessary and include relevant information thereon	64
	Electrical equipment	Achieve concrete results from its effort to ensure the time-series consistency of the estimates of sulphur hexafluoride (SF_6) emissions from electrical equipment and report thereon	68
Agriculture	General	Correct the presentation of the uncertainties in annex 6 to the NIR, either by explaining that the reported uncertainties for the agriculture sector are the combined ones or by disaggregating them into AD and EF uncertainties	71
	General	Include more information on the specific quality assurance procedures undertaken for the agriculture sector	72
	Manure management	Keep regular quality control checks of the nitrogen model to avoid any future error in the model	75
	Direct soil emissions	Provide an explanation of why the EFs for arable land were subject to a correction factor of 0.5	78
	Direct soil emissions	Report and explain the recalculations due to the fact that Finland will no longer subtract the volatilization of ammonia before estimating emissions from pasture, range and paddock manure	79
	Direct soil emissions	Include the information explaining why the annual N_2O IEF has changed	80
LULUCF	General	Improve the transparency of reporting on the identification of areas of land use and land-use change by providing clear descriptions of the rationale for using the moving average method, of the logic and the stepwise approach followed in the	85

Sector	*Category*	*Recommendation*	*Paragraph reference*
		application of the method, and of the data used, including the use of National Forest Inventory (NFI) and Official Land Survey data	
	General	Report estimates for the mandatory pools currently reported as "NE" (not estimated)	86
	Land converted to forest land	Provide a more detailed description of the method used for estimating and reporting losses in carbon stock in living biomass for all types of land converted to forest land	91
	Grassland remaining grassland	Improve the reporting of this category by reporting estimates for the living biomass pool.	96
	Grassland remaining grassland	Report on improvements made, if any, in estimating the uncertainties for CO_2 estimations in this category	97
	Land converted to wetland	Obtain national data for the conversion of grassland and settlements into wetland in order to complete the reporting of the subcategories currently reported as "NE", or to report in its next annual submission on when such information will become available.	98
Waste	General	Report on its plan to improve its AD for composting and its waste composition data in order to reduce the uncertainty of its estimates	104
	General	Include a time frame for each individual element of the improvement plan for the waste sector and report on the progress made in implementing the plan	105
	Solid waste disposal on land	Explain why some plants reported a zero value for the volume of collected gas from landfills, as this could point to either a malfunction of the equipment or the closure of landfills	108
KP-LULUCF	General	Provide separate estimates of uncertainty for the KP-LULUCF activities	116
	Afforestation and reforestation	Use the data on dead wood collected in the NFI to estimate the carbon stock change in dead wood for afforestation/reforestation land	119
	Afforestation and reforestation	Address the inconsistency in the reporting of dead organic matter, in order to ensure the consistent reporting of the dead wood pool for afforestation and reforestation activities	120
	Deforestation	Address the mistake in the accounting of emissions from dead wood, and ensure that the estimation of emissions from deforestation is as accurate as possible	121
	Calculation of the commitment period reserve	Include the correct value of its commitment period reserve	126

IV. Questions of implementation

144. 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 Finland 2012. Available at <http://unfccc.int/resource/docs/2012/asr/fin.pdf>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2012. Available at <http://unfccc.int/resource/webdocs/sai/2012.pdf>.

FCCC/ARR/2011/FIN. Report of the individual review of the annual submission of Finland submitted in 2011. Available at <http://unfccc.int/resource/docs/2012/arr/fin.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 Ms. Riitta Pipatti (Statistics Finland), including additional material on the methodologies and assumptions used. The following documents[1] were also provided by Finland:

Grönroos, J. et all. 2009. *Development of the ammonia emission inventory in Finland: Revised model for agriculture*. Finnish Environment Institute. Available at http://www.environment.fi/download.asp?contentid=105290&lan=EN

[1] Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

AD	activity data
ARR	annual review report
AWMS	animal waste management system
CH_4	methane
cm	centimetre (1 cm = 0.01 meter)
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
DOM	dead organic matter
EF	emission factor
ERT	expert review team
EU	European Union
EU ETS	European Union emissions trading scheme
EUROCONTROL	European Organization for the Safety of Air Navigation
Finavia	Finnish Civil Aviation Administration
FOD	first order decay
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
Gg	gigagramme (1 Gg = 10^9 grams)
HFCs	hydrofluorocarbons
HWPs	harvested wood products
IE	included elsewhere
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
kg	kilogram (1 kg = 1,000 grams)
LULUCF	land use, land-use change and forestry
Metla	Finnish Forest Research Institute
MSW	municipal solid waste
MTT	MTT Agrifood Research Finland
N	nitrogen
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NFI	national forest inventory
NH_3	ammonia
NIR	national inventory report
NMVOC	non-methane volatile organic compound
NO	not occurring
PCC	precipitated calcium carbonate
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
SEF	standard electronic format

SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
SOM	soil organic matter
SYKE	Finnish Environment Institute
TJ	terajoule (1 TJ = 10^{12} joules)
UNFCCC	United Nations Framework Convention on Climate Change
VAHTI	VAHTI compliance monitoring data system