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**Report of the individual review of the greenhouse gas inventories of Finland
submitted in 2007 and 2008***

* In the symbol for this document, 2008 refers to the year in which the inventory was submitted, and not to the year of publication.

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I. Overview

A. Introduction

1. This report covers the centralized review of the 2007 and 2008 greenhouse gas (GHG) inventory submissions of Finland, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. In accordance with the conclusions of the twenty-seventh session of the Subsidiary Body for Implementation the focus of the review is on the most recent (2008) submission.¹ The review took place from 1 to 6 September 2008 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalists – Mr. Bernd Gugele, (European Community) and Ms. Inga Konstantinaviciute (Lithuania); energy – Mr. Michael Strogies (Germany) and Mr. Hristo Vassilev (Bulgaria); industrial processes – Mr. Masato Yano (Japan) and Ms. Valentina Idrissova (Kazakhstan); agriculture – Mr. Paul Duffy (Ireland) and Ms. Batima Punsalmaa (Mongolia); land use, land-use change and forestry (LULUCF) – Mr. Emil Cienicala (Czech Republic) and Richard Volz (Switzerland); and waste – Mr. Sabin Guendehou (Benin) and Ms. Tatiana Tugui (Moldova). Mr. Gugele and Ms. Tugui were the lead reviewers. The review was coordinated by Ms. Ruta Bubniene (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.

B. Inventory submission and other sources of information

3. The 2008 inventory was submitted on 11 April 2008; it contains a complete set of common reporting format (CRF) tables for the period 1990–2006 and a national inventory report (NIR). This is in line with decision 15/CMP.1. The Party indicated that the 2008 submission is also its voluntary submission under the Kyoto Protocol.² In its 2007 submission, Finland included a complete set of CRF tables for the period 1990–2005 and an NIR. In addition, in its 2007 submission Finland included the Kyoto Protocol LULUCF tables on a voluntary basis. The full list of materials used during the review is provided in the annex to this report.

C. Emission profiles and trends

4. In 2006 (as contained in the 2008 inventory submission), the main GHG in Finland was carbon dioxide (CO₂), accounting for 84.8 per cent of total GHG emissions³ expressed in CO₂ equivalent (CO₂ eq), followed by nitrous oxide (N₂O) (8.5 per cent) and methane (CH₄) (5.6 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) collectively accounted for 1.0 per cent of the overall GHG emissions in the country. The energy sector accounted for 82.2 per cent of the total GHG emissions, industrial processes 7.6 per cent, agriculture 6.9 per cent, waste 3.1 per cent and solvents 0.1 per cent. Total GHG emissions amounted to 80,290.52 Gg CO₂ eq and increased by 13.2 per cent between the base year⁴ and 2006. The main increases in emissions were in public electricity and heat production.

5. In 2005 (as contained in the 2007 inventory submission), total GHG emissions amounted to 69,240.79 Gg CO₂ eq. There are considerable differences between the shares of gases and sectors

¹ FCCC/SBI/2007/34, paragraph 104.

² Parties may start reporting information under Article 7, paragraph 1, of the Kyoto Protocol from the year following the submission of the initial report, on a voluntary basis (decision 15/CMP.1).

³ In this report the term total GHG emissions refers to the aggregated national GHG emissions expressed in terms of CO₂ eq excluding LULUCF, unless otherwise specified.

⁴ Base year refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. The base year emissions do not include any possible emissions from deforestation; however, these are taken into account for the purpose of calculating the assigned amount.

between inventory years 2005 (2007 submission) and 2006 (2008 submission) due to changes in the public heat and power production. As explained in the NIR, the water resources available for hydro power plants changed significantly in the Nordic countries between 2005 and 2006, and Finland changed from being a net importer to a net exporter of electricity in the Nordic market during this period. Consequently the share of emissions in the energy sector increased in 2006 (2008 submission) compared to 2005 (2007 submission) by about 2.5 percentage points whereas the shares of other gases and sectors decreased.

6. Tables 1 and 2 show the GHG emissions by gas and by sector, respectively.

D. Key categories

7. Finland has reported a key category tier 2 analysis, both level and trend assessment, as part of its 2008 submission. The key category analyses performed by the Party and by the secretariat⁵ produced different results owing to the different approaches used. Finland has included the LULUCF sector in its key category analysis, which was performed in accordance with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) and the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). The key categories identified by Finland in its 2007 submission were almost identical to those in 2008 submission. The only difference was that N₂O from road transportation was identified as a key category in the 2008 submission but not in 2007 submission. No key categories have been identified using the qualitative approach.

8. For key categories Finland applied category specific quality control checks (tier 2) which include technical reviews of the source categories, activity data (AD), emission factors (EF) and methods. The expert review team (ERT) noted that Finland provide a key category analysis for 1990 and the latest year in tabular format in the NIR.

E. Main findings

9. The inventory is in line with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines), the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The 2008 inventory submission is of a high quality and the Party addressed most issues raised in the initial review. However, the ERT made several recommendations on how the Finnish inventory may be further improved.

10. With regard to completeness, a few categories are reported as not estimated ('NE'); these are considered as small by Finland. The transparency could be increased by including separate chapters in the NIR describing each source/sink category (especially key categories), ensuring a minimum level of documentation on methods, EFs and AD for all key categories, and providing explanations of peculiar emission and/or IEF trends for key categories at category level. The ERT noted that quality

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 Intergovernmental Panel on Climate Change *Good Practice Guidance for Land Use, Land-use Change and Forestry*. Key categories according to the tier 1 trend assessment were also identified for Parties that provided a full set of common reporting format tables for the base year. 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.

Table 1. Greenhouse gas emissions by gas, 1990–2006

Greenhouse gas emissions	Gg CO ₂ eq								Change base year–2006 (%)
	Base year ^a	1990	1995	2000	2003	2004	2005	2006	
CO ₂	56 710.39	56 710.39	58 004.64	56 969.38	72 330.68	68 455.49	56 699.71	68 098.01	20.1
CH ₄	6 288.82	6 288.82	6 073.05	5 381.09	4 865.91	4 698.33	4 484.11	4 535.83	-27.9
N ₂ O	7 852.29	7 852.29	7 154.41	6 849.74	6 911.24	6 907.04	6 949.64	6 853.15	-12.7
HFCs	29.33	0.02	29.33	501.73	652.07	695.07	863.80	747.66	2 449.2
PFCs	0.14	0.07	0.14	22.46	14.85	12.23	9.88	15.43	10 921.4
SF ₆	68.53	94.38	68.53	51.49	41.71	23.18	19.56	40.44	-41.0

^a Base year refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. The base year emissions do not include any possible emissions from deforestation; however, if applicable, these are taken into account when the assigned amount is calculated.

Table 2. Greenhouse gas emissions by sector, 1990–2006

Sectors	Gg CO ₂ eq								Change base year–2006 (%)
	Base year ^a	1990	1995	2000	2003	2004	2005	2006	
Energy	54 616.93	54 616.93	56 367.43	54 873.65	70 279.18	66 248.47	54 672.28	66 003.87	20.8
Industrial processes	5 062.62	5 059.09	4 592.22	5 542.30	5 923.31	6 181.61	6 216.25	6 124.76	21.0
Solvent and other product use	178.37	178.37	142.77	124.71	104.46	105.10	106.39	100.18	-43.8
Agriculture	7 113.47	7 113.47	6 317.60	5 960.54	5 737.77	5 616.64	5 595.19	5 564.46	-21.8
LULUCF	NA	-18 442.26	-17 547.94	-20 459.23	-25 848.21	-26 964.82	-31 473.20	-33 443.84	NA
Waste	3 978.11	3 978.11	3 910.07	3 274.69	2 771.73	2 639.52	2 436.59	2 497.24	-37.2
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF)	NA	52 503.71	53 782.15	49 316.66	58 968.25	53 826.52	37 553.50	46 846.68	NA
Total (without LULUCF)	70 949.50	70 945.97	71 330.10	69 775.88	84 816.46	80 791.34	69 026.70	80 290.52	13.2

Abbreviations: LULUCF = land use, land-use change and forestry; NA = not applicable.

^a Base year refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. The base year emissions do not include any possible emissions from deforestation; however, if applicable, these are taken into account when the assigned amount is calculated.

assurance/quality control (QA/QC) procedures need further strengthening, in particular in the agriculture sector, that the N₂O EF for gasoline from road transportation needs further checking, and that voluntary reporting under Article 3.3 and 3.4 of the Kyoto Protocol needs more detailed explanation and reconsideration.

F. Cross-cutting issues

1. Completeness

11. The inventory covers all source and sink categories for the period 1990–2006 and the complete territory of the Party. Some minor categories are reported as ‘NE’ in agriculture and LULUCF mainly because of lack of AD or because no IPCC default methods are available. The ERT recommends that further efforts be put into reporting these categories.

2. Transparency

12. The transparency of the CRF and the NIR has been improved since previous submissions, for example by the addition of explanations of trends in the sectors. However, the level of detail of the documentation and the level of transparency still differ between the sectors. The ERT noted, for example, that changes in technology and the vehicle composition in road transportation, the use of some country-specific parameters in the waste sector, are not described in detail. The ERT encourages Finland to further improve transparency by including separate chapters for each key source/sink category (in particular for direct and indirect emissions from agricultural soils), by ensuring a minimum level of documentation on methods, EF and activity data, and by providing explanations of peculiar emission and/or IEF trends for key categories at category level. As indicated by the previous review team, this could be done by developing internal reporting guidelines.

3. Recalculations and time-series consistency

13. The ERT noted that recalculations reported by the Party of the time series from 1990 to 2005 have been undertaken mainly in order to take into account revisions of data from the plants. The effect of the recalculations was a decrease by 0.08 per cent for 1990 and by 0.31 per cent for 2005 of total GHG emissions (excluding LULUCF). The major changes include corrections of plant level data (for example in manufacturing industries and construction – chemicals), and corrections of combustion technology of plants or reallocations of plants. The rationale for these recalculations is provided in the NIR and the CRF.

4. Uncertainties

14. Finland provided a tier 1 and a tier 2 uncertainty assessment including the LULUCF following the IPCC good practice guidance. The tier 2 analysis covers all categories except for a few minor sources. Changes of the uncertainty estimates between 1990 and 2006 are transparently explained. The uncertainty estimates are included in the key category analysis leading to category specific QC checks. The ERT noted that tier 2 uncertainty results provided in the 2008 submission are different to those in the 2007 submission. The ERT noted that according to the tier 1 uncertainty analysis the uncertainty in the level of emissions is lower in the 2008 submission than in the 2007 submission, but that the uncertainty in the trend of emissions is higher. The ERT recommends that Finland include a summary of the changes of the uncertainty estimates in its next annual submission.

5. Verification and quality assurance/quality control approaches

15. Finland has elaborated and implemented QA/QC procedures in accordance with the IPCC good practice guidance. This includes quality objectives, a QA/QC plan and general QC procedures (tier 1) as well as category-specific procedures (tier 2) for key categories and for those individual categories in

which significant methodological and/or data revisions have occurred. The ERT noted that Finland revised its QA/QC plan for the preparation of the 2008 submission, updated the documentation of QA/QC and continues to improve the procedures for QC checks. The ERT noted several minor discrepancies between the NIR and the CRF and within the CRF, in particular in the agriculture sector and encourages the Party to correct them in its next inventory submission. The ERT also recommends that Finland further strengthen the QA/QC procedures, in particular in the agriculture sector, and include a summary of the improved QA/QC procedures in the NIR.

16. In the NIR Finland stated that procedures for audits are under development. During the review the Party informed the ERT that the internal audits may start in 2009. Finland has comprehensive data sets of point source data available and is performing cross-checks of these data sets. The NIR includes information on these checks. The ERT encourages Finland to include in its next annual submission the main results of checks performed on point source data.

6. Follow-up to previous reviews

17. The ERT acknowledges the improvements made by Finland since the last review, such as provision of a summary of the agreements on the institutional arrangements in the NIR, an update of the time series for source categories revised during the initial review, revision of the QA/QC plan and update of the QA/QC documentation, improvement of the sectoral chapters in terms of transparency and trend description, inclusion of an improvement plan, improvement of NIR version management and archiving of emails, improvement of consistency of land area, and provision of additional information on the national registry.

18. The ERT noted that procedures for internal audits are under development and that the Party is considering providing a summary of the results of the checks performed at relevant institutions in the NIR of its annual submission.

G. Areas for further improvement

1. Identified by the Party

19. In its 2008 submission Finland includes the inventory improvement plan which summarizes the sectoral improvement needs for future inventories. The ERT noted that the inventory improvement plan is discussed in the advisory board set up by Statistics Finland before the beginning of the inventory compilation. In response to the ERT questions during the review week regarding the emissions reported as 'NE', Finland expressed its intention to include a rough estimate of CH₄ emissions from enteric fermentation, and of CH₄ and N₂O emissions from field burning of agricultural residues, in its next submission. Finland also stated that it will provide more accurate time series for CO₂ emissions from cement production. The ERT commends Finland for this intention.

2. Identified by the expert review team

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

- (a) The improvement of transparency by including separate chapters in the NIR for each source/sink category or for a group of related categories (especially for all key categories), ensuring a minimum level of documentation on methods, EFs and AD, and providing (additional) explanations of peculiar emission and/or IEF trends for key categories at category level (e.g. N₂O from road transport, CO₂ from grassland remaining grassland);
- (b) The further strengthening of the QA/QC procedures, in particular in the agriculture sector, in order, for example, to ensure consistent reporting of nitrogen amounts under N₂O emissions from manure management and under agricultural soils;

- (c) The checking of the N₂O EF for gasoline from road transportation and the inclusion of a separate chapter in the NIR on this key category;
 - (d) The elaboration of the further reporting under Article 3, paragraphs 3 and 4, of the Kyoto Protocol and the reporting of these issues in the 2010 annual submission.
21. Recommended improvements relating to specific source/sink categories are presented in the relevant chapters of this report.

II. Energy

A. Sector overview

22. The energy sector is the main source of GHG emissions in Finland. In 2006, the energy sector accounted for 66,003 Gg CO₂ eq, or 82.5 per cent of total GHG emissions. GHG emissions from the sector increased by 20.8 per cent between the base year and 2006. The key driver for the rise in emissions is the emissions from energy industries.
23. Within the sector, 49.8 per cent of the emissions were from energy industries, 21.8 per cent were from transport, 17.8 per cent from manufacturing industries and construction and 8.0 per cent from other sectors. The remaining 0.3 per cent was from fugitive emissions from fuels – oil and natural gas. Between the base year and 2006 emissions in other sectors (1.A.4) fell by 27.4 per cent, and in manufacturing industries and construction by 12.6 per cent, whereas emissions increased by 71.5 per cent in energy industries and by 12.0 per cent in transport.
24. The Finnish inventory of the energy sector is in line with the IPCC good practice guidance. The energy inventory is based on many country-specific EF and plant-specific AD obtained from the detailed VAHTI data base and the available energy balance. The estimates were made by using a wide variety of specifically developed models. The ILMARY system includes the information for stationary combustion and the LIPASTO system estimates emissions from mobile sources. All models are briefly explained in the NIR and further information sources are provided.
25. The ERT commends Finland for the improvements in transparency made in response to the recommendations of the previous review. The ERT noted that the NIR describes the trends at an aggregate level, but does not provide an explanation of technological changes in road transportation and of changes in the vehicle composition. Finland informed the ERT that inclusion of separate chapters for each source/sink category in NIR would lead to repetition as for some categories (especially in the energy sector) the same methods, AD or EFs are used. The ERT encourages Finland to further improve transparency by adding more explanations of emissions trends of subcategories, to the extent possible.
26. The ERT noted that Finland use a detailed model to combine plant-specific information for energy consumption with energy balance data. QC procedures are implemented but it is not clear if these procedures cover the net calorific values (NCVs) used in the inventories over time. Responding to recommendations from the previous review, Finland indicated small variations in the values used (for example for jet kerosene). The ERT recommends that Finland include an explanation of the NCVs used for the entire time series in its next annual submission.

B. Reference and sectoral approaches

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

27. Finland has calculated CO₂ emissions from fossil fuel combustion using the reference and the sectoral approaches for all years in the time series. In 2006, CO₂ emissions estimated using the sectoral approach are 1.2 per cent higher than those estimated using the reference approach. Over the time series, the mean difference in the CO₂ emissions estimated using the sectoral and references approaches is

1.9 per cent (range from +2.8 to -9.4 per cent). The ERT noted that explanations for the differences are provided for all years, but for cases the large discrepancies in the early 1990s the explanations are not sufficient. The ERT encourages Finland to continue its efforts to better explain these differences.

28. Finland applies IPCC default factors for the carbon content of almost all fuels in the entire time-series, with some exceptions identified by the ERT. There are three exceptions which are not documented: other kerosene (19.5 t/TJ instead of the IPCC value of 19.6 t/TJ), solid biomass (29.5 t/TJ instead of 29.9 t/TJ) and coking coal (24.0 t/TJ instead of 25.8 t/TJ). The ERT noted that annex 3 of the NIR provides a country-specific analysis of the CO₂ EF for coal and indicates EFs that are higher than the IPCC default values. It also indicates that EF varies over time.

29. The ERT noted that Finland is reporting carbon stored by substituting the assumption of carbon stored with actual data available from the plants. The ERT also noted that Finland uses an incorrect conversion factor for ktoe to TJ for crude oil (42.66); the correct international standard factor is 41.86. The Party explained that the error is in the unit labels, not in the conversion factor. All crude oil figures are reported in kt. The conversion factor 42.66 applies to conversion from kt to TJ. The ERT recommends that Finland correct the unit labels (kt instead of ktoe and TJ/kt instead of TJ/ktoe) in its next annual submission.

30. In its NIR Finland compares rough estimates of CO₂ with the detailed results of the sectoral approach using both the reference approach and an additional approach. The results of this additional approach match well with the sectoral estimates (the difference is only 2 per cent). The ERT noted that the origin of the EF used is not explained. The ERT also noted that annex 4 of the NIR compares fuel use data reported under the sectoral approach with the original energy balance data, but differences are not explained. The ERT recommends that Finland extend the justification of the differences between the approaches applied in its next annual submission.

2. International bunker fuels

31. Finland reported emissions from international bunker fuels on the basis of fuel sales using national EF derived from the national calculation system. The used NCVs vary over time and are different to International Energy Agency data. The ERT recommends that, for those fuels where variations occur, Finland include the annual NCVs in a tabular format in its next annual submissions for transparency reasons.

3. Feedstocks and non-energy use of fuels

32. The ERT noted that Finland, following recommendations of the previous review, updated the methods used to estimate emissions from feedstock and non-energy use of fuels and included results in the entire time series. The ERT commends Finland for this improvement.

4. Country-specific issues

33. Under fugitive emissions from oil, natural gas and other sources – other, Finland reports indirect CO₂ emissions through atmospheric transformation of non-methane volatile organic compound (NMVOC) emissions released during the processing of oil and gas. The ERT noted that the NIR provides only the method applied and the C-content value of the NMVOC emissions used and encourages Finland to further explain the reasons for this transformation.

34. The ERT noted that Finland has compared the CO₂ data derived from the European Union emission trading scheme (EU ETS) with the results of the estimates under sectoral approach. This comparison is complex due to different accounting methods applied (for example for CO₂ from iron and steel industry) and different definitions of the sectors. Despite the complexity of the comparison, the ERT encourages Finland to continue to use the EU ETS data for the purpose of verifying the emission estimates reported in the inventory.

35. The ERT also noted that Finland includes peat under 'other fuels' and not under 'solid fuels' as required by the Revised 1996 IPCC Guidelines. This limits comparability with other Parties. The ERT recommends that Finland report peat under 'fossil fuels' or provide an explanation for reporting peat under 'other fuels' in its next annual submission.

III. Industrial processes and solvent and other product use

A. Sector overview

36. In 2006, the industrial processes sector accounted for 6,124.76 Gg CO₂ eq, or 7.6 per cent of total GHG emissions, and the solvent and other product use sector accounted for 100.18 Gg CO₂ eq, or 0.1 per cent of total GHG emissions. Between the base year and 2006 emissions from the industrial processes sector increased by 21.0 per cent and emissions from the solvent and other product use sector decreased by 43.8 per cent. The key drivers for the trend of emissions in the industrial processes sector are CO₂ emissions from metal production and HFCs emissions from consumption of halocarbons and SF₆.

37. Within the industrial processes sector, 40.4 per cent of GHG emissions were from metal production, 26.0 per cent from chemical industry, 20.5 per cent from mineral products and 13.1 per cent from consumption of halocarbons and SF₆. Finland used various country-specific data to estimate emissions. The ERT noted that transparency of the inventory was improved in some categories such as CO₂ emissions from chemical industry – other and SF₆ emissions from consumption of halocarbons and SF₆ – electrical equipment. The ERT also noted that Finland reports some data as confidential (for example, N₂O emissions from nitric acid production).

38. Emissions from the industrial processes sector were recalculated in line with the IPCC good practice guidance as recommended by the previous review team, and the recalculations are well documented. Finland calculated indirect CO₂ emissions from CH₄ emissions in some subcategories such as ethylene production and iron and steel production, and identified the equations used in the NIR. However, Finland has not provided justification of such a transformation and relevant methodologies. The ERT recommends that Finland provide such relevant information in its next annual submission.

B. Key categories

1. Cement production – CO₂

39. Finland used plant-specific EFs for the whole time series. The ERT noted that the IEF is not stable, with notable decrease by 8.0 per cent in 2004. The ERT further noted that the NIR contains discrepancies in the determination of calcium oxide and magnesium oxide contents in clinker. In response to ERT questions during the review, Finland explained that the emissions for the most recent year represents the best available data, and that it is continuing to explore this issue and will report findings in its next annual submission. The ERT welcomes further exploration of this matter and recommends that Finland provide the findings in its next annual submission.

2. Nitric acid production – N₂O

40. Finland used plant-specific AD and EFs to estimate N₂O emissions from nitric acid production. The EFs were based on plant-specific measurements and have changed annually. Finland explained that the inter-annual changes of the EFs were due to replacement of plants, the use of new catalysts and changes to some processes. In addition, in response to the recommendation of the previous review, Finland provided the trends of some plant-specific EFs in the NIR. The ERT noted that the IEF decreased by 14.1 per cent in between 1990 and 2006. In response to a request by the ERT, Finland provided additional information on complete trends of EFs and confirmed that the methodologies and data used were adequate. Also Finland informed the ERT that it cannot give complete trends for plant-

specific EFs for confidentiality reasons. The ERT recommends that Finland provide complete trends of EFs and relevant data calculations to the extent possible in its next annual submission.

3. Iron and steel production – CO₂

41. Emissions of CO₂ from this category were estimated by subtracting combustion-related emissions based on the ILMARI system from total CO₂ emissions (combustion-related emissions and process-related emissions) based on the compliance monitoring data system VAHTI. The ERT noted that the VAHTI system was not complete and that some corrections were made in estimating total CO₂ emissions. Finland assessed the total CO₂ emissions estimated by the VAHTI system as being almost accurate and informed the ERT that more detailed information would require publishing confidential plant level calculations. The ERT recommends that Finland provide relevant verification data, to the extent possible, to demonstrate the accuracy of CO₂ emissions from iron and steel production.

C. Non-key categories

Soda ash production and use – CO₂

42. Most of the AD for this category were gathered direct from the individual companies. The ERT recommends that Finland check coverage of these data and provide relevant description in its next annual submission.

IV. Agriculture

A. Sector overview

43. In 2006, the agriculture sector in Finland accounted for 5,564.46 Gg CO₂ eq, or 6.9 per cent of total GHG emissions. Emissions from the sector decreased by 21.8 per cent between 1990 and 2006. This decrease in emissions was driven mainly by the fall in the populations of dairy cattle (by 36.8 per cent) and non-dairy cattle (by 26.4 per cent). In 2006, N₂O emissions accounted for 66.9 per cent and CH₄ for 33.1 per cent of sectoral emissions.

44. Within the agricultural sector most of the emissions came from agricultural soils, which accounted for 57.6 per cent of sectoral emissions; enteric fermentation accounted for 28.1 per cent and manure management the remaining 14.3 per cent. Finland stated that field burning of crop residues occurs occasionally on a small scale, but it considers emissions to be negligible and reports them as not occurring ('NO').

45. Since its 2007 submission Finland has carried out minor recalculations of emission estimates in agriculture for all years. The reasons for these recalculations are well documented in the NIR but not in the CRF. The ERT encourages Finland to report recalculations in CRF table 8(b) to improve completeness of its inventory in its next annual submission.

46. The ERT has noted some errors of nitrogen excretion reported under N₂O emissions from manure management (table 4.B (b)), which resulted in incorrect estimates of N₂O emissions under direct and indirect emissions from agricultural soils (table 4.Ds1). Finland may wish to provide a full nitrogen balance, for manure management and agricultural soils for the entire time series in the NIR; this will improve the transparency of the reporting. The ERT recommends that Finland improve its QC checking, which will improve the accuracy of reporting.

B. Key categories

1. Enteric fermentation – CH₄

47. Finland uses a tier 2 methodology and livestock population data from the MATILDA database, maintained by the Information Centre of the Ministry of Agriculture and Forestry, to estimate CH₄

emissions from enteric fermentation for all major livestock categories, together with country-specific EFs. A country-specific method and EFs have been developed and used to estimate emissions from reindeer and sheep. A tier 1 approach with IPCC default EFs was used to estimate CH₄ emissions from swine, horses and goats.

48. The ERT noted a discrepancy in the EFs of CH₄ for all cattle species for 2006 in the NIR (table 6.2_3) and CRF (table 4.A) and recommends that Finland correct it in its next annual submission.

49. Finland produces more than 3.7 million fur-farming animals per year, the highest production of all Annex I Parties, but has reported emissions from fur-farming livestock as 'NE'. The ERT noted that at least two Annex I Parties already report CH₄ emissions from this animal category and encourages Finland to develop an appropriate method to estimate them.

2. Manure management – N₂O

50. The ERT noted some discrepancies in the reporting of N₂O emissions in the NIR and CRF. According to the nitrogen excretion rates and animal population numbers reported in NIR tables 6.3_3 and 6.3_4 and CRF table 4.B (b), total nitrogen excretion for all livestock categories should be 116,634,528 kg in 2006 and not 113,872,898 kg as reported in CRF table 4.B (b). The ERT also noted that only 97.8 per cent of nitrogen from dairy cattle and 69.7 per cent from poultry is accounted for in the inventory. The ERT recommends that Finland correct the data in the CRF tables in its next annual submission.

51. The ERT noted that the IEF for solid storage and dry lot reported in the CRF is (0.0202 kg N₂O N/kg N) and not 0.02 kg N₂O-N/kg N as reported in the NIR (table 6.3_7). This is due to the error in the amount of nitrogen reported in CRF table 4.B (b) for solid storage and dry lot. If the correct nitrogen amount was reported in this table under solid storage and dry lot the EF would be 0.02 kg N₂O-N/ kg N as stated by Finland in the NIR. The ERT recommends that Finland corrects the data in CRF (table 4.B (b)) in its next annual submission.

3. Direct soil emissions – N₂O

52. Finland used the IPCC default tier 1a methodology and EFs to estimate direct N₂O emissions from agricultural soils. The ERT noted that Finland estimates and reports direct N₂O soils emissions from sewage sludge applied to fields under agricultural soils – other (4.D.4), which is not in line with the Revised 1996 IPCC guidelines. All emissions from direct soils should be reported under category 4.D.1. The ERT recommends that Finland report direct sewage sludge emissions under direct soil emissions – other direct emissions (4.D.1.6) in its next annual submission.

53. The ERT noted some discrepancies between the CRF and the NIR for manure nitrogen. The NIR states that total manure nitrogen, including grazing deposits, is 114,675 t, but CRF table 4.B (b) reports only 113,873 t. The time series reported in table 6.4_3 of the NIR appear incorrect for 2004, 2005 and 2006. In response to a question from the ERT, Finland acknowledged this error in its estimates. The ERT recommends that Finland correct this discrepancy in its next annual submission.

4. Indirect soil emissions – N₂O

54. Finland used an IPCC good practice guidance method (equation 4.32), together with a country-specific fraction of nitrogen input to soils that is lost through leaching and run-off (Frac_{LEACH}), to estimate indirect N₂O emissions from soil. In response to a question raised by the ERT during the review, Finland stated that it subtracted Frac_{GASF} and Frac_{GASM} from the nitrogen inputs before applying the Frac_{LEACH} value of 0.15. The ERT noted that this is not in line with the IPCC good practice guidance, which advises that Frac_{LEACH} should be applied to total synthetic fertilizer and animal manures unadjusted for volatilization of NO_x and ammonia (NH₃). The ERT recommends that Finland revise this emission estimation in its next annual submission.

C. Non-key categories

1. Manure management – CH₄

55. Finland estimated CH₄ emissions from this category using a tier 2 method and country-specific EFs for all animal categories. The ERT noted that all the percentages of manure and all the methane conversion factors (MCF) allocated to the different animal waste management systems in CRF table 4.B (a) s2 are incorrect. In response to a request by the ERT, Finland has agreed to correct these errors in its next annual submission. The ERT recommends that Finland ensure that the proper QC procedures are implemented in order to avoid errors of this nature in the future.

2. Pasture, range and paddock manure – N₂O

56. The ERT noted that the amount of nitrogen reported in CRF table 4.Ds1 for 2006 (15,308.4 t) does not correspond with the amount of nitrogen in CRF table 4.B. (b) (22,035.5 t) taking into account the fraction of N excretion that is volatilized as NH₃ and NO_x (Frac_{GASM} = 0.33). The ERT estimates the correct amount of nitrogen to be 14,763.8 t; it recommends that Finland correct this value in its next annual submission and ensure that the proper QC procedures are implemented in order to avoid errors of this nature in the future.

57. The ERT also noted that the fraction of livestock nitrogen excreted and deposited onto soils during grazing (Frac_{GRAZ}) is reported as 0.2 in CRF table 4.Ds2. The value of Frac_{GRAZ} reported should be based on the total nitrogen excreted to pasture, range and paddock reported in CRF table 4.B (b) divided by total nitrogen excreted as reported in CRF table 4.B (b). This value is 0.1935 for Finland in 2006, or possibly 0.1889 if the total nitrogen excreted as reported in CRF table 4.B (b) is corrected as mentioned above. The ERT recommends that Finland revise the estimates accordingly in its next annual submission.

V. Land use, land-use change and forestry

A. Sector overview

58. In 2006, the LULUCF sector accounted for net removals of 33,443.84 Gg CO₂ eq. Emissions from cropland and grassland amounted to 3,224.1 and 3,828.36 Gg CO₂ eq, respectively. Most of the removals (40,844.30 Gg CO₂ eq) came from forest land. Removals from the sector increased by 81.3 per cent between 1990 and 2006. The key driver for the rise in removals was the increase in removals from forest land. Settlements are reported as 'NE' and 'IE'. Under other land both 'NA' and 'NE' are reported.

59. The ERT noted that the impact of recalculations of the changes of the areas among the different land-use categories is less than 1 per cent. On the other hand, the ERT noted that the impact of the recalculation of the CO₂ uptake in tree biomass is quite high and varies from -2.8 per cent in 1998 to +11.9 per cent in 2004, which implies changes in methodologies applied.

60. Finland provided updated consistent data on areas of all land use categories for 1990–2006, but has not yet quantified the changes between the different land-use categories. Therefore all estimates of emissions and removals are reported under the subcategories of land remaining under the same land use. In the NIR, Finland states that the method for estimating converted areas is under development and will be ready for the 2010 inventory submission.

B. Key categories

1. Forest land remaining forest land – CO₂

61. Forest land, constituting 72.8 per cent of the total land area of Finland, is a sink offsetting 50.9 per cent of the total GHG emissions in 2006. The CO₂ uptake per hectare increased by 27 per cent from 1990 to 2006. Over that period removals from mineral soils increased by 50 per cent whereas emissions from organic soils decreased by 28 per cent. In response to a question from the ERT during the review Finland explained that these changes are caused by changes in forest management since 1960 and by the change in age class distribution. The ERT acknowledges that these changes are soundly based on the results of the national forest inventory.

2. Cropland remaining cropland – CO₂

62. Finland reported carbon stock changes of mineral and organic soils and CO₂ emissions from agricultural lime application. To estimate carbon stock change in the soil Finland used default IPCC values. Since 1990, CO₂ emissions from cropland remaining cropland have decreased almost continuously, mainly due to a reduction in the area of cultivated organic soils. Finland informed the ERT during the review week that it plans to apply a tier 3 method for estimating the carbon stock change of cropland soils in the future. The ERT commends this intention of Finland.

3. Grassland remaining grassland – CO₂

63. Grassland remaining grassland was a sink of 2,468.1 Gg CO₂ in 1990 and a source of 3,828.4 Gg CO₂ in 2006. The main source of CO₂ emissions is mineral soils. Finland explained that this trend was caused by an increase in the area of grassland in the 1970s and a decrease since 1990. The ERT could not fully follow the explanation in the NIR, which is based on the fact that a decreasing area causes an increasing emission; it invites Finland to explain the context more transparently.

64. Finland applied a tier 1 approach following the IPCC good practice guidance for LULUCF. The ERT noted that tier 1 approach applies only in the case of a change of the management regime, but Finland does not indicate such a change of the grassland management regime. The ERT recommends that Finland explore the possibilities of applying a higher tier approach for this key category, and include information on the changes in grassland management in its next annual submission.

C. Non-key categories

Agricultural lime application – CO₂

65. The ERT has noted a discrepancy between CO₂ emissions reported in the CRF and in the NIR. During the review Finland informed the ERT that the values in the CRF, which are about 7 per cent lower than those reported in the NIR, are the correct ones. The ERT recommends that Finland correct this discrepancy in its next annual submission.

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

66. In its 2007 submission, Finland provided a complete set of tables for the LULUCF sector under the Kyoto Protocol and an annex to the NIR with supplementary information. The ERT commends this voluntary submission.

67. The ERT noted that in the land transition matrix, Finland reported that the area for deforestation in the current year was less than that in the previous year that leads to an incorrect estimate of total land area. The ERT further noted that the changes in the area under forest management do not correspond with the size of deforested areas but that no explanations are provided for these changes. The ERT

invites Finland to provide the explanations and also to specify the content of land use change and forestry – other (5.G) in its next submission of the LULUCF tables under the Kyoto Protocol.

68. The ERT also noted that in some tables Finland reported carbon stock change in dead organic matter, litter or soil as included elsewhere ('IE'). It is not explained how and where it is included. According to decision 16/CMP.1, all pools have to be reported unless a Party provides information that the pool is not a source. If the pool is not a source, the ERT suggests that Finland report 'NO' instead of 'IE'.

69. In the supplementary background tables for LULUCF activities under Article 3, paragraph 3, of the Kyoto Protocol (table 5(KP-1)A.1.3), Finland reports afforested areas that would otherwise be reported under cropland, grassland, peat extraction areas, wetlands and settlements. As Finland did not elect those activities, they should not be reported in this table. The only parameter Finland should report in this table is units of land under afforestation otherwise subject to forest management.

70. Finland stated in its NIR that it uses growth functions for afforestations/reforestations based on National Forest Inventory measurements. It is not clear whether these are simply average growth factors or whether they were specifically derived for young stands that have growth factors that are very small at the beginning but that increase with time. The ERT encourages Finland to provide explanations in its next submission of the LULUCF tables under the Kyoto Protocol.

71. In its NIR, Finland stated that one purpose of deforestation is the restoration of forests in peatland. The ERT could not verify if this is deforestation or reforestation, and it encourages Finland to further elaborate peatland conversion to forest land in its next submission of the LULUCF tables under the Kyoto Protocol.

72. Finland reported further that in the case of forest land conversion to settlements, not all trees are cut; it estimated that an average biomass of 20 t of carbon per hectare is not removed. The ERT noted that this may still result in a cover that is higher than the minimum cover according to the Finnish forest definition, so that land cannot be considered as settlements. The ERT encourages Finland to justify the forest land conversion to settlements and the estimate of biomass left on the converted land in its next submission of the LULUCF tables under the Kyoto Protocol.

73. The ERT noted that the NIR reports areas cleared for forest roads but that Finland declares that forest roads are classified as forest land. It is not clear whether the carbon losses from forest road construction are reported under deforestation or under forest management. The ERT encourages Finland to provide clarification of this issue in its next submission of the LULUCF tables under the Kyoto Protocol.

VII. Waste

A. Sector overview

74. In 2006, the waste sector accounted for 2,497.24 Gg CO₂ eq, or 3.1 per cent of total GHG emissions. Emissions from the sector decreased by 37.2 per cent between 1990 and 2006. The key driver for the fall in emissions is the implementation of the Waste Act since 1994 which endorses the minimization of waste generation, recycling and reuse of waste material, landfill gas recovery and alternatives to landfill and treatment methods. Within the sector, 85.7 per cent of the emissions were from solid waste disposal on land, 9.4 per cent were from wastewater handling, and 5.0 per cent from composting. Incineration and composting are minor categories in the sector.

75. The ERT noted that Finland reported only the QC procedures implemented and recommends that Finland implement QA procedures, at least for key categories, for the future inventory submissions.

76. The ERT appreciated the implementation of the tier 2 uncertainty assessment but recommends that Finland provide more explanation on some uncertainty estimates based on expert judgment. The major planned improvement reported by Finland is related to time series consistency on data and information on solid waste composition and generation and on wastewater.

B. Key categories

Solid waste disposal on land – CH₄

77. Finland applied the first order decay model as required by the IPCC good practice guidance to estimate CH₄ emissions from landfills. In response to a question from the ERT during the review, Finland explained that the historical waste amount was estimated on the basis of different population size and gross domestic product. The ERT encourages Finland to improve the transparency of data compilation and estimation of trends in its next annual submission.

78. Finland reported that before 2002 many of the landfills were shallow (less than 5 m deep) and that since 2002 the MCF equal to 1 has been applied for all managed landfills. The ERT noted that the MCF values reported for the period 1990–2001 range from 0.982 to 0.988. In response to the request for clarifications by the ERT during the centralized review, Finland explained that the average MCF values have been calculated using the IPCC default values. The ERT recommends that Finland explain how the average has been derived in the next annual submission.

79. As required by the IPCC good practice guidance, Finland considered different waste types – slowly degradable, rapidly degradable and moderately degradable – and used the IPCC default values for the methane generation rate constant. The ERT noted that the degradable organic carbon (DOC) for municipal solid waste (0.1975) has been derived from the composition of solid waste based on the data for 1990, and advised that using the 1990 waste composition for the period 1990–2006 is not in line with the IPCC good practice guidance. Given that Finland is compiling data and information on waste composition for 1990–2006, the ERT recommends that Finland update information on waste composition for this period in its next annual submission, as was recommended by the previous review. The ERT encourages Finland to explain how the DOC corresponding to the total amount of waste has been derived, considering the different waste groups and subgroups reported, and why the value for DOC has been kept constant throughout the time series 1990–2006.

C. Non-key categories

1. Wastewater handling – CH₄

80. The ERT noted that a comprehensive description of the wastewater management system is not provided in the NIR. Finland reported that collected domestic and industrial wastewater is treated anaerobically or aerobically, but the ERT found that the MCF reported for domestic wastewater (0.01 or 1 per cent) and industrial wastewater (0.005 or 0.5 per cent), both based on expert judgement, are very low, close to that for aerobic treatment. The ERT recommends that Finland explain the expert judgment in its next annual submission.

81. The ERT further recommends that, in its next submission, Finland use the IPCC method based on the maximum CH₄ producing capacity and the weighted average MCF, as provided in the IPCC good practice guidance.

2. Waste incineration – CO₂, CH₄ and N₂O

82. Incineration is used in Finland to produce energy and emissions are reported in the energy sector, as required by the IPCC good practice guidance. Finland reported these emissions under ‘energy industries and manufacturing industries and construction’. The ERT noted that Finland provided

background data – for example, on amount of waste, carbon content, calorific value of waste – for which it is commended.

3. Composting – CH₄ and N₂O

83. Emissions are estimated using EFs from a recently published scientific international literature. Estimates include emissions from municipal solid waste, municipal and industrial sludge and industrial solid waste (construction and demolition waste). The ERT commends Finland for reporting on this category.

VIII. Other issues

1. Changes to the national system

84. In its annual 2008 submission, Finland reported that since the submission of Finland's initial report under the Kyoto Protocol to the UNFCCC secretariat on 22 December 2006, only minor changes have occurred in the national system. These minor changes concern matters for which reporting is not required, such as temporary changes of personnel.

2. Changes to the national registry

85. In its 2008 annual submission, Finland reported that since the submission of Finland's initial report under the Kyoto Protocol to the UNFCCC secretariat on 22 December 2006, only minor changes have occurred in the national registry. These minor changes concern matters for which reporting is not required, such as temporary changes of personnel. The independent assessment report identified some minor errors in the stage of registry readiness. Additional clarifications on these errors were sent to the operator of the international transaction log. Additional information on the registry administrator and on the division of duties between the institutions involved in the registry is included in the NIR.

3. Commitment period reserve

86. Finland has not reported its commitment period reserve in the 2008 annual submission. In response to questions raised by the ERT during the review, Finland reported that its commitment period reserve has not changed since the initial report review (319,515,791 t CO₂ eq). The ERT agrees with this figure. The ERT recommends that Finland include information on its commitment period reserve in its next annual submission under the Kyoto Protocol.

IX. Conclusions and recommendations

87. Finland submitted its 2008 inventory in time; it contains a complete set of CRF tables for the period 1990–2006 and an NIR. The inventory covers all source and sink categories for the period 1990–2006 and the complete territory of the Party. Some minor categories are reported as 'NE' in agriculture, LULUCF and waste, mainly because of lack of AD or because no IPCC default methods are available.

88. The inventory is in line with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The 2008 inventory submission is of a high quality and the Party addressed most issues raised during the initial review.

89. The key recommendations of the ERT are:

- (a) To improve transparency by including separate chapters for each source/sink category especially for all key categories, ensuring a minimum level of documentation on methods, EFs and AD, and providing explanations of peculiar emission and/or IEF trends for key categories at category level;

- (b) To further strengthen the QA/QC procedures, in particular in agriculture, for example, to ensure consistent nitrogen amounts in manure management and soil emissions;
- (c) To check the N₂O EF for gasoline from road transportation and include a separate chapter in the NIR on this key category;
- (d) To reconsider and elaborate voluntary reporting under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.

X. Questions of implementation

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

Annex**Documents and information used during the review****A. Reference documents**

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/gp/lulucf/gp/lulucf.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 2007. Available at <<http://unfccc.int/resource/docs/2007/asr/fin.pdf>>.

Status report for Finland 2008. Available at <<http://unfccc.int/resource/docs/2008/asr/fin.pdf>>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2007. Available at <<http://unfccc.int/resource/webdocs/sai/2007.pdf>>.

Synthesis and assessment report on the greenhouse gas inventories submitted in 2008. Available at <<http://unfccc.int/resource/webdocs/sai/2008.pdf>>.

FCCC/ARR/2006/FIN. Report of the individual review of the greenhouse gas inventory of Finland submitted in 2006. Available at <<http://unfccc.int/resource/docs/2008/arr/fin.pdf>>.

FCCC/IRR/2007/FIN. Report of the review of the initial report of Finland. Available at <<http://unfccc.int/resource/docs/2007/irr/fin.pdf>>.

B. Additional information provided by the Party

Responses to questions during the review were received from Ms. Riitta Pipatti (Greenhouse Gas Inventory Unit, Statistics Finland), including additional material on the methodology and assumptions used.
