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

* In the symbol for this document, 2010 refers to the year in which the inventory was submitted, and not to the year of publication.

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I. Introduction and summary

A. Overview

1. This report covers the centralized review of the 2010 annual submission of Finland, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 13 to 18 September 2010 in Bonn, Germany, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalists – Mr. Domenico Gaudioso (Italy) and Mr. Justin Goodwin (United Kingdom of Great Britain and Northern Ireland); energy – Ms. Kristien Aernouts (Belgium), Mr. Gebru Jember Endalew (Ethiopia), Mr. Fernando Farías (Chile) and Mr. Suthum Patumsawad (Thailand); industrial processes – Ms. Marisol Bacong (Philippines) and Mr. Dušan Vácha (Czech Republic); agriculture – Mr. Sergio González (Chile) and Mr. Mahmoud Medany Awad (Egypt); land use, land-use change and forestry (LULUCF) – Ms. Savitri Garivait (Thailand), Ms. Gro Høyen (Norway) and Mr. Harry Vreuls (Netherlands); and waste – Mr. Mark Hunstone (Australia) and Ms. Baasansuren Jamsranjav (Mongolia). Mr. Goodwin and Mr. González were the lead reviewers. The review was coordinated by Mr. Sabin Guendehou and Mr. Matthew Dudley (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. Emission profiles and trends

3. In 2008, the main greenhouse gas (GHG) in Finland was carbon dioxide (CO₂), accounting for 82.7 per cent of total GHG emissions¹ expressed in carbon dioxide equivalent (CO₂ eq), followed by nitrous oxide (N₂O) (9.6 per cent) and methane (CH₄) (6.2 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) collectively accounted for 1.5 per cent of the overall GHG emissions in the country. The energy sector accounted for 78.2 per cent of total GHG emissions, followed by industrial processes (10.0 per cent), agriculture (8.4 per cent), waste (3.2 per cent) and solvent and other product use (0.1 per cent). Total GHG emissions amounted to 70,281.51 Gg CO₂ eq and decreased by 0.2 per cent between the base year² and 2008. The trends for the different gases and sectors are reasonable and consistent with the explanations provided in the national inventory report (NIR).

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, paragraphs 3 and 4, of the Kyoto Protocol (KP-LULUCF), by gas and by sector, respectively. In table 1 CO₂, CH₄ and N₂O emissions included in the rows under Annex A sources do not include emissions and removals from the LULUCF sector.

¹ In this report, the term “total GHG emissions” refers to the aggregated national GHG emissions expressed in terms of CO₂ eq excluding LULUCF, unless otherwise specified.

² “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 include emissions from Annex A sources only.

Table 1
Greenhouse gas emissions from Annex A sources and emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, by gas, base year to 2008^a

| | | <i>Gg CO₂eq</i> | | | | | | | | <i>Change</i> | |
|-----------------------|--------------------------|----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------------------|----|
| | | <i>Base year</i> | <i>1990</i> | <i>1995</i> | <i>2000</i> | <i>2005</i> | <i>2006</i> | <i>2007</i> | <i>2008</i> | <i>Base year– 2008 (%)</i> | |
| <i>Greenhouse gas</i> | | | | | | | | | | | |
| Annex A sources | CO ₂ | 56 624.33 | 56 624.33 | 57 858.58 | 56 710.30 | 56 357.05 | 67 737.78 | 66 102.46 | 58 138.74 | 2.7 | |
| | CH ₄ | 6 315.25 | 6 315.25 | 6 103.65 | 5 405.55 | 4 529.75 | 4 587.93 | 4 465.74 | 4 339.81 | –31.3 | |
| | N ₂ O | 7 410.16 | 7 410.16 | 6 806.29 | 6 498.74 | 6 712.04 | 6 603.73 | 6 626.85 | 6 757.40 | –8.8 | |
| | HFCs | 29.33 | 0.02 | 29.33 | 494.13 | 863.95 | 747.84 | 904.12 | 993.97 | 3 289.0 | |
| | PFCs | 0.14 | 0.07 | 0.14 | 22.46 | 9.88 | 15.43 | 8.40 | 11.23 | 7 922.1 | |
| | SF ₆ | 68.53 | 94.38 | 68.53 | 51.49 | 32.68 | 40.25 | 35.97 | 40.36 | –41.1 | |
| KP-LULUCF | Article 3.3 ^b | CO ₂ | | | | | | | 1 809.24 | | |
| | | CH ₄ | | | | | | | IE, NA, NO | | |
| | | N ₂ O | | | | | | | 6.81 | | |
| | Article 3.4 ^c | CO ₂ | NA | | | | | | | –39 926.56 | NA |
| | | CH ₄ | NA | | | | | | | 1.28 | NA |
| | | N ₂ O | NA | | | | | | | 34.23 | 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, IE = included elsewhere, NA = not applicable, NO = not occurring.

^a “Base year” for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆. The “base year” for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

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

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

Table 2
Greenhouse gas emissions by sector and activity, base year to 2008

| | Sector | Base year ^a | Gg CO ₂ eq | | | | | | Change Base year–2008 (%) | |
|-------------------------------|-------------------------------|------------------------|-----------------------|------------------|------------------|------------------|------------------|-------------------|------------------------------|-------------|
| | | | 1990 | 1995 | 2000 | 2005 | 2006 | 2007 | | 2008 |
| Annex A | Energy | 54 517.24 | 54 517.24 | 56 069.69 | 54 391.53 | 53 947.52 | 65 186.92 | 63 165.46 | 54 973.36 | 0.8 |
| | Industrial processes | 5 074.09 | 5 070.56 | 4 638.36 | 5 504.24 | 6 211.33 | 6 157.45 | 6 693.06 | 7 030.84 | 38.7 |
| | Solvent and other product use | 178.37 | 178.37 | 142.77 | 124.71 | 106.39 | 100.18 | 97.07 | 85.88 | –51.9 |
| | Agriculture | 6 703.44 | 6 703.44 | 6 104.64 | 5 891.02 | 5 831.89 | 5 824.06 | 5 808.75 | 5 922.90 | –11.6 |
| | Waste | 3 974.60 | 3 974.60 | 3 911.06 | 3 271.16 | 2 408.21 | 2 464.35 | 2 379.20 | 2 268.53 | –42.92 |
| | Other | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | LULUCF | NA | –15 985.44 | –14 061.23 | –22 590.80 | –32 823.12 | –37 854.79 | –30 651.60 | –35 393.84 | NA |
| Total (with LULUCF) | | NA | 54 458.77 | 56 805.29 | 46 591.86 | 35 682.22 | 41 878.17 | 47 491.94 | 34 887.67 | NA |
| Total (without LULUCF) | | 70 447.74 | 70 444.21 | 70 866.52 | 69 182.66 | 68 505.34 | 79 732.96 | 78 143.54 | 70 281.51 | –0.2 |
| KP-LULUCF | Article 3.3 ^b | | | | | | | | | |
| | Afforestation & reforestation | | | | | | | | –1 077.08 | |
| | Deforestation | | | | | | | | 2 893.13 | |
| | Total (3.3) | | | | | | | | 1 816.05 | |
| | Article 3.4 ^c | | | | | | | | | |
| | Forest management | | | | | | | | –39 891.04 | |
| | Cropland management | NA | | | | | | | NA | NA |
| Grazing land management | NA | | | | | | | NA | NA | |
| Revegetation | NA | | | | | | | NA | NA | |
| Total (3.4) | NA | | | | | | | –39 891.04 | NA | |

Abbreviations: LULUCF = land use, land-use change and forestry; KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable.

^a “Base year” for Annex A sources 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” 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.

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

Table 3

Information to be included in the compilation and accounting database in t CO₂ eq

| | <i>As reported</i> | <i>Adjustment^a</i> | <i>Final^b</i> | <i>Accounting quantity^c</i> |
|---|--------------------|-------------------------------|--------------------------|--|
| Commitment period reserve | 319 515 790 | | 319 515 790 | |
| Annex A emissions for current inventory year | | | | |
| CO ₂ | 58 138 745 | | 58 138 745 | |
| CH ₄ | 4 237 117 | | 4 339 810 | |
| N ₂ O | 6 704 131 | | 6 757 404 | |
| HFCs | 993 966 | | 993 966 | |
| PFCs | 11 231 | | 11 231 | |
| SF ₆ | 40 355 | | 40 355 | |
| Total Annex A sources | 70 125 545 | | 70 281 511 | |
| Activities under Article 3, paragraph 3, for current inventory year | | | | |
| 3.3 Afforestation and reforestation on non-harvested land for current year of commitment period as reported | -1 077 083 | | -1 077 083 | |
| 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 | 2 893 130 | | 2 893 130 | |
| Activities under Article 3, paragraph 4, for current inventory year^d | | | | |
| 3.4 Forest management for current year of commitment period | -39 891 042 | | -39 891 042 | |
| 3.4 Cropland management for current year of commitment period | | | | |
| 3.4 Cropland management for base year | | | | |
| 3.4 Grazing land management for current year of commitment period | | | | |
| 3.4 Grazing land management for base year | | | | |
| 3.4 Revegetation for current year of commitment period | | | | |
| 3.4 Revegetation in base year | | | | |

Abbreviations: NA = not applicable.

^a "Adjustment" is relevant only for Parties for which the expert review team (ERT) has calculated one or several adjustment(s).

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

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

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

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

6. The 2010 annual inventory submission was submitted on 15 April 2010 and resubmitted on 26 May 2010; it contains a complete set of common reporting format (CRF) tables for the period 1990–2008 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 under Article 3, paragraph 14, of the Kyoto Protocol. The standard electronic format (SEF) tables were submitted on 26 March 2010. The annual submission was submitted in accordance with decision 15/CMP.1.

7. Finland officially submitted revised emission estimates on 13 October 2010 in response to questions raised by the expert review team (ERT) during the course of the centralized review for: CH₄ emissions from enteric fermentation (see para. 64 below), CH₄ emissions from manure management (see para. 73 below), indirect N₂O emissions from agricultural soils (see para. 71 below) and CH₄ emissions from solid waste disposal on land (see para. 96 below). The revised estimates result in an increase in total GHG emissions of 0.2 per cent in 2008 compared to the initial submission. Where necessary, the ERT also used the previous year's submission during the review.

8. In addition, the ERT used the standard independent assessment report (SIAR), parts I and II, to review information on the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and on the national registry.³

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

Completeness of inventory

10. The inventory covers all source and sink categories for the period 1990–2008, and is complete in terms of years and geographical coverage. Finland has provided all CRF tables for the years 1990–2008. Completeness, comparability and accuracy of the inventory have improved since the Party's last submission, in particular with regard to the LULUCF sector, where the Party reported for the first time land remaining in the same land-use category and land converted to another land-use category separately and included associated carbon stock changes in litter, dead wood and soils. The ERT commends Finland for this achievement. However, the ERT noted that CH₄ emissions from enteric fermentation and manure management, indirect N₂O emissions from agricultural soils and CH₄ emissions from solid waste disposal on land were potential underestimations of emissions (see para. 7 above).

³ The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5(a), 6(c) and 6(k)), under the auspices of the international transaction log 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.

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

Overview

11. Finland reported that no changes in the national system under Article 5, paragraph 1, of the Kyoto Protocol have been implemented. The ERT concluded that the national system continued to perform its required functions.

Inventory planning

12. The NIR described the national system and institutional arrangements for the preparation of the inventory. Statistics Finland has overall responsibility for the national inventory. Other institutes are also involved in the preparation of the inventory at the sectoral level: the Finnish Environment Institute (responsible for fluorinated gases (F-gases) and waste); MTT Agrifood Research Finland and the Finnish Forest Research Institute (responsible for agriculture and LULUCF); VTT Technical Research Centre of Finland (responsible for transport); and Finavia (the former Civil Aviation Administration) (responsible for aviation). Statistics Finland was appointed as the national authority for Finland's GHG inventory at the beginning of 2005. In addition to the preparation of the inventory, Statistics Finland is also responsible for inventory reporting and submission under the Convention and the Kyoto Protocol.

Inventory preparation

Key categories

13. Finland has reported key category, tier 1 and tier 2 analyses, both level and trend assessment, as part of its 2010 submission. The key category analysis performed by the Party and that performed by the secretariat⁴ produced different results, owing to the use by the Party of a more detailed categorization of source and sink categories than the approach contained in 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). Finland reported that the tier 2 key category analysis is used in annual quality meetings to screen the long list of category–gas combinations and to identify those that are most important in terms of the emissions level and the trend, and to assess the need for improvement with the sectoral experts. The key categories are also subject to more detailed documentation and quality control. Finland reported that none of the key categories were identified using the qualitative criteria.

14. Finland has included the LULUCF sector in its key category analysis, which was performed in accordance with 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 ERT noted that the key categories list reported in CRF table 7 is not consistent with the list reported in the NIR. For example, grassland remaining grassland – CO₂ is reported as a key category in CRF table 7 but is not reported in the key categories list in the NIR, and cropland converted to forest land – CO₂ is

⁴ The secretariat identified, for each Party, the categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance for 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.

reported as a key category in the NIR but not in CRF table 7. During the review process, Finland explained that the key categories in CRF table 7 are correct. The ERT recommends that Finland improve the consistency between the NIR and CRF table 7 in its next annual submission.

15. The key category analysis for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol was performed according to section 5.4 of the IPCC good practice guidance for LULUCF. The correlation with the corresponding LULUCF key category analysis under the Convention is provided only in CRF table NIR.3.

Uncertainties

16. Finland reported in its NIR that both the IPCC tier 1 and tier 2 uncertainty analyses have been performed. The results of the tier 1 analysis are presented in annex 6 to the NIR, both at a summary level and at the individual category level. Sector-specific descriptions of the uncertainties are also provided in the sectoral chapters. The estimate of the overall uncertainty of the inventory is within ± 49 per cent, which is 26 per cent higher than in the 2009 submission. In response to recommendations formulated in previous review reports, Finland included in its 2010 NIR a summary of the changes in the uncertainty estimates in its most recent submissions. In response to a question raised by the ERT during the review, the Party explained that the high uncertainty for the whole inventory is largely due to the LULUCF sector, and that its changes from year to year are in line with changes in the share of LULUCF. The ERT encourages Finland to continue to provide information on the development of its uncertainty estimates over time. The NIR explains how uncertainty assessments at the sectoral level carried out using a tier 2 methodology are used in the preparation of the inventory in order to identify assumptions and data that have the greatest bearing on uncertainty, and therefore potential for improvement.

17. Finland reported that uncertainties were not estimated separately for land under forest management and it was assumed that uncertainty estimates for forest land also apply to land under forest management. The relative standard error reported by Finland was 30 per cent for carbon stock changes in living biomass, 92 per cent for carbon stock changes in mineral soils and 78 per cent for organic soils. The Party also indicated that the uncertainty estimates for Article 3, paragraph 3, activities are expected to be much higher, but that the method for uncertainty estimation will be further developed. The ERT recommends that Finland improve the uncertainty estimates for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol in future annual submissions.

Recalculations and time-series consistency

18. Recalculations since the previous submission have been performed and reported in accordance with the IPCC good practice guidance. The ERT noted that recalculations reported by the Party of the time series 1990–2007 have been undertaken to take into account the guidance contained in the IPCC good practice guidance and the recommendations from previous ERTs. The main drivers for the recalculations were: in the energy sector – the update of N₂O emission factors (EFs) used in the LIISA road transportation model to follow the COPERT 4 programme; in the industrial processes sector – the revision of some activity data (AD) and EFs and the modification of the calculation model for foam blowing and SF₆ emissions from electrical equipment; in the agriculture sector – the incorporation into the inventory of a nitrogen (N) mass flow model and changes in data; in the LULUCF sector – the splitting of each category between land remaining in the same land-use category and land converted to another land-use category; and in the waste sector – the improvement of AD for N₂O and CH₄ emissions from uncollected domestic wastewater. The major changes, and the magnitude of the impact, include a decrease in the estimated total GHG emissions in the base year (0.7 per cent) and

a decrease in 2007 (0.4 per cent). During the review, Finland provided revised emission estimates for the agriculture and waste sectors (see para. 7 above) in response to questions raised by the ERT.

Verification and quality assurance/quality control approaches

19. Statistics Finland has overall responsibility for the quality assurance and quality control (QA/QC) process. The other institutions involved are represented in the inventory working group, which meets four to seven times a year, and take part, once a year, in the bilateral quality meetings between the inventory unit and the expert organizations, where issues concerning the inventory quality and improvement needs are discussed. The NIR presents the quality objectives and the QA/QC plan. The category-specific QA/QC details are discussed in the sectoral chapters of the NIR. As a follow-up to previous reviews, Finland has included, in its 2010 inventory submission, summary results of the QC procedures performed. More detailed information has also been provided on the quality checks performed by the supervising authority before accepting the information communicated to the central database of environmental administration (VAHTI). During the review, Finland also explained that the need and focus of internal audits are identified annually during the bilateral quality meetings. The ERT commends Finland for the elaboration and implementation of these systematic QA/QC procedures, and encourages the Party to continue to provide information on this subject, in particular by including in an annex to future annual submissions, information on QC checks for the VAHTI database, and on the reporting on the audits performed every year.

Transparency

20. Finland has improved the transparency of its annual inventory submission, in particular by including separate chapters in the NIR for each source/sink category or for a group of related categories. The ERT did not experience major difficulties in understanding the information provided by Finland in its 2010 annual submission. However, the ERT noted that documentation on the N mass flow model used in the agriculture sector could be improved (see para. 67 below). 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 GHG inventory. The sectoral chapters include information on methodological issues, AD and EFs, together with source-specific uncertainty assessments, QA/QC procedures and verification activities, recalculations and planned improvements. The information provided in the CRF tables and the NIR is largely consistent, except for a few instances. For example, CRF table summary 3 indicates that a tier 3 approach has been used for energy industries, manufacturing industries and construction, transport and other sectors for CO₂, CH₄ and N₂O, while the NIR (page 59) reports the use of a method consistent with a tier 2 approach. The ERT recommends that Finland continue to improve the transparency of information provided in the NIR and the consistency between the NIR and CRF table summary 3 in its next annual submission.

Inventory management

21. Finland has a centralized archiving system located at Statistics Finland, which includes the archiving of disaggregated EFs and AD and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory. The archived information also includes internal documentation on QA/QC procedures, external and internal reviews, and documentation on annual key categories and key category identification and on planned inventory improvements. The annual inventory process documents, including primary material and internal documents used for the calculations, are also archived at the expert organizations responsible for the sectors.

3. Follow-up to previous reviews

22. Finland has made major improvements in its 2010 inventory submission by implementing most of the recommendations formulated during the previous expert reviews. For example, the Party has provided information on the basis for the uncertainty estimates and a summary of the changes in the uncertainty estimates, and has improved the description of QA/QC procedures by including in the NIR a summary of the results of the checks performed as well as information on internal audits. The way in which Finland has implemented the recommendations formulated in the 2009 expert review report is transparently documented in table 10.4-2 of the NIR. The ERT noted with appreciation that Finland explained how it will consider the recommendations from the previous expert reviews that have not yet been addressed (see para. 23 below).

4. Areas for further improvement

Identified by the Party

23. The 2010 NIR identifies several areas for improvement. Finland provided, in table 10.4-1 of its NIR, a summary of the sectoral improvements for forthcoming inventories identified by the expert review process, together with a tentative time schedule for their implementation. Below are the main improvements reported by the Party:

- (a) Using emission data for aviation from the sources of the European Organization for the Safety of Air Navigation (EUROCONTROL);
- (b) Improving the calculation of emissions from leisure boats and adjusting the model to follow the changes due to the new boat register;
- (c) Providing a national reference calculation for CO₂ emissions from energy combustion;
- (d) The methods to update the distribution of different manure management systems will be regularly explored in the agriculture sector;
- (e) The methodology for estimating carbon stock changes in cropland and grassland will be reviewed in the LULUCF sector;
- (f) Further developing the methodology used to identify transitions between land-use categories with national forest inventory (NFI) field data to fulfil the requirements of Article 3, paragraph 3, regarding the reporting of activities (with a possibility for additional sampling) in the LULUCF sector;
- (g) Investigating the possibility of using NFI sample plot data with forest statistics to quantify the annual drain in the LULUCF sector;
- (h) Investigating the possibility of using NFI sample plot data to estimate the division of the drain between the remaining and conversion classes in the LULUCF sector;
- (i) Analysing the sensitivity, uncertainty and applicability of the Yasso07 soil carbon model in order to establish a consistent soil carbon estimation method for the whole LULUCF sector;
- (j) The waste composition data will be checked, especially for the last three to four years;
- (k) The need for new composition data for mixed construction and demolition waste is under consideration;
- (l) The AD in the VAHTI system for wastewater handling will be checked;
- (m) The AD for waste composting will be checked.

Identified by the expert review team

24. The ERT identified the following cross-cutting issues for improvement:
- (a) The improvement of the consistency between the NIR and CRF table summary 3, and the NIR and CRF table 7;
 - (b) The improvement of transparency in the NIR on the N mass flow model in the agriculture sector by including the information provided during the centralized review and the reference of the paper on the model in the NIR list of references;
 - (c) The provision of information on internal audits identified annually in the bilateral quality meetings;
 - (d) The provision of uncertainty estimates for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;
 - (e) The inclusion of more detailed information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol.
25. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report.

B. Energy

1. Sector overview

26. The energy sector is the main sector in the GHG inventory of Finland. In 2008, emissions from the energy sector amounted to 54,973.36 Gg CO₂ eq, or 78.2 per cent of total GHG emissions. Since 1990, emissions have increased by 0.8 per cent. The key driver for the rise in emissions is the growth of emissions from energy industries, driven by the change in shares of imported electricity across the time series, and from transport, primarily driven by road transportation. The main contributors to the rise in emissions are energy industries, with a 26.5 per cent growth, and transport, with a 6.6 per cent growth. Within the sector, 44.2 per cent of the emissions were from energy industries, followed by 24.8 per cent from transport, 19.6 per cent from manufacturing industries and construction and 8.7 per cent from other sectors. The category other accounted for 2.4 per cent. The remaining 0.3 per cent was from fugitive emissions.

27. Finland has calculated emissions for all categories, gases and fuels used in the energy sector, as recommended by the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines). Emissions from the energy sector have been reported for all years of the inventory time series and have been mainly calculated using the ILMARI calculation system developed at Statistics Finland. Only fugitive emissions from solid fuels have been reported as not occurring (“NO”). Emissions from peat production are reported in the LULUCF sector under wetlands consistent with the IPCC good practice guidance for LULUCF.

28. Finland has also provided information on QA/QC procedures performed at the national level according to the IPCC good practice guidance. One of the QA/QC procedures implemented by Finland is the verification of emission estimates by comparing the estimates with emissions reported under the European Union emissions trading scheme (EU ETS).

29. Finland has provided quantitative information on the energy sector recalculations in table 10.1-1 of the recalculations chapter. The recalculations were performed to update the N₂O EFs used in the LIISA road transportation model to follow the COPERT 4 programme and to remove inconsistencies in plant-level time-series data (activity, combustion

technology or allocation). The overall results of the recalculations show a decrease in total emissions of 0.6 per cent in 2007.

2. Reference and sectoral approaches

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

30. Finland has calculated CO₂ emissions from fossil fuel combustion using the reference approach and the sectoral approach for all years in the time series. In 2008, CO₂ emissions estimated using the sectoral approach were 0.2 per cent lower than those estimated using the reference approach. The early years of the time series exhibit the largest differences, especially in 1992 and 1993. Finland indicated in its NIR that no obvious reasons for these differences have been found. Previous review reports have encouraged Finland to continue its efforts to better explain these differences, and the ERT reiterates that encouragement. In its response to the draft annual review report, Finland emphasized, as in responses to previous reviews, that efforts to explain the differences have been made but the obvious reasons for the differences have not been found (see NIR pages 123–124). As explained in the NIR, further work to clarify this issue would be very resource consuming. Finland will not prioritize this issue when improving the Finnish inventory due to its minor importance and in order not to jeopardize resources for more significant tasks.

31. The previous review report recommended that Finland include in future annual submissions an annex providing the national energy balances used in the top-down reference calculation in order to increase the transparency of the comparison between the energy balance and the GHG inventory. Finland indicated in its NIR (page 440) that this annex will be included in the 2011 submission, as the finalized energy balance was not available for the preparation of the 2010 submission. The ERT reiterates the recommendation from the previous review report that Finland include this annex in its next annual submission.

International bunker fuels

32. Finland reported emissions from international bunker fuels on the basis of fuel sales using country-specific CO₂ EFs and non-CO₂ EFs from the Revised 1996 IPCC Guidelines. Finland indicated the possibility of minor double counting with domestic navigation where there are both international and domestic ports. The ERT recommends that Finland address this issue and ensure that emissions are not double counted in the next annual inventory submission.

33. The previous review report indicated that transparency could be increased by including separate fuel consumption values in appendix 3b of the NIR, which provides details of the consumption of international bunker fuels by fuel type. The ERT noted that information on bunker fuels is now provided in the NIR and the ERT commends Finland for this action.

Feedstocks and non-energy use of fuels

34. Finland reported emissions from feedstocks and non-energy use of fossil fuels under the category other (energy (1.A.5.a)). The Party applied the IPCC default factors from the Revised 1996 IPCC Guidelines and country-specific EFs. The information presented in the NIR is generally transparent with regard to the methodological approach and the reporting of the emissions. However, Finland reported lubricant usage as non-energy use of fuels, but did not split it between domestic and international usage, as only information on total sales of lubricants is available in the fuel statistics. Although Finland stated that the impact of this on total emissions is estimated to be very small, the ERT encourages Finland to

increase the transparency of its emission calculations by reporting lubricant usage separately between domestic and international usage.

Country-specific issues

35. Finland reported the use of peat under other fuels in the CRF tables. The Party has provided a detailed explanation in the NIR for the reporting of this fuel. Finland explained that this classification is appropriate since peat is a domestic fuel and is reported separately from solid fuel, which is usually imported coal. This allows Finland to estimate and interpret emissions transparently. The ERT commends Finland for its efforts to improve transparency.

36. In the 2010 submission, Finland has reported for the second time a category entitled "CO₂ transfer" under other (manufacturing industries and construction). Finland indicated in the NIR that the lime kilns from the pulp production process have been chosen for the CO₂ source of precipitated calcium carbonate (PCC) production because an excess amount of CO₂ is produced in the process, which captures CO₂ from fuel combustion in the kilns. PCC is widely used in different kinds of paper and paperboard as a filling or coating material. The first PCC plant using transferred CO₂ in Finland started operating in 1993. The PCC in paper and paperboard stores the captured CO₂ long term, except in cases where the paper or sludge from recycled paper is combusted. The emissions from fuel combustion are taken into account separately under relevant categories in the energy sector. Long-term storage is the main criteria used for the inclusion of CO₂ capture and storage in the inventory. Finland exports more than 90 per cent of paper and paperboard. Possible emissions from PCC in exported paper are not taken into account, as these emissions are classified as not occurring within the national borders of Finland.

37. The PCC plants do not measure their CO₂ emissions or the amount of CO₂ captured. Therefore, the amount of CO₂ transferred to PCC is estimated based on the amount of PCC produced. The calculated amount of stored CO₂ is subtracted from the subcategory other and a negative emission figure is in fact reported in this subcategory. Finland has provided further information on this methodology in the 2010 annual submission, thereby improving transparency. The information exchanged during the review has improved the ERT's understanding of this country-specific method. The ERT recommends that Finland further develop the reporting of CO₂ captured in the PCC production process in terms of the proportion of CO₂ from fossil fuels and of CO₂ from biomass fuels to increase the transparency of reporting on the trend of CO₂ emissions. In its response to the draft annual review report, Finland indicated that it has provided the data in the Appendix 3-c, pp. 137 in the NIR. The ERT identified that Finland has provided the share of fossil fuels of total transferred CO₂ in the Appendix 3-c of the NIR but no detail has been provided on, for example, the amounts of fossil fuels and biomass used, which would increase transparency. Finland responded to this, stating that giving the amount of fossil fuels and biomass in the NIR would mean the disclosure of confidential data, as some of the fuels are used only by one or two of the six plants capturing CO₂.

38. Finland considers that the principles of CO₂ capture and storage (CCS) mentioned in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines) can be applied to the PCC production process and indicates that, according to the 2006 IPCC Guidelines, once CO₂ is captured, there is no differentiated treatment between biogenic carbon and fossil carbon. Finland calculates the amount of CO₂ absorbed during PCC production process in which the CO₂ source is the combustion of mixed fuels which are a combination of fossil and biomass fuels. Since Finland reported separately CO₂ emissions from biomass combustion and did not include it in the total inventory, this amount of CO₂ should not be subtracted from total national inventory. For this reason, the ERT recommends that Finland report separately CO₂

emissions from fossil fuels and CO₂ emissions from biomass fuels captured in the PCC production process and subtract only CO₂ emissions from fossil fuel combustion. Finland does not agree with the ERT's recommendation and reasoning as it would lead to double counting of emissions to the atmosphere (CO₂ emissions from biomass are reported in the LULUCF sector, or under Article 3, paragraph 3 activities and forest management under Kyoto Protocol as harvesting losses). Finland further noted that the approach to treat the capture and storage of fossil and biomass CO₂ in the same way is consistent with the 2006 IPCC Guidelines (Volume 2, Chapter 6), and that this approach is consistent with the actual changes in atmospheric CO₂ concentration. Finland does not understand why the abatement measure, capture and storage of biomass CO₂, is not allowed to be taken into account in the inventory in accordance with the guidance of the IPCC.

3. Key categories

Stationary combustion: solid fuels – CO₂

39. Finland calculated CO₂ emissions from fuel combustion using a country-specific method and cross-checked the results with CO₂ emissions calculated from the national energy consumption reported in the national energy balance sheet using a top-down calculation as the reference approach. As already indicated by the Party, the ERT recommends that Finland include the results of the cross-check in its next annual submission. The country-specific method uses detailed AD on fuel consumption and fuel-specific EFs. Finland has a detailed database of EFs and a calculation system. In response to questions raised by the ERT during the review on the use of these country-specific CO₂ EFs, Finland indicated that it uses data collected through the EU ETS for the calculations to supplement and verify the inventory data; monitored EU ETS data for CO₂ emissions are only available for the inventory years 2005–2008 and allocation of the EU ETS data is not always sufficiently detailed for inventory purposes. The Party indicated that, among others, the issue of how to address time-series consistency for the years prior to the implementation of the EU ETS needs to be resolved before the EU ETS data use in the inventory can be substantially increased.

Road transportation: liquid fuels, biofuels – CO₂

40. Finland calculated fuel consumption and emissions from transport using the LIPASTO models developed by VTT. The submodels used for road transportation include LIISA. The NIR provides information on the models, general methodologies, fuel consumption and EFs used. Finland indicated, for example, that it uses the EFs of fossil transport fuels based on the product analysis carried out by Neste Oil laboratories. However, the EFs of biofuels are initial estimates justified by expert judgement. The ERT recommends that Finland provide additional information including documentation on how these EFs are derived by expert judgement, in order to improve transparency.

4. Non-key categories

Fugitive emissions: natural gas – CH₄

41. Finland reported CH₄ emissions from natural gas transmission and distribution based on measurements conducted by private companies. The ERT encourages Finland to include further documentation on the measurements (e.g. the techniques and methods used) received from private companies in order to improve the transparency of its reporting.

C. Industrial processes and solvent and other product use

1. Sector overview

42. In 2008, emissions from the industrial processes sector amounted to 7,030.84 Gg CO₂ eq, or 10.0 per cent of total GHG emissions, and emissions from the solvent and other product use sector amounted to 85.88 Gg CO₂ eq, or 0.1 per cent of total GHG emissions. Since the base year, which is 1990 for CO₂, CH₄ and N₂O, and 1995 for HFCs, PFCs and SF₆, emissions have increased by 38.7 per cent in the industrial processes sector, and decreased by 51.9 per cent in the solvent and other product use sector. The key driver for the rise in emissions in the industrial processes sector is the increase in emissions of HFCs from 29.33 Gg CO₂ eq in 1995 to 993.97 Gg CO₂ eq in 2008 (an increase of 3,289.1 per cent) and of PFCs from 0.14 Gg CO₂ eq to 11.23 Gg CO₂ eq in the same period (an increase of 7,922.1 per cent). The growing trend in HFC and PFC emissions is due to their increased use as substitutes for ozone-depleting substances. Within the industrial processes sector, 36.0 per cent of the emissions were from metal production, followed by 31.5 per cent from chemical industry, 17.6 per cent from mineral products and 14.9 per cent from consumption of halocarbons and SF₆.

43. Finland's inventory in the industrial processes and solvent and other product use sectors is complete, incorporating emission estimates for all categories. The reporting is transparent, providing clear explanations regarding the sources of data and factors, and the methods and assumptions used for the entire time series. Recalculations were reported by Finland for seven categories, including limestone and dolomite use, glass production, nitric acid production, hydrogen production, iron and steel production, consumption of halocarbons in foam blowing and SF₆ in electrical equipment. Finland explained in the NIR that the recalculations were due to: an improvement in emission calculations; the incorporation of missing emissions from one plant for 2006 and 2007 using limestone and dolomite; the inclusion of emissions from one plant for 2005–2007 in glass production; revised emissions from one nitric acid plant in 2007; the correction of AD from a new hydrogen plant in 2006; an improvement in time-series consistency in emissions from iron and steel production; changes in the calculation model in order to make HFC emission estimates from foam blowing consistent across the time series; and the use of the new mass balance method (tier 3c) to estimate SF₆ emissions from electrical equipment from 2003 to 2007. The recalculations have improved time-series consistency and resulted in an increase in total emissions in the industrial processes sector of 1.5 per cent in the base year, 2.28 per cent in 1990 and 0.16 per cent in 2007, but have not affected the emissions trend.

44. Finland has provided a full explanation of the uncertainty estimates and QA/QC procedures in all categories of the industrial processes sector, including the verification of emission estimates by comparing the estimates with emissions reported under the EU ETS. Other than the improvements to the approach used to estimate SF₆ emissions from electrical equipment, there are no other planned improvements.

2. Key categories

Nitric acid production – N₂O

45. Finland calculated plant-specific EFs based on the N₂O emissions measured by individual plants. The AD were obtained either from individual plants or from the VAHTI system. VAHTI is a compliance data system where AD are reported by nitric acid plants to obtain environmental permits and are therefore consistent with those obtained from individual plants. The method used is appropriate and in line with the IPCC good practice guidance.

46. Finland improved transparency in the 2010 submission by reporting EFs and identifying plants that had closed down, plants that had started to operate, as well as process changes in specific plants throughout the time series, thereby justifying the trend in N₂O emissions and the implied emission factor (IEF). The ERT noted that plant-specific EFs were reported as confidential but commends the efforts made by Finland to improve transparency regarding the trends for EFs and data as recommended by the previous ERT. The ERT recommends that Finland continue to improve transparency by explaining trends in EFs and data in future submissions if EFs are still reported as confidential.

Other (industrial processes) – CO₂

47. Finland calculated CO₂ emissions from hydrogen production using EFs derived from stoichiometric ratios of the chemical reaction of hydrocarbon feeds and hydrocarbon consumption of individual companies. Although there is no IPCC methodology for this category, the ERT finds the method used appropriate and considers it to be a good approximation of emissions for this plant type. Finland also verified that the calculated emissions of two plants, representing more than 90 per cent of the total emissions, are equal to those reported under the EU ETS. The ERT recommends that Finland report in its next annual submission the consumption by type of feedstock and the EFs of each type in order to improve transparency. In its response to the draft annual review report, Finland indicated that it cannot provide plant-level consumption data in the NIR for confidentiality reasons. However, the Party clarified that EFs by type of feedstock can be reported in its next annual submission.

Iron and steel production – CO₂

48. Finland reported that the method used to calculate CO₂ emissions is country-specific and that the split between fuel-based emissions and process emissions was determined according to the ILMARI calculation system developed by Statistics Finland for energy-based emissions. In the NIR, Finland reported that CO₂ emissions were based on fuel- and carbonate-based calculations from 1990 to 1995, on the VAHTI system from 1996 to 2004 and on EU ETS data from 2005 to 2008.

49. Finland performed quality checks by comparing different methodologies and the mass balance approach for certain years and by checking AD from several independent sources. To improve time-series consistency, missing and poor-quality data from 1990 to 1995 were complemented by data from different sources. The ERT noted with appreciation these efforts of Finland. However, because Finland uses data from different sources, the ERT was concerned about how consistency in data was ensured. In its response to the draft annual review report, Finland confirmed that it made best use of existing data from several sources in line with the IPCC good practice guidance. Finland performed category-specific recalculations, resulting in an increase in CO₂ emissions of 3.97 per cent in 1990 and 0.02 per cent in 2007.

50. The ERT noted, as also indicated in the previous review, the large inter-annual changes in the CO₂ IEF across the time series. In addition, the 2008 value is 15.5 per cent lower than the 1990 value. Finland explained that the positive and negative changes over the years are due to annual variations in the use of blast furnace gas in energy production. These fuel-based emissions are reported under the energy sector and subtracted from the total emissions. The remaining emissions are then reported as process emissions. The ERT also noted that Finland reported that some streams of carbon stored had not been taken into account. Finland stated that EU ETS data found these streams to be very small, with an overall cumulative effect on emissions of less than 1 per cent of the plant's total emissions. Failing to take account of carbon stored is not consistent with the IPCC good practice guidance. The ERT recommends that Finland include carbon stored in the calculation of

CO₂ emissions in its next annual submission. In its response to the draft annual review report, Finland informed the ERT that it will not be able to act upon the recommendation, as the resources needed for this task would be significant and resulting improvements in the accuracy of the emissions very minor, and much smaller than overall uncertainties in emissions from this category.

51. The ERT noted that coke and steel production almost doubled from 1990 to 2008 and therefore recommends that Finland explain the increasing trend in its next annual submission.

Refrigeration and air-conditioning equipment – HFCs

52. Finland reported the use of the IPCC tier 1a and 1b methods to calculate potential emissions and the IPCC tier 2 top-down sales-based method to calculate actual emissions for all subcategories of refrigeration and air conditioning. The ERT identified from the NIR that the methods are consistent with the IPCC good practice guidance. The AD for 2008 were compiled by a survey conducted from April to October 2009. The ERT commends Finland for implementing its planned improvement on survey methods by introducing an Internet-based electronic data collection system and improving its questionnaires and instructions.

53. The ERT noted, as also indicated in the previous review report, that large inter-annual changes in emission estimates are observed for 1990–1997 (ranging between –7.1 per cent and 4,090.7 per cent), 2001–2002 (–29.7 per cent) and 2005–2006 (–15.2 per cent). Finland indicated that the observed increase in the 1990s is due to the substitution of ozone-depleting substances while the decrease in 2002 is due to missing data, and the decrease in 2006 is partly due to a low response rate to the 2006 questionnaire but the main reason is analyzed to be real fluctuations in the market. The history of AD collection, the methodologies used, and the improvements of estimates for the whole time series are clearly described in the NIR. Finland indicated that the methodologies were not the same for the entire time series until 2001 when the tier 2 top-down method was applied to all subcategories of refrigeration and air conditioning. Finland tested the effect of the previous methodologies on time-series consistency and concluded that the estimates are fairly close and that little can be gained from conducting a recalculation. The ERT commends Finland for implementing the tier 2 top-down approach, as recommended by the IPCC good practice guidance to estimate actual emissions.

3. Non-key categories

Cement production – CO₂

54. Finland reported the use of the IPCC tier 2 methodology to estimate emissions. The clinker production data were complete and received directly from the companies. The ERT noted a decrease in the trend in CO₂ emissions from 1990 to 1993 (50.5 per cent) and an increase from 1993 to 2008 (75.8 per cent) onwards. Finland explained that the decrease was due to the economic recession and the closing of a plant in 1993, while the increase in the latter period of the time series is due to an increase in clinker production. The ERT recommends that Finland explain the increasing trend in CO₂ emissions from 1993 onwards and provide the total rated clinker production capacity of cement plants in Finland in the next annual submission. In its response to the draft annual review report, Finland indicated that it will provide more information on the trend in CO₂ emissions from cement production. Finland also clarified that the production capacity is not relevant in this respect, and that it would increase the resources needed for data collection unduly.

Electrical equipment – SF₆

55. Finland used the tier 1b method from the IPCC good practice guidance to calculate potential emissions and the modified IPCC tier 3c country-level mass-balance approach to calculate actual emissions. The AD from electrical equipment are obtained from the annual survey of the Finnish companies that manufacture, import and export electrical equipment.

56. The NIR indicated that SF₆ emissions from 2003 to 2007 were recalculated due to the use of the modified IPCC tier 3c model. The data for the years prior to 2003 are not detailed enough to use the tier 3c method and Finland concluded that a recalculation would not result in improved emission estimates. In addition, Finland reported that the new tier 3c model had resulted in higher SF₆ emission estimates than the Finnish Electrical Equipment Industry's emission estimates in 2008 and in a fivefold increase compared with the old estimates in 2005. The ERT recommends that Finland explain in the next annual submission how it envisages improving time-series consistency, as different methods have been used before and after 2003.

D. Agriculture

1. Sector overview

57. In 2008, emissions from agriculture amounted to 5,922.90 Gg CO₂ eq, or 8.4 per cent of total GHG emissions. Since the base year, emissions have decreased by 11.6 per cent. The key drivers for the fall in emissions are a decrease in the cattle population and a decrease in the use of synthetic fertilizers. Within the sector, 61.1 per cent of the emissions were from agricultural soils, followed by 26.5 per cent from enteric fermentation and 12.3 per cent from manure management. The remaining 0.01 per cent was from field burning of agricultural residues. Rice cultivation and prescribed burning of savannas do not occur in Finland.

58. Finland has reported recalculations for N₂O emissions from manure management and N₂O emissions from agricultural soils due to the incorporation into the inventory of an N mass flow model and changes in data such as animal allocation to animal waste management systems (AWMS), N excretion rates, cattle weight and number of animals. The effect of these recalculations is a decrease of 7.2 per cent in emissions in 1990 and an increase of 3.5 per cent in emissions in 2007. Finland informed the ERT during the review that the aim of introducing the new model was to improve the accuracy of the inventory and the consistency with the reporting under the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollutants (CLRTAP). The Party also indicated that the model will be documented more transparently in the next NIR. The ERT recommends that Finland provide more documentation on the N mass flow model in the next annual submission.

59. During the review, Finland addressed the potential underestimation issues raised by the ERT and provided revised estimates for CH₄ emissions from enteric fermentation of piglets, CH₄ emissions from manure management of piglets and indirect N₂O emissions from agricultural soils. These revised estimates resulted in an increase in emission estimates in the agriculture sector of 1.5 per cent in 2008 compared to the initial submission. The ERT noted that the revised estimates made the Party's inventory more accurate and complete and recommends that Finland include these emissions in future annual submissions.

60. The transparency of the NIR is generally high. However, additional information on the N mass flow model, the estimation of emissions from field burning of agricultural residues (there is no justification in the NIR of the low values for the fraction of straw burned that were derived from expert judgement), and the rationale for the subtraction of

the piglet population from the total swine population is needed in order to increase transparency.

61. Quantitative uncertainty estimates were provided separately for each category. The inventory of Finland is time-series consistent due to the consistent use of methods, AD and EFs throughout the years. Category-specific QA/QC and verification procedures have been applied.

62. In general, the use of notation keys is correct. However, some misuses were detected: CH₄ and N₂O emissions from some subcategories of field burning of agricultural residues were reported as not estimated (“NE”) but, during the review, the Party explained that the notation key “NE” is not correct and will be corrected to “NO” in the next annual submission; and in CRF table 4.C, the notation key “NA” (not applicable) was used for the addition of an organic amendment instead of “NO” as the activity does not occur. The ERT recommends that Finland use the correct notation keys in line with the UNFCCC reporting guidelines.

2. Key categories

Enteric fermentation – CH₄

63. Finland has estimated CH₄ emissions from swine, applying a total population value which is lower (between 45 and 50 per cent) than the total population reported in the national statistics and in the Food and Agriculture Organization of the United Nations Statistical Database (FAOSTAT). The difference arises from the fact that Finland has reported a group of “sows with piglets”, which takes into account only the population of sows consistently in the time series; the number of piglets is thus subtracted. In response to a question raised by the ERT regarding the provision of an explanation for the difference between the swine population reported by the Party in its NIR and the Food and Agriculture Organization (FAO) data, Finland explained that “sows” and “piglets” were considered as one group of animals and that the number of piglets (less than 20 kg) was discounted. The ERT noted that discounting the piglet population is not in line with the IPCC good practice guidance and would lead to an underestimation of CH₄ emissions from enteric fermentation.

64. During the review, the ERT recommended that Finland estimate CH₄ emissions from enteric fermentation for swine including piglets with the methodology reported by the Party. Following this recommendation, Finland provided revised estimates for the entire time series 1990–2008 by adding the number of piglets to the number of swine and using the same default EF from the IPCC good practice guidance for both piglets and swine (1.5 kg CH₄/head/year). The inclusion of CH₄ emissions from piglets increased emissions from enteric fermentation by 0.9 per cent in 2008 compared with the original estimates. The Party also indicated in its response that, as the IPCC gives only one default EF for swine, it will study the issue further and, if the study brings new information to light, the Party may recalculate the time series for swine in future submissions. The ERT identified from the NIR that the revised estimates are in line with the IPCC good practice guidance and recommends that Finland include CH₄ emissions from piglets in future annual submissions.

65. For 1990, Finland reported a sheep population that is 42 per cent higher than the FAOSTAT data, with a decreasing difference until 1997 and no difference from 1998 onwards. In response to a question from the ERT, the Party answered that the origin of the difference is unknown and, although it is an issue that has already been covered in previous reviews, the ERT encourages Finland to find the origin of the difference for the next annual submission.

66. Finland reported emissions from fur animals (3.3 million heads in 1990 and 3.4 million heads in 2008). The ERT noted that, despite this high population, the contribution of fur animals to total emissions in the category is less than 0.5 per cent. Although encouraged by the previous ERT to develop country-specific EFs for fur animals, the rather negligible impact of the emissions allows Finland to continue using an EF developed by Norway. The ERT recommends that Finland report in its next annual submission the assumption on the similarities of the digestive systems of swine and fur animals in support of its use of the Norwegian EF.

Manure management – N₂O

67. N₂O emissions from manure management were calculated in the previous submissions using equation 4.18 of the IPCC good practice guidance and different values of N excretion rates per AWMS. In its 2010 submission, Finland used the N mass flow model, which produced new emission estimates. Although the NIR contains very valuable information on the model, the ERT recommends that Finland include the reference of the paper on the model in the NIR list of references in its next annual submission and that the Party improve transparency by including the information on the N mass flow model provided during the centralized review.

68. Following the recommendations from the previous ERT, Finland has reported in the CRF tables new IEFs for solid storage and dry lot, which range from 0.0150 to 0.0164 kg N₂O-N/kg N. Finland explained that the deviation from the IPCC default value for solid manure (0.2 kg N₂O-N/kg N) was due to the inclusion of dung and urine stored separately, which have much lower EFs than the EFs for solid manure.

69. Finland has used the notation key “NA” for AWMS not applied to some animal species in CRF table 4.B(b). The ERT recommends that Finland use the notation key “NO” in its next inventory submission when the activity does not occur, so as to be in line with the UNFCCC reporting guidelines.

70. During the review, the ERT noted that discounting the piglet population, as described in paragraph 63 above, would lead to an underestimation of N₂O emissions from manure management and recommended that Finland estimate N₂O emissions from manure management for swine including piglets. In its response, Finland explained that the related N₂O emissions from piglets are included in the category “sows with piglets” (one sow and its piglets = one unit) and provided clear and sufficient information to demonstrate that the emissions had not been underestimated. The ERT noted that the problem was rather one of transparency, and recommends that Finland, in its next annual submission, either continue to report the group “sows with piglets” but clarify that piglets are implicitly taken into account in the group “sows with piglets” to estimate emissions or disaggregate the group “sows with piglets” into two groups – “sows” and “piglets” – and that it report emissions separately.

Agricultural soils – N₂O

71. Although previous ERTs had recommended that Finland follow the IPCC good practice guidance, which indicates that N applied from fertilizer and manure has to be used unadjusted in estimating indirect N₂O emissions, Finland reported in the NIR (page 234) that “for leaching and run-off, volatilized N has been subtracted before applying $Frac_{LEACH}$ ”. In response to a question raised by the ERT during the review, Finland indicated that the subtraction was done to avoid double counting. However, the ERT found that this was not in line with the IPCC good practice guidance and recommended that Finland submit revised estimates of indirect N₂O emissions from leaching and run-off according to the IPCC good practice guidance. Following the recommendation from the ERT, Finland provided, during the review, revised estimates for the entire time series

1990–2008. The revised estimate is 1.58 Gg N₂O in 2008, which is 12.2 per cent higher than the initial estimate. This resulted in an increase in emissions from agricultural soils of 1.5 per cent in 2008. The ERT recommends that Finland report indirect N₂O emissions from agricultural soils in line with the IPCC good practice in the next annual submission. The ERT noted that by discounting the piglet population, as described in paragraph 63 above, direct and indirect N₂O emissions from agricultural soils would be underestimated. Finland clarified during the review that the related N₂O emissions from piglets are included in the category “sows with piglets” (one sow and its piglets = one unit). The ERT identified that the problem is one of transparency and recommends that Finland, in its next annual submission, include the information provided during the review which clarifies that piglets are implicitly taken into account in the category “sows with piglets” and that there is no underestimation of N₂O emissions due to the subtraction of piglets.

3. Non-key categories

Manure management – CH₄

72. During the review process, the ERT identified that discounting the piglet population, as described in paragraph 63 above, would lead to an underestimation of CH₄ emissions from manure management and recommended that Finland estimate CH₄ emissions from manure management for swine including piglets. Following the recommendation from the ERT, Finland provided revised estimates for the time series 1990–2008 by adding the number of piglets to the number of swine. The same distribution of AWMS was used for piglets as for sows. Finland indicated in its response that it will study the issue further and if the study brings new information to light, the Party may recalculate the time series for sows and piglets in future submissions. The inclusion of CH₄ emissions from manure management for piglets increased emissions from manure management by 3.1 per cent in 2008 compared to the original estimates reported by the Party. The ERT recommends that Finland include CH₄ emissions from manure management for piglets in future annual submissions.

E. Land use, land-use change and forestry

1. Sector overview

73. In 2008, net removals from the LULUCF sector amounted to 35,393.84 Gg CO₂ eq. Since the base year, net removals have increased by 121.41 per cent. The key driver for the rise in removals is the increase in carbon stock changes in living biomass and the decrease in emissions from organic soils in forest land remaining forest land. Within the sector, 40,794.56 Gg CO₂ eq of removals were from forest land remaining forest land followed by 1,168.61 Gg CO₂ eq from land converted to forest land, 94.77 Gg CO₂ eq from other (harvested wood products (HWP)) and 77.03 Gg CO₂ eq from land converted to grassland. The other land-use categories are reported as net sources. Cropland accounted for 5,320.74 Gg CO₂ eq, grassland remaining grassland accounted for 75.20 Gg CO₂ eq and wetlands accounted for 1,308.35 Gg CO₂ eq. Settlements and other land are reported as “IE” (included elsewhere), “NA”, “NE” and “NO”.

74. Finland provided the AD and parameters used for all categories and reported estimates of emissions and removals for all categories for the time series 1990–2008 except for the voluntary land-use categories settlements and other land. For the first time, N₂O emissions from disturbance associated with land-use conversion to cropland are reported in CRF table 5 (III). Uncertainty estimates as well as QA/QC procedures were provided for all land-use categories and for HWP.

75. Finland has reported recalculations for forest land, cropland, grassland, wetlands and HWP, and for non-CO₂ emissions from the drainage of soils and wetlands, as well as emissions from biomass burning. The main reason for the recalculations is that Finland reported for the first time land remaining in the same land-use category and land converted to another land-use category. Additional improvements in specific land-use categories that justify the recalculations include: country-specific biomass equations applied to estimate tree biomass; a full set of NFI10 data used for biomass and litter fall estimation; new EFs for CH₄ emissions from peat extraction; a correction in the time-series data for land area; and updated estimation methods for biomass burning using country-specific biomass equations. The effect of these recalculations is a decrease in removals of 1,851.23 Gg CO₂ eq (–10.3 per cent) in 1990 and an increase in removals of 5,302.96 Gg CO₂ eq (+20.8 per cent) in 2007 for the whole sector. The major changes are observed in grassland (a 100 per cent decrease in CO₂ emissions), cropland (a 60.5 per cent increase in CO₂ emissions), forest land (a 10.0 per cent increase in CO₂ removals) and wetlands (a 71.1 per cent decrease in CH₄ emissions). All recalculations are well-described in the NIR. The ERT commends Finland for these important improvements achieved by implementing the recommendations from the previous expert reviews.

76. Finland has also reported a recalculation of the total land area for all years since 1990. The estimation of areas is based on Finland's official land area published by the National Land Survey of Finland. This official area can vary between years and cause a recalculation of the time series. Compared to the previous annual submission, the total land area decreased from 30,409,000 ha to 30,390,000 ha (–0.1 per cent) and, when including the inland waters, the total area is 33,842,000 ha. Although the official land area may vary between years, for the next four annual submissions, Finland has decided to apply the same area. During the review process, Finland confirmed that it might decide to change the land area for all years in the 2014 inventory submission. The ERT welcomes this decision to keep the total land area constant in future submissions.

77. Finland reported a different total land area under the Convention and under the Kyoto Protocol. During the review process, Finland informed the ERT that there was an error in the calculation of the total land area under the Convention, resulting in a small difference. The ERT noted that this error was related to the land area for settlements and did not influence the reported emissions and removals. The ERT recommends that Finland report in its next annual submission a consistent total land area.

78. The fact that Finland has reported, for the first time, land remaining in the same land-use category and land converted to another land-use category has resulted in changes in identified key categories in the LULUCF sector compared to previous annual submissions. The ERT noted with appreciation that Finland has also identified corresponding significant pools. For example, for forest land remaining forest land, net carbon stock changes in living biomass, mineral soils and organic soils are significant pools and for land converted to forest land, five significant carbon pools have been identified. In the NIR, Finland has provided information on the carbon stock changes in soil, litter and dead wood for land converted to forest land in a separate section of the NIR, while the information on living biomass for these land-use categories is still presented together. To improve transparency, the ERT suggests that Finland provide information on living biomass for land converted to forest land in separate sections in the NIR in future annual submissions.

2. Key categories

Forest land remaining forest land – CO₂

79. Forest land remaining forest land, constituting 71.9 per cent of the total land area of Finland, is a net sink of 40,757.72 Gg CO₂ eq, offsetting 58.1 per cent of total GHG emissions in 2008. To estimate the change in carbon stock in living tree biomass, Finland has applied the default method (method 1) of the IPCC good practice guidance for LULUCF, which requires the annual decrease in carbon stocks due to biomass loss to be subtracted from the annual increase in carbon stocks due to biomass growth. Country-specific biomass models for pine, spruce and broadleaved trees have been used for the first time. The changes in tree biomass and biomass stock for the different tree compartments, used for soil carbon computations, are now estimated using the same new country-specific tree-level biomass model. Finland has also implemented some changes in the data used to estimate the increment in biomass by reallocating the data from each of the forest inventories so that they correspond better to the actual period for which the increment was assessed. The ERT commends Finland for these improvements, but recommends that the Party report, in future annual submissions, separate estimates for above- and below-ground biomass in order to improve transparency.

80. Net carbon stock changes were 2,571.74 Gg C in mineral soils and –1,622.30 Gg C in organic soils in 2008. For mineral soils, Finland uses the Yasso model to estimate carbon stock, changes in carbon stock and CO₂ emissions for soils. For this submission, the Yasso steady state of soil carbon model was estimated with the NFI6 (1971–1976) data, while in previous submissions, the estimates were based on old data (the litter input of forests during the 1800s, as stated in the NIR). The model provides an aggregated estimate for litter, dead wood and soil organic matter (SOM), but Finland does not report dead organic matter (DOM) and SOM separately, arguing that the division of soil carbon pools between SOM and DOM is artificial. The recalculations performed and reported in this category result in an increase in mineral soil removals of 2,000.00 Gg CO₂ in 1990 and 3,700.00 Gg CO₂ in 2007. The increase for 2007 is greater than 50 per cent. The ERT recommends that Finland provide, in its next annual submission, further information on the changes resulting from the improvements in the model and report in future annual submissions separate estimates for SOM and DOM in order to improve transparency. In its response to the draft annual review report and the recommendation to provide separate estimates for SOM and DOM, Finland indicated that, in the modelling approach, the origin of the litter input is known (for example, whether it is dead wood or leaf litter), but when running the model and during the decomposition process it is impossible to identify from which pool organic matter in the soil originates. It is also impossible to draw a line between dead wood, soil and litter in the model (Yasso and Yasso07) where the division of material and its flows are based on the quality of material, not on its size. The carbon stock change of the aggregated SOM and DOM pool could be divided by a random ratio, but this would decrease the transparency of the reporting. Therefore, Finland will continue to report estimates for SOM and DOM in an aggregate way.

Grassland converted to forest land – CO₂

81. Finland reported that an area of 80,587 ha changed from grassland to forest land in 2008. Of this, 35,752 ha is organic soil. This resulted in a removal of 642.09 Gg CO₂. The gains in living biomass are estimated based on the mean stock per area for lands converted from grassland to forest land. The losses in living biomass are reported in forest land remaining forest land. As Finland does not yet estimate living biomass in grassland, no information has been provided on the initial living biomass. The ERT commends Finland for its reporting of this land-use category, but recommends that the Party provide

information on the initial living biomass in its next annual submission. In its response to the draft annual review report, Finland stated that it will provide additional information on tree biomass in grasslands in its 2013 annual submission.

82. Finland has used the Yasso07 model for mineral soils to calculate the carbon stock changes in soils and DOM and has reported these two pools together. For grassland converted to forest land on organic soils, the emissions are estimated following the approach used for organic soil in forest land remaining forest land: the below-ground litter input of the trees was derived from the biomass estimates of the corresponding NFI data and average estimates of below-ground litter were used. However, the ERT identified that in previous submissions, Finland used the default factors from the IPCC good practice guidance for LULUCF to estimate emissions for grassland and grassland converted to forest land on organic soils. Finland has acknowledged this inconsistency in the NIR and announced that it will be evaluated. The ERT recommends that Finland report, in its future annual submission, changes in carbon stock in soils and DOM separately and that it improve the consistency in the methods used to calculate emission estimates for grassland and grassland converted to forest land on organic soils. In its response to the draft annual review report, Finland indicated that for organic grasslands converted to forest land a national EF will be applied in the next annual submission.

Wetlands converted to forest land – CO₂

83. Finland reported in CRF table 5.A an area of 32,041 ha of wetlands converted to forest land in 2008 and, of this, 27,310 ha is drained wetlands. In table 7.1-4 of the NIR, Finland reported that the area of wetlands converted to forest land is 21 kha. The ERT recommends that Finland correct this inconsistency in the next annual submission. This land-use change resulted in emissions of 181,08 Gg CO₂ and Finland does not separate wetlands converted to forest land between the northern and southern parts of the country. The initial emissions prior to the land-use conversion might be different, as the NIR provides, in table 7.2-12, different values related to the fertility of the land, while for the conversion of settlements to forest land, the NIR provides, in table 7.2-17, different values for the north and the south. In its response to the draft annual review report, Finland clarified that the calculation method itself takes into account the different fertility sites of organic soils and that the calculation is made separately for north and south Finland (even if this deviation does not show in the table 7.2-17). The ERT recommends that Finland include this information on the emissions estimation of this category in its next annual submission.

Settlements converted to forest land – CO₂

84. Finland reported in CRF table 5.A that an area of 25,658 ha changed from settlements to forest land in 2008. In table 7.1-4 of the NIR, the area of settlements converted to forest land is 20 kha. The ERT recommends that Finland correct this inconsistency in the next annual submission. The conversion to forest land is the whole land-use change from settlements. The ERT believes that it is not because the conversion of settlements to forest land occurs only rarely that Finland should not provide a more detailed explanation for this land-use change in the NIR. The ERT recommends that Finland provide further information on this land-use change and on the different values reported in the CRF tables and in the NIR in its next annual submission.

85. This land-use change resulted in a removal of 572,73 Gg CO₂. For settlements, the starting value of soil carbon in mineral soil as well as of organic soil was assumed to be zero. Finland reported that it is known that part of the settlements converted to forest land have an original soil carbon stock that is different from zero, but that appropriate estimates for the carbon stock of settlements could not be made. The application of the Yasso model results in a change in DOM and SOM of 5.33 t C/ha in the south and 6.75 t C/ha in the

north, 20 years after conversion. However, the category settlements converted to forest land holds information on land-use changes during the past 20 years. The ERT recommends that Finland provide, in its next annual submission, more detailed information on the estimation of CO₂ removals from this category and on the parameters used.

Cropland remaining cropland – CO₂

86. Cropland remaining cropland was a net source of 4,649.84 Gg CO₂ in 2008 and 5,492.75 Gg CO₂ in 1990, as reported in CRF table 5. The area estimates are now derived using the NFI data and, thus, the time series was recalculated. This recalculation resulted in a more stable emissions trend over time. To calculate CO₂ emissions from organic soils, the area is multiplied with the national EF of 5.7 t C/ha for crops and 4.1 t C/ha for grass (<5 years). The ERT commends Finland for this improvement in the reporting of organic soils under grass or other crops.

Forest land converted to cropland – CO₂

87. Finland reported a land area for forest land converted to cropland of 58,926 ha in 2008 and 36,210 ha in 1990. This land-use change resulted in emissions of 448.37 Gg CO₂ in 2008 and 247,39 Gg CO₂ in 1990. Finland has not provided detailed information on the land-use conversion on organic soils in the NIR. Further, removals from living biomass are not included in these figures as this pool is reported under forest land remaining forest land. For the reporting under the Kyoto Protocol, Finland has provided, in table 5(KP-I)A.2, information on the carbon stock changes in biomass for deforestation (the conversion of forest land to cropland). The ERT recommends that Finland provide information on the emission estimates for forest land converted to cropland on organic soils and that the Party improve consistency by reporting the removals of biomass in this land-use category in its next annual submission.

Grassland remaining grassland – CO₂

88. Finland updated the area estimates of both mineral and organic soils of grassland, and all area estimates are now derived from the NFI data in a consistent way. In the previous inventory submissions, some areas, such as small roads and buildings, were included. Estimates for carbon stock changes in living biomass have not yet been included in the inventory. CO₂ emissions from mineral soils are calculated by using a methodology which corresponds to a tier 1 method and the default EFs of the IPCC good practice guidance for LULCUF. For organic soils, the IPCC default EF (0.25 t C/ha/a) for grassland is used. Future planned improvements reported by Finland include the use of the Yasso07 model to estimate carbon stock changes for mineral soils in grassland remaining grassland and a national EF for organic soils. The ERT encourages Finland to implement the planned improvements and to report on them in future annual submissions.

3. Non-key categories

Harvested wood products – CO₂

89. The category HWP includes the carbon balance of all wood products which are in use in Finland, calculated by the stock change approach. Estimates are made for solid wood products and paper products. Finland has used a country-specific tier 3 method: a combination of the first order decay method and a direct inventory of HWP. The inventories of the building stock for the years 1995, 2000 and 2005 were used, and then interpolated or extrapolated using annual data on apparent consumption of solid wood products. The carbon stock in paper products and its annual change are estimated using the HWP worksheet with default parameters; this part of the estimation thus uses a tier 1 method. HWP were a sink of 99.77 Gg CO₂ in 2008 and 945.64 Gg CO₂ in 1990. In 2007, HWP were a sink of 1,210.51 Gg CO₂. Finland has presented information on these changes

in the NIR. For 2008, Finland has estimated, for the first time since 1993, emissions of 167 Gg CO₂ and, for the first time since 2001, a sink of 262 Gg CO₂ for paper products.

F. Waste

1. Sector overview

90. In 2008, emissions from the waste sector amounted to 2,268.53 Gg CO₂ eq, or 3.2 per cent of total GHG emissions. Since the base year, emissions have decreased by 42.9 per cent. The key drivers for the fall in emissions are the implementation of the new Waste Act and the Landfill Directive, which endorsed the minimization of waste generation, recycling and re-use of waste materials, landfill gas recovery and alternative waste treatment methods for landfills. Within the sector, 84.6 per cent of the emissions were from solid waste disposal on land, followed by 10.1 per cent from wastewater handling and 5.2 per cent from composting.

91. In general, the methods and data used are transparently documented in the NIR, except for industrial solid waste composition and the corresponding degradable organic carbon (DOC) content. During the review week, Finland provided additional data on the amount of landfilled industrial solid waste components and average DOC content. The ERT recommends that Finland include this information in the NIR of its next annual submission.

92. Recalculations were performed for solid waste disposal on land (due to the correction of an error in transferring data from a database calculation to the emission model and a revision to the dry matter of the DOC content of de-inking sludge) and wastewater handling (due to a minor correction of protein consumption and a revision to the population in rural areas) which resulted in a decrease of 2.3 per cent in CH₄ emissions and 0.4 per cent in N₂O emissions from the waste sector for 2007 compared to the previous submission. Finland implemented category-specific QA/QC measures in the waste sector in line with the IPCC good practice guidance. However, the ERT identified some inconsistencies between the NIR and the CRF tables on CH₄ recovery from landfills, the amount of construction and demolition waste, and the criteria used to identify key categories. The ERT recommends that Finland improve the QA/QC procedures in the waste sector in its next annual submission.

93. Waste incineration is used for energy purposes in Finland and the emissions (CO₂, N₂O and CH₄) from the incineration are reported in the energy sector in line with the IPCC good practice guidance.

2. Key categories

Solid waste disposal on land – CH₄

94. The first order decay model of the IPCC good practice guidance has been applied. The EFs and parameters used are mainly IPCC defaults, including values from the 2006 IPCC Guidelines. Some country-specific EFs, including the fraction of DOC dissimilated and the CH₄ correction factor and oxidation factor have also been used in the emission estimation. The AD used in the calculation are mainly from the VAHTI system.

95. The ERT identified that CH₄ recovery for 2008 from solid waste disposal sites estimated by the ERT using data provided in annex 8b of the NIR is lower than the values reported by Finland in the NIR and the CRF tables and concluded that CH₄ emissions have been underestimated. In response to a question raised by the ERT during the review, Finland provided revised estimates for CH₄ recovery and CH₄ emissions from solid waste disposal on land for 2008. The revised estimate is 1,919.96 Gg CO₂ eq, 3.6 per cent higher than the initial estimate reported by Finland, and results in an increase of 3.0 per cent in

emissions in waste in 2008. The ERT agrees with the revised estimates and recommends that Finland report revised estimates for all years in the time series in its next annual submission.

3. Non-key categories

Wastewater handling – CH₄ and N₂O

96. Finland estimated CH₄ emissions from municipal and industrial wastewater treatment plants, uncollected domestic wastewater and N₂O emissions from the N input of fish farming as well as from domestic and industrial wastewater into waterways.

97. The N₂O emissions from uncollected domestic wastewater handling were recalculated for 2003 and 2005–2007 due to preliminary and corrected information on protein consumption. The indicative value of the population in rural areas has been revised for a more accurate calculation of CH₄ and N₂O emissions from uncollected wastewater for 2002–2007.

Composting – CH₄ and N₂O

98. Finland estimated the emissions from the composting of biowaste (municipal solid waste (MSW), municipal and industrial sludge and industrial solid waste including construction and demolition waste) using the method and default EFs given in the 2006 IPCC Guidelines. The emissions from composting have increased by 182 per cent since 1990.

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

99. Finland used the annotated NIR to provide the information required as outlined in paragraphs 5 to 9 of the annex to decision 15/CMP.1 and consistent with decision 16/CMP.1. Finland provided all the information related to activities under Article 3, paragraph 3, and for forest management as its elected activity under Article 3, paragraph 4.

100. Finland reported in the NIR that dead wood for afforestation and reforestation had been excluded from the reporting. During the review, the Party explained that this should not be understood as a choice “not to account for” this pool in line with paragraph 6(e) of the annex to decision 15/CMP.1 (see para. 112 below). From the information provided in the NIR and during the review, the ERT concluded that Finland has accounted for all five carbon pools: above-ground biomass, below-ground biomass, litter, dead wood, and soil organic carbon.

101. In the KP-LULUCF CRF tables, Finland reported some changes in carbon pools and GHG categories using notation keys. For example, changes in the carbon pool for below-ground biomass, litter and dead wood are reported as “IE”, and CO₂ emissions from liming are reported as “NE”. In the NIR and during the review, Finland clarified the use of these notation keys and provided information on planned and ongoing research in order to be able to report separately carbon stock changes for pools reported as “IE” and those reported as “NE”. The ERT commends Finland for these efforts to improve the reporting on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, and concludes that the information provided by Finland is mostly complete and sufficiently transparent to

understand the reporting and the accounting of activities under Article 3, paragraphs 3 and 4.

102. Finland reported direct N₂O emissions from N fertilization and emissions from biomass burning under forest management, arguing that it is not possible to allocate these emissions separately. Finland also reported N₂O emissions from disturbance associated with land-use conversion to cropland.

103. Finland reported information on uncertainty estimates for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, as indicated in paragraph 17 above.

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

Afforestation and reforestation – CO₂

104. The land areas for Article 3, paragraph 3, activities are estimated using the NFI10 data and assessments with aerial photos, satellite images and digital map data; the most recent data in this database were measured during the period 2005–2009. The annual land-use change areas were calculated for the period 1990–2008. For the years during the period 2004–2008, a five-year average for land-use changes was applied because, for example, for 2008 only one year of NFI data were available. The land-use change matrix was developed by adding and subtracting the converted areas to and from land-use category areas. The matrix was first developed for the period from 1 January 1990 to 31 December 2007 and then for the year 2008. The method will be developed to produce annual area data on land-use changes for the commitment period. Finland reported 149,216 ha as afforested/reforested during the period 1990–2008. The NFI will continue to monitor forest and other land uses. The ERT notes that the NFI11 data are currently being compiled and that the website of the Finnish Forest Research Institute (Metla) (<<http://www.metla.fi/ohjelma/vmi/vmi11-info-en.htm>>) states that “as NFI10, NFI11 is carried out in five years so that measurements are made in whole country each year. This makes combined use of the new data and recent NFI10 data possible, so that new results can be calculated already in 2011”. The NFI11 should also provide better information on young forests and trees outside forests. The ERT recommends that Finland provide, in its next annual submission, further information on how and when it expects to report the annual area of afforestation/reforestation for 2008 and subsequent years using the NFI11 as well as when the NFI11 will be used in future reporting and how this will influence the reporting on land areas.

105. Finland provided in the NIR information on the annual area of afforested and reforested land since 1990, specified for two regions: Region 1 covers the southern part of Finland, and Region 2 covers the northern part (ecological considerations and the NFI sampling design are used for the boundary identification between the two regions). Finland’s method is in line with the reporting method 1 of the IPCC good practice guidance for LULUCF. In the reporting, the same geographical boundaries were used for activities under Article 3, paragraph 3, and forest management activities under Article 3, paragraph 4. Approach 3 of the IPCC good practice guidance for LULUCF is used for land representation. Finland has subdivided the afforestation and reforestation areas according to the land-use and soil types and has reported emissions and removals for seven afforestation and reforestation subdivisions. Finland has also conducted a QC check by comparing afforestation and reforestation areas with areas reported in the statistics. The ERT commends Finland for providing this information and for reporting land areas in CRF tables NIR-2 and 5(KP-1)A.1.1.

106. Finland reported that 20,324 ha and 20,298 ha of the afforested area were settlements and wetlands, respectively. These areas are almost the same as those reported for land-use changes under the Convention (NIR table 7.1-4), while the forest definition used for the south of Finland is different between the reporting under the Convention and under the Kyoto Protocol. The ERT suggests that Finland provide, in its next annual submission, additional information on the types of settlements that are afforested. In its response to the draft annual review report, Finland indicated that the types of conversions “settlement converted to forest land” will be clarified in the next annual submission.

107. Finland reported in the NIR that it excludes carbon stock changes in dead wood from its reporting and uses the notation key “NO” in CRF table 5(KP-1)A.1.1. In response to a question raised by the ERT during the review, Finland clarified that this does not mean that it is not accounted. The Party indicated that the pool is currently reported as “NO”, but it is planning to start estimating and reporting carbon stock changes in dead wood in future submissions. The ERT welcomes this plan and recommends that Finland estimate and report carbon stock changes in the dead wood pool in future annual submissions.

108. To estimate carbon stock changes in mineral soils, Finland used the Yasso07 model. This model estimates total carbon stock changes for litter, dead wood and SOM. Finland refers to the Convention reporting for the description of the model and reported that the division of soil carbon pools, as calculated by the model, is artificial and, for this reason, it uses the notation key “IE” for carbon stock changes in litter in table 5 (KP-1)A.1.1. However, for dead wood, the notation key “NO” is used as dead wood was excluded from the reporting (see para. 107). Finland used the documentation box to explain that litter is reported under soil carbon. The Party also explained that below-ground biomass is included in above-ground biomass and that gains and losses of carbon stock changes in above-ground biomass are combined and reported under gains. The ERT also notes that in figure 7.2-2 input from above-ground biomass is presented as input for the Yasso07, while in the same figure for Yasso three types of litter are presented as input. A general description on the Yasso07 states that the model requires information only on litter input and climate (see <www.environment.fi/syke/yasso Yasso07>). To improve transparency that all pools are accounted in the model, the ERT recommends that Finland provide, in its next annual submission, information on the input for Yasso07 taking into consideration the descriptions of pools provided in table 3.1.2 (page 3.15) of the IPCC good practice guidance for LULUCF.

109. The Yasso07 model uses, as input information on climate, the average temperature and precipitation for the period 1971–2000. The ERT identified that using the average of these climate parameters instead of real annual data would underestimate emissions (for the years where the average is below the real values) or overestimate emissions (for the years where the average is above the real values). Further, updating the average weather data to, for example, 1981–2010, does not resolve the problem. In response to this issue raised during the review, Finland informed the ERT that the Party will update the weather data using average data for 1971–2009 in the 2010 submission. In response to the draft annual review report, Finland clarified that this is consistent with the guidance in section 4.2.3 of the IPCC good practice guidance for LULUCF. Furthermore, Finland stated that a study has just begun to address how weather data should be used in applying the Yasso model to provide estimates that correspond to measurements and knowledge on carbon stock changes in conditions corresponding to those in Finland. Finland also indicated that it will report on progress on this issue in its next annual submission. The ERT recommends that Finland demonstrate that the weather data to be used in future submissions provide accurate emission and removal estimates in line with the IPCC good practice guidance for LULUCF, meaning that emissions and removals are neither overestimated nor underestimated. In

response to the draft annual review report, Finland notes that the science and methodologies for the estimation of carbon stock changes are not mature, and it may take years before it is possible to “demonstrate” the estimates for carbon stock changes in soils are accurate; however, Finland’s aim is to produce estimates that are neither over- nor underestimates consistent with the IPCC good practice guidance.

Deforestation – CO₂ and N₂O

110. Finland has used the same method to estimate the deforested area and the afforested area and has reported 226,633 ha as deforested in the period 1990–2008. The deforested area since 1990, specified for the northern and southern regions of the country, is presented in the NIR. Finland has subdivided the deforested areas according to land-use change and soil types and has reported emissions and removals for eight subdivisions. Finland also conducted a QC check by comparing deforested areas with areas reported in the statistics. The annual deforested areas for the years of the period 1990–2003 fluctuate between 4.6 ha for 1994 and 23.3 ha for 2003. From 2004 to 2008, Finland reported a constant deforested area of 15.4 ha. As the same method is used to estimate afforested, reforested and deforested areas, the ERT recommends that Finland justify why the land area is kept constant for the last years of the time series or provide information on any plan to report correct values in future annual submissions. The ERT reiterates the recommendation on the reporting on the annual areas from 2008 onwards (see para. 104 above) and suggests that Finland provide, in its next annual submission, information on whether resources will be available to increase the number of samples in the NFI in the last years of the commitment period.

111. Finland has reported the net carbon stock change in dead wood in deforestation in table 5(KP-I)A.2, with the exception of deforestation on wetlands and on organic soils (WL_{org}) reported as “IE” and included in SOM. In table NIR-1, Finland has reported dead wood in deforested areas using only the notation key “IE”. The ERT recommends that Finland use the notation key “R” (reported) for dead wood in deforestation in table NIR-1 as the pool is reported. The ERT also recommends that Finland provide information in the NIR to justify why changes in litter cannot be estimated separately.

112. Finland also reported emissions of 0.02 Gg N₂O from disturbance associated with land-use conversion to cropland for mineral soils. The emissions from this disturbance for organic soils are reported as “IE”. The ERT recommends that Finland provide, in its next annual submission, information on where these N₂O emissions for organic soils are reported.

113. The CRF does not allow the reporting of CH₄ and N₂O emissions from land deforested to peat extraction. Finland has therefore reported these net emissions in deforested land only in the NIR.

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

Forest management – CO₂

114. Finland has used a broad approach for the definition of forest management and has provided in the NIR information on the area under forest management, resulting in 21,873,000 ha by 31 December 2008. This area is estimated using an average value for deforestation for the period 2003–2008. This could result in an over- or underestimation of the area under forest management. The ERT recommends that Finland present, in its next annual submission, further information on the planning of the annual reporting of areas based on non-average values for deforestation.

115. Finland has estimated the changes in carbon stock in living biomass as the difference between the biomass increment in all forest land and the biomass increment in afforested land. Finland has reported above-ground living biomass in Kyoto Protocol table 5(KP-I)B.1 and has used the notation key "IE" for below-ground biomass, but the Party has indicated that the method used produces estimates for total tree biomass, and below-ground biomass is therefore included in above-ground biomass. However, the ERT noted that Finland has reported, in paragraph 7.2.2.1 of the NIR, biomass stocks in living trees, the biomass increment due to tree growth and the drain of the growing stock. The ERT recommends that Finland provide more detailed information on the estimation of below-ground biomass and that it explain why this pool is reported as "IE" and not as a separate pool in its next annual submission.

116. N₂O emissions from the drainage of soils are reported as "not reported". Finland has not provided information in the NIR to explain why this category is not a source. During the review, Finland informed the ERT that in Finland, N₂O emissions from drained mineral soils are minor, but that drained organic forest soils are a source of N₂O emissions. As the method and EFs used to estimate these emissions are given in Appendix 3a.2 of the IPCC good practice guidance for LULUCF, reporting N₂O emissions from the drainage of soils is optional. Finland has made some efforts to decrease the uncertainty of the national EFs and will implement national EFs when the method and the EFs are evaluated. The ERT commends Finland's plan and encourages the Party to report N₂O emissions from the drainage of soils in future annual submissions.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

117. 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.⁵ The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10.

118. Information on the accounting of Kyoto units has been prepared and reported in accordance with chapter I.E of the annex to decision 15/CMP.1, and reported in accordance with decision 14/CMP.1 using the SEF tables.

119. Finland has reported on corrective actions undertaken to reduce discrepancies between the national registry and the international transaction log (ITL), improve reporting on any discrepancies occurring, improve registry conformance with message flows and technical standards, and improve the availability of public information. Further, the Party has provided information on plans for switching registry software providers. These actions were identified as necessary by the previous ERT.

National registry

120. The ERT took note of the SIAR and its finding that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT further noted from the SIAR and its finding that the national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant Conference of Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) decisions.

⁵ 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.

Calculation of the commitment period reserve

121. Finland has reported its commitment period reserve in its 2010 annual submission. Finland reported its commitment period reserve to be 319,515,790 t CO₂ eq and that its commitment period reserve has not changed since the initial report review as it is based on the assigned amount and not on the most recently reviewed inventory. The ERT agrees with this figure.

3. Changes to the national system

122. Finland reported that there has been no change in its national system since the previous annual submission. The ERT concluded that the Party's national system continues to be in accordance with the requirements of national systems outlined in decision 19/CMP.1.

4. Changes to the national registry

123. Finland provided information on changes to its national registry in its annual submission. The Party indicated that the national registry authority, the Finnish Energy Market Authority, changed the software used for Finland's emissions trading registry from Greta software to CR software developed by the European Commission. The Party reported that the decision for the change was based mainly on the need to take a more robust, less expensive and better supported software in use and that the user interface of the CR software is more user-friendly and certain repetitive operations are easier and more flexible to carry out. The ERT concluded that the Party's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions.

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

124. Finland has reported information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as requested in chapter I.H of the annex to decision 15/CMP.1, in its 2010 annual submission. The Party submitted this information on 15 April 2010 and resubmitted it on 26 May 2010.

125. The reported information is considered mostly complete and transparent, as it provides examples of specific actions addressing the requirements of paragraph 24 of the annex to decision 15/CMP.1, but does not specifically include the information required by paragraph 23 of the annex to decision 15/CMP.1. Concerning the prioritization of actions, Finland has stated that the factors listed in paragraph 24(a) (the progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies) are taken into account for all GHG-emitting sectors, and that, with reference to paragraph 24(b), no subsidies for environmentally unsound and unsafe technologies have been identified. Specific cooperation initiatives are also mentioned with regard to the promotion of energy efficiency and renewable energy sources; in particular, within the Energy and Environment Partnership (EEP) with Central America, the Government of Finland has provided support to 189 projects. The ERT recommends that Finland improve the completeness of information relating to how it is striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement its commitments mentioned in Article 3, paragraph 14, of the Kyoto Protocol, as required by paragraph 23 of the annex to decision 15/CMP.1, and encourages the Party to report on how it gives priority to the actions taken, in implementing its commitments under Article 3, paragraph 14.

III. Conclusions and recommendations

126. Finland made its annual submission on 15 April 2010 and resubmitted it on 26 May 2010. The annual submission contains the GHG inventory (comprising CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (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 minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

127. 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 the Party has submitted a complete set of CRF tables for the years 1990–2008 and an NIR; these are complete in terms of geographical coverage, years and sectors, as well as complete in terms of categories and gases. Some of the categories, particularly in the agriculture sector (CH₄ emissions from enteric fermentation, CH₄ emissions from manure management, indirect N₂O emissions from agricultural soils) and the waste sector (CH₄ emissions from solid waste disposal on land) were not completely reported.

128. 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.

129. The Party's inventory is generally in line with the UNFCCC reporting guidelines, the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF.

130. The information provided by Finland is mostly complete and sufficiently transparent to understand the reporting and the accounting of activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol. The planned improvements, if implemented, will greatly improve the reporting on these activities.

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

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

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

134. Finland has reported the information requested in chapter I.H of the annex to decision 15/CMP.1, "Minimization of adverse impacts in accordance with Article 3, paragraph 14" as part of its 2010 annual submission. The information was provided on 15 April 2010 and is generally complete and transparent.

135. In the course of the review, the ERT formulated a number of recommendations relating to the completeness of the annual submission (including Article 7, paragraph 1, information), transparency and consistency of the information presented in Finland's annual submission. The key recommendations are that Finland:

(a) Improve the consistency between the NIR and CRF table summary 3 and between the NIR and CRF table 7;

(b) Improve emission estimates in agriculture and waste: correct the underestimated categories by reporting full emission estimates in agriculture and waste;

- (c) Improve transparency on the N mass flow model in the agriculture sector by including the information provided during the centralized review and the reference of the paper on the model in the NIR list of references;
- (d) Submit information on internal audits identified annually in the bilateral quality meetings;
- (e) Implement the improvement plans described to improve the reporting of emissions and removals for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;
- (f) Improve the uncertainty estimates for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol;
- (g) Improve the completeness of information relating to how the Party is striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement its commitments, in particular with regard to paragraph 23 of the annex to decision 15/CMP.1.

IV. Questions of implementation

136. 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 2010. Available at <http://unfccc.int/resource/docs/2010/asr/fin.pdf>.

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

FCCC/ARR/2009/FIN. Report of the individual review of the greenhouse gas inventory of Finland submitted in 2009. Available at <http://unfccc.int/resource/docs/2010/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 (Greenhouse Gas Inventory Unit, Statistics Finland), including additional material on the methodologies and assumptions used. The following documents¹ were also provided by Finland:

Grönroos, J., Mattila, P., Regina, K., Nousiainen, J., Perälä, P., Saarinen, K., Mikkola-Pusa, J. 2009. Development of the ammonia emission inventory in Finland: revised model for agriculture. Finnish Environment 8/2009: 60 p.

¹ Reproduced as received from the Party.

Annex II

Acronyms and abbreviations

| | |
|--------------------|--|
| AD | activity data |
| AWMS | animal waste management systems |
| C | carbon |
| CCS | carbon dioxide capture and storage |
| CH ₄ | methane |
| CMP | Conference of 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 |
| DOC | degradable organic carbon |
| DOM | dead organic matter |
| EF | emission factor |
| ERT | expert review team |
| EU ETS | European Union emissions trading scheme |
| FAO | Food and Agriculture Organization |
| FAOSTAT | Food and Agriculture Organization of the United Nations Statistical Database |
| F-gas | fluorinated gas |
| Gg | gigagram |
| GHG | greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs and SF ₆ without GHG emissions and removals from LULUCF |
| HFCs | hydrofluorocarbons |
| IE | included elsewhere |
| IEF | implied emission factor |
| HWP | harvested wood products |
| IPCC | Intergovernmental Panel on Climate Change |
| ITL | international transaction log |
| kg | kilogram (1 kg = 1,000 grams) |
| 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 |
| MSW | municipal solid waste |
| N | nitrogen |
| NA | not applicable |
| NE | not estimated |
| NO | not occurring |
| N ₂ O | nitrous oxide |
| NIR | national inventory report |
| 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 |
| UNFCCC | United Nations Framework Convention on Climate Change |