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FINLAND

**REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY
SUBMITTED IN THE YEAR 2004[1]**

I. OVERVIEW

A. Introduction

1.   This report covers the centralized review of the 2004 greenhouse gas (GHG) inventory
submission of Finland, coordinated by the United Nations Framework Convention on Climate Change
(UNFCCC) secretariat, in accordance with decision 19/CP.8 of the Conference of the Parties. The review
took place from 11 to 16 October 2004 in Bonn, Germany, and was conducted by the following team of
nominated experts from the roster of experts: Generalists – Ms. Ruta Bubniene (Lithuania) and
Mr. Jan Pretel (Czech Republic), Energy – Mr. Christo Christov (Bulgaria), Mr. Amit Garg (India) and
Ms. Kristin Rypdal (Norway), Industrial Processes – Mr. Justin Goodwin (United Kingdom) and
Ms. Natalya Parasyuk (Ukraine), Agriculture – Mr. Michael McGettigan (Ireland) and Mr. Vitor Gois
(Portugal), Land-Use Change and Forestry (LUCF) – Mr. Tomas Hernandez-Tejeda (Mexico) and
Mr. Walter Oyhantcabal (Uruguay), Waste – Mr. Sabin Guendehou (Benin) and Ms. Maria Paz Cigaran
(Peru). Mr. Michael McGettigan and Ms. Maria Paz Cigaran were the lead reviewers. The review was
coordinated by Ms. Rocio Lichte (UNFCCC secretariat).

2.   In accordance with the "UNFCCC guidelines for the technical review of greenhouse gas
inventories from Annex I Parties", a draft version of this report was communicated to the Government of
Finland, which provided comments that were considered and incorporated, as appropriate, in this final
version of the report.

B. Inventory submission and other sources of information

3.   In its 2004 submission, Finland has submitted a complete set of common reporting format (CRF)
tables for the years 1990–2002 and a national inventory report (NIR) along with the comprehensive
additional report entitled "Finnish 2002 inventory of HFC, PFC and SF_6 emissions" (Oinonen, 2004).
A methodologies report ("Greenhouse gas emissions and removals in Finland", Pipatti, 2001) provided as
part of the 2001 inventory submission also constitutes part of the 2004 submission. The full list of
materials used during the review is provided in annex 1 to this report.

C. Emission profiles and trends

4.   In the year 2002, the most important GHG in Finland was carbon dioxide (CO_2), contributing
84.8 per cent to total[2] national GHG emissions. Nitrous oxide (N_2O) accounted for 8.3 per cent of the
total, methane (CH_4) for 6.2 per cent and fluorinated gases (F-gases) for 0.6 per cent of total GHG

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[1] In the symbol for this document, 2004 refers to the year in which the inventory was submitted, and not to the year
of publication.
[2] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2
equivalent excluding LUCF, unless otherwise specified.

emissions in the country. The Energy sector accounted for 82.9 per cent of total GHG emissions, Agriculture for 9.1 per cent, Waste for 3.6 per cent and Industrial Processes and Solvent Use for 3.5 per cent. Emissions reported under sector "7 Other" (CO_2 emissions from fuels used as feedstocks) accounted for 0.9 per cent. Total GHG emissions amounted to 81,963 Gg CO_2 equivalent and increased by 6.7 per cent from 1990 to 2002.

D. Key sources

5.   Finland has reported a tier 2 key source analysis using both level and trend assessment as part of its 2004 submission. A 90 per cent uncertainty threshold has been used for the key sources. The number of key categories when compared with the 2001 inventory has decreased, mainly due to the use of a higher level of aggregation, in particular for CO_2 from fuel combustion. The Party has applied a simulation tool for the sensitivity analysis for the level assessment (2002). The method allows identification of the sources of uncertainties at a disaggregated level, which is useful when planning inventory improvements. The key source analysis performed by Finland identified 17 key sources by trend and 16 key sources by level. The results are broadly similar to those of the secretariat,[3] which indicate 21 key source categories based on level and trend assessment.

E.   Main findings

6.   In general, both the NIR and the CRF are largely complete and transparent. The inventory includes information on key sources, methods, data sources, emission factors (EFs), uncertainty estimates and quality assurance/quality control (QA/QC) procedures, and contains most of the relevant information needed for replication of the inventory. The methodologies for estimating GHG emissions are consistent with the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Guidelines) and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance), and there are no major inconsistencies between the CRF and the NIR. However, some transparency is lost where more complex methods or models have been used. The expert review team (ERT) welcomes Finland's application of national EFs, methodologies and models, but encourages the Party to provide more detailed explanation and more precise references (e.g., data in the web sites which are referenced are not updated). Finland has significantly improved its national inventory system except insofar as it has not established the formal QA/QC system for which the plan was provided in its 2003 submission.

F. Cross-cutting topics

Completeness

7.   Finland has submitted GHG inventories for the years 1990–2002 using the CRF tables and has provided a comprehensive NIR. The geographical coverage is complete and all major sources and sinks as well as the relevant GHGs (CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)) and the indirect GHGs nitrogen oxide (NO_X), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs), and sulphur oxide (SO_X) are covered. CRF table 9 states that further studies are needed, in particular for fugitive emissions from oil and gas and international bunkers. In some cases (e.g., LUCF), sectoral background data tables have not been completed and non-standard notation keys are used (e.g., in CRF table 1.B.2, "not estimated/zero" ("NE/0"). Nevertheless, the inventory is sufficiently complete and the missing categories do not suggest any major gaps in coverage.

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[3] The secretariat had identified, for each individual Party, those source categories which are key sources in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance. Key sources according to the tier 1 trend assessment were also identified for those Parties providing a full CRF for the year 1990. Where the Party has performed a key source analysis, the key sources presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key source assessment conducted by the secretariat.

Transparency

8.   The NIR provides general information on the methodologies, activity data (AD) and EFs but several reports which the Party references need to be consulted to obtain a full understanding of the methodologies and the country-specific approaches to estimating GHG emissions. The information on recalculations, uncertainties, verification and QA/QC procedures, key sources and GHG trends is also of a general nature. In general, the ERT considered that the transparency of the inventory and consistency between the NIR and the CRF are satisfactory. The NIR refers at several points to the VAHTI database system, which serves as basis for data on point sources which account for approximately two-thirds of total annual fuel combustion. More detailed information on the principles on which the VAHTI database is based, the sources and pollutants it covers, the frequency of updating, data quality and verification should be included in the NIR to increase the transparency of this important source of data for the inventory. The ERT welcomes the application of models (e.g., in the Energy sector) but encourages proper QA/QC of the calculations, assumptions and data.

Recalculations and time-series consistency

9.   Finland has provided recalculations of emission estimates for the years 1990–2001 that reflect the exclusion of indirect N_2O emissions caused by nitrogen deposition due to NO_X emissions previously reported in the Energy sector. The effect of the recalculations is a decrease in the estimates of emissions in all years, ranging from 0.87 per cent in 1990 to 0.49 per cent in 2001. This change increases transparency and comparability with other countries' inventories. Some inconsistencies in time series of emissions and implied emission factors (IEFs) (e.g., for transport) should be corrected and more transparency is needed on the methodologies used for the Industrial Processes and Waste sectors. Finland has provided a plan for further inventory improvements which may lead to further recalculations in the future.

Uncertainties

10.   Finland has provided uncertainty estimates according to the IPCC tier 1 and tier 2 analysis. The results are presented both at a summary and at individual source category level. A detailed uncertainty estimate using the tier 2 method was performed for the first time for the 2001 inventory, and since the previous inventory submission only minor changes in uncertainty estimates have occurred. Total uncertainty in the inventory based on the tier 2 approach is between –5 and +6 per cent. The current uncertainty estimate does not cover LUCF. The NIR discusses planned improvements and uncertainty analysis within each category, indicating that the results of the uncertainty analysis are being considered in developing and prioritizing improvements to the inventory.

Verification and quality assurance/quality control approaches

11.   The formal QA/QC plan is not described in the NIR but, as indicated by Finland, it should be in use in time for the 2003 inventory as a part of the quality management system now under development. The system will cover the QA/QC plans for the sectoral inventories of the expert institutes, documentation, archiving, review, verification and improvement procedures of the inventory. Statistics Finland will coordinate the project. The inventory project in Statistics Finland is developing inventory review methods and verification procedures in the context of general QA/QC functions. A general schedule for implementation in each sector as well for most categories is provided. The NIR also mentions that standard statistical quality checks have been implemented, but without any detailed description.

Follow-up to previous reviews

12.   Compared with previous review findings, the completeness of the inventory has been improved, mainly due to transparent recalculations of all years of the time series and more consistent use of notation keys, in accordance with the UNFCCC reporting guidelines, in the CRF. However, Finland last year indicated its intention to establish a formal QA/QC plan and present it in its 2004 submission. For technical and administrative reasons which are described in the NIR, implementation has been postponed by one year.

G. Areas for further improvement

Identified by the Party

13.   Finland is prioritizing the implementation of the formal QA/QC plan for the preparation of its 2005 submission. Formalized QA/QC procedures remain to be developed in cooperation with Statistics Finland. It would also be useful to look for potential ways of verifying the current level of F-gas emissions in Finland. A new database system is under development to reduce uncertainties in the Energy sector and the inventory agency will harmonize the EFs in the ILMARI and LIPASTO calculation models. The estimates of fugitive emissions from solid fuels, CO_2 emissions from the use of mineral products and N_2O emissions in agriculture, and the CH_4 EF for municipal solid waste are all seen as areas for improvement.

Identified by the ERT

14.   The ERT recognized that the inventory of Finland is sufficiently complete and the NIR provides comprehensive and in general transparent descriptions of methodology used and the overall structure of the national inventory system. The overall effort to produce emissions inventories which are fully consistent with the UNFCCC reporting guidelines and the IPCC Guidelines and good practice guidance is welcomed. The ERT also recommends that Finland focus on the further improvement of QA/QC procedures and verification processes in all the areas it identifies. Recommendations related to specific source/sink categories are presented in the relevant sector sections of this report.

15.   The ERT urges the Party to provide more precise references and summaries of the methodologies in the NIR rather than provide links to web sites. The Party is encouraged to do this in its future submissions.

II. ENERGY

A. Sector overview

16.   In 2002, the Energy sector accounted for 82.9 per cent of total national GHG emissions. Fuel combustion emissions contributed 78.6 per cent of total national GHG emissions. An increase in the Energy sector emissions of 15 per cent over the period 1990–2002 is mainly caused by the increase in stationary combustion emissions. Transport contributed 16.4 per cent of the total national emissions. Energy sector emissions increased by 2.7 per cent between 2001 and 2002.

17.   All important sources are addressed for the Energy sector and all years and gases are covered. The level of disaggregation is in line with the IPCC Guidelines. All the CRF tables, including the sectoral background tables, are provided.

18.   The reporting in the Energy sector is generally transparent. Calculation methodologies are not documented in the NIR, but the NIR provides references to a report on the methodologies used and sufficient back-up information (the national energy balance and EFs) to enable the ERT to follow the calculations for some but not all source categories. The Party is using a large number of models and sub-models for preparing the Energy sector inventory. The ERT would welcome a peer review of these models and encourages proper QA/QC of the calculations, assumptions and data.

19.   Recalculations in the Energy sector following previous review recommendations have affected the estimates of N_2O emissions from all combustion sources. The recalculations are reported in the CRF for the entire time series. Due to the recalculations, the estimates for total GHG emissions are 0.4–0.6 per cent lower than in the previous submission. An inventory improvement programme to identify the needs for methodological improvements was established in 2003 and there could be significant recalculations in future submissions.

20.   There are a large number of inconsistencies in the time series of emissions and IEFs in several subcategories as a result of some data input errors and model artifacts which were highlighted in the 2004

Synthesis and Assessment (S&A) report. The Party has responded that it is working to correct these inconsistencies. The Party has indicated that a new database supporting the ILMARI calculation system is under development, to include plant-level data for all inventory years into one database in order to reduce inconsistencies in the time-series of the Energy sector emissions estimates. The ERT looks forward to corrections and recalculations in future submissions.

21.   The Party has also revised the classifications of some sources, resulting in a reallocation of emissions between 1.A.1 and 1.A.2. CO_2 emissions in the Energy sector increased by 15.4 per cent from 1990 to 2002. This is mostly because emissions from source category 1.A.1 increased by 56.3 per cent. CO_2 emissions from 1.A.1 also show large inter-annual fluctuations. A major increase is reported between 2000 and 2001, due to the changeover to the new database system. The reclassifications and variations are explained only partially and in general terms. The ERT recommends the Party to provide further details of the effects of the new database.

22.   There are no changes in the uncertainty assessment of the Energy sector compared to the previous submission.

B. **Reference and sectoral approaches**

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

23. CO_2 emissions from fuel combustion have been calculated using the reference approach and the sectoral approach. Comparing the reference approach CO_2 emissions estimates against those from the sectoral approach, the difference between the two approaches is 1 per cent for 2002. Explanations are provided in the documentation box of CRF table 1.A(c). The differences between CO_2 emissions from the reference approach and the sectoral approach for 1990–2002 range from –8.3 per cent in 1991 to +9.3 in 1994. The ERT would encourage the Party to provide an explanation of these much larger and highly variable differences.

International bunker fuels

24.   Finland is using a model to estimate emissions from shipping and aviation. According to the NIR bunker fuel is determined from the sale of fuels to ships and aircrafts going abroad. There is generally good agreement between the AD reported and the data of the International Energy Agency (IEA) for international transport.

C. **Key sources**

Stationary combustion: Other fuels, solid fuels and liquid fuels – CO_2

1.A.1a Public electricity and heat production

25. CO_2 emissions from other fuels more than doubled from 1990 to 2002. These emissions represented 11.6 per cent of Finland's CO_2 emissions in 2002. However, the Party has not provided details about the methodology adopted, the AD of the other fuels considered or their EFs. This is also connected with source subcategory 6.C Waste Incineration, CO_2 emissions from solid fuels, which are reported under the Energy sector. However, specific details about the composition of waste, the CO_2 EF and the methodology employed for the estimation of emissions are not provided. The ERT would recommend the Party to provide further documentation to enhance transparency.

1.A.2a Iron and steel

26.   All CO_2 emissions from solid and liquid fuels have been reported here, including process-based emissions (from category 2.C.1), even though the IPCC good practice guidance recommends reporting of emissions from the use of reducing agents in the Industrial Processes sector. The ERT recommends that Finland include a detailed description of the methodology used for estimating these process emissions in

the NIR. It would also encourage reporting of these emissions under Industrial Processes, as recommended in the previous review report.

1.A.4 Other sectors

27.	In explaining a 76 per cent difference between the figures for fuel use for domestic navigation reported in the CRF and those published by the IEA, the Party indicated that such difference is due to the fact that the IEA data also include military fuel use and fishing. However, the IEA reporting follows the same definitions as in the CRF with respect to allocating emissions from fishing to 1.A.4 Other Sectors. The ERT would welcome a further clarification on how emissions from fishing (and military fuel use) are allocated in the CRF and of the data submitted by Finland to the IEA.

Mobile combustion: 1.A.3.b Road transportation[4]

28.	The methodological descriptions in the NIR make extended references to models (LIPASTO, LIISA) and to web sites which carry descriptions of these models. It would be useful to provide a short description of the basis for these models in the NIR and how they are linked, including examples of their data inputs and basic principles. Aggregate EFs for transport are summarized in an annex to the NIR. However, it is not specified what year these EFs refer to. Furthermore, information about how EFs are applied for different technologies and the basis for the EFs do not appear to be accessible from the web page referenced for LIPASTO. The ERT would encourage greater transparency with respect to these models, as well as the models used for the transport sector in general, given that the issues identified with regard to road transport are also relevant for the transport sector as a whole. In particular, the ERT would welcome a comparison of calculated fuel use and amounts of fuel sold within the Transport sector.

29.	The reported fuel consumption and CO_2 emissions from road transport are almost the same in 1990 and 2002 (with inconsistencies, as addressed above, for intermediate years), which contrasts sharply with increasing emissions from road transport in all other Annex I Parties. The reduction of 14 per cent in reported gasoline consumption from 1990 to 2002 is particularly unusual, and inter-annual variations within the time series need further explanation. The ERT would encourage an explanation in the NIR of how assumptions about specific fuel use affect the emissions estimates and a comparison of the fuel consumption calculated in the LIISA model with fuel sales.

Fugitive emissions from solid fuels: 1.B.1.c Other

30.	The estimates of CO_2 emissions from the preparation of soils for peat production have been kept constant from 1990 to 2002. The Party has indicated that efforts to improve the estimates are ongoing. The ERT would welcome these improvements in Finland's next submission, including recalculation of the time series.

D. **Non-key sources**

Mobile combustion: 1.A.3a Civil aviation – CO_2

31.	The LIPASTO model used by the Party estimates CO_2 emissions to be far higher than indicated by the energy statistics. The Party is checking these differences. The ERT would welcome an explanation of these differences and appropriate corrections or harmonizations.

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[4] According to Finland's key source analysis which is based on a tier 2 approach, only N_2O emissions from this category were identified as key source but not CO_2 (CO_2 from road transport was identified as key source according to the secretariat's key source analysis, which is based on tier 1). However, for reasons of structuring the report the entire 1.A.3b Road transport category is addressed in this section.

Mobile combustion: 1.A.3d Navigation

32.   According to the NIR, emissions from transport on inland waterways have not been estimated. Given that Finland has a large number of lakes where significant boating activities would be expected to occur, the ERT would invite Finland to provide an estimate of these emissions.

1.B.2 Fugitive emissions from oil and gas

33.   According to the NIR, estimates of emissions of CO_2 and CH_4 are based on plant-specific data. However, no description or reference is given as to the origin of these data. Furthermore, the CRF is largely incomplete, only giving AD and no emissions estimates for a large number of subcategories under 1.B.2 ("NE/0" is reported). The ERT would encourage the Party to estimate the subcategories under 1.B.2 that are currently not estimated, possibly using IPCC default EFs, and to complete table 1.B.2 correspondingly. The NIR also describes evaporative emissions from cars and from refuelling of cars. Normally such emissions include NMVOCs only and not CH_4. Furthermore, emissions from evaporation from cars are most appropriately reported under 1.A.3b.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

34.   The Industrial Processes and Solvent Use sectors taken together contribute 3.5 per cent to the total GHG emissions in Finland. The most important emissions are N_2O emissions from nitric acid production, and CO_2 emissions from cement and lime production. Emissions of F-gases account for about 0.6 per cent of the total. Emissions from industrial processes fluctuated somewhat during the 1990s. The most significant change is the five-fold increase in emissions of F-gases between 1990 and 2002. N_2O emissions decreased significantly over the period and almost offset the increase in emissions of F-gases. CH_4 emissions increased by nearly 37 per cent over the same period but their contribution to the total emissions from the Industrial Processes sector is very small. CO_2 emissions from the sector in 2002 were about 15 per cent lower than emissions in 1990.

35.   Four key sources are identified by the secretariat – cement, lime and nitric acid production, and the consumption of halocarbons and SF_6. The Finnish NIR identifies only two key sources in Industrial Processes – nitric acid production, and the consumption of ozone depleting substances (ODS) substitutes in refrigeration and air conditioning equipment, but not cement and lime production as identified according to the secretariat's analysis (based on the tier 1 method). As explained by Finland this is due to the use of the tier 2 method for identifying key sources and the relatively low uncertainty associated with AD and EFs in the these two production processes in Finland.

36.   The CRF includes estimates of most gases and sources of emissions from the Industrial Processes sector, as recommended by the IPCC Guidelines. CO_2 emissions from Solvent use are flagged as not occurring. Not included in the inventory are 2.A.3 Limestone and Dolomite Use, 2.A.4 Soda Ash Production and Use, 2.A.5 Asphalt Roofing and 2.A.6 Road Paving with Asphalt. However, notation keys are used and information is provided in CRF table 9 to the effect that these emissions are estimated to be small and that further studies are needed to consider these sources. In the NIR this is mentioned as a planned improvement.

37.   There has been no recalculation in the Industrial Processes sector. There may be some issues with time-series consistency in category 2.F as the method used to estimate the time series of emissions is not clear. The ERT suggests that further clarification on the consistency of the time series be provided.

B. Key sources

2.B.2 Nitric acid production – N_2O

38.   The EF is plant-specific and based on measurements carried out at two plants in 1999. The AD are obtained directly from these production plants. The ERT encourages Finland to update its plant-specific data for the preparation of the next inventory.

2.F. Consumption of halocarbons and SF_6

39.   Finland has reduced the uncertainty in the 2002 estimates by improving its survey methods and the response rate. The ERT was unable to find an explanation for the decrease in emissions between 2001 and 2002 apart from the report referenced (Oinonen, 2004, page 21), which indicates that in 2001 the quantities of HFCs and PFCs containing refrigerants sent for disposal were negligible and that 2002 was the first year when significant quantities were disposed of. The ERT invites Finland to confirm that the decrease in emissions between 2001 and 2002 is a result of changes in disposal practice and not of changes of methodology between the years resulting from different survey responses. The method used to estimate the time series of emissions is not clear. The ERT suggests that further clarification on the consistency of the time series be provided.

C. **Non-key sources**

2.A.1 Cement production – CO_2

40. CO_2 emissions from cement production are calculated using the tier 2 method. AD are obtained from the production plants directly. Due to lack of clinker production data, estimates of CO_2 emissions are based on cement production. The CO_2 IEF of 0.47 tonne CO_2/tonne cement is at the low end of the range of reporting Parties and the value cannot be derived as indicated in the NIR. The ERT encourages Finland to clarify the data used to estimate clinker production from cement production and to detail the assumptions behind the 60 per cent lime content presented in the NIR. It also encourages Finland to collect clinker statistics for the cement industry and to use a clinker-based method for this source in accordance with the IPCC good practice guidance. Finland has indicated in its response to the 2004 S&A report that a recalculation for this sector is being considered and will be reported in the 2005 submission.

2.A.2 Lime production – CO_2

41.   The methodology for estimating emissions from lime production is not presented in the NIR. A default methodology is indicated but no details are provided. As this is a key source identified according to the tier 1 assessment by the secretariat the ERT encourages Finland to present a full description of the emissions estimation methodology for lime production in the NIR and preferably to use a tier 2 methodology to estimate the emissions for the full time series.

2.C.1 Iron and steel – CO_2

42.   As indicated in the NIR, CO_2 emissions are calculated on the basis of coke and residual fuel oil used in blast furnaces and allocated to metal production in the Energy sector. Thus the emissions could be overestimated because stored carbon in iron and steel is not accounted for. From the UN statistics this source is likely to be a key source. As indicated in the 2003 review report, the emissions from the process component of the iron and steel emissions should be included in the Industrial Processes sector. Finland in response to this review intends to revise the methodology for iron and steel emissions estimates in 2005 or 2006 and separate process and energy emissions, and this is welcomed.

2.C.2 Ferroalloys – CO_2 and CH_4

43.   These emissions are reported as "included elsewhere" ("IE") but no information is provided on where they are included and no information is provided on the estimation methodology. The ERT would welcome more information on the estimation methodology and the allocation of the emissions.

IV. AGRICULTURE

A. **Sector overview**

44.   Finland has reported emissions in the year 2002 for categories 4.A, 4.B and 4.D amounting to 7,475 Gg CO_2 equivalent, which accounted for 9.1 per cent of total national GHG emissions. Within the sector, category 4.D accounted for 71.3 per cent of emissions (43.8 per cent from N_2O and 27.5 per cent

from CO_2), 4.B for 7.76 per cent (2.7 per cent as CH_4 and 5.0 per cent as N_2O) and category 4.A for 20.9 per cent. Emissions from the sector in 2002 were approximately 26 per cent lower than in the year 1990. The reporting for Agriculture in the CRF for 2002 is complete. Emissions for 4.F are considered negligible and reported in the CRF tables as "not occurring" ("NO") or "NE/0". The ERT recommends Finland to use the notation keys in accordance with the reporting guidelines.

45.   The NIR provides a general description of the methodologies and data sources used for estimating emissions from agriculture and, in general, the detailed methods, assumptions made and modifications to the IPCC and good practice guidance approaches are described in several comprehensive reports referenced as supporting material to the NIR. However, information for the most recent years (2000 and beyond) and for some sub-sources (reindeer) is not available and this hinders assessment of the recalculations. The ERT encourages Finland to update this supporting material or include full documentation in the NIR.

46.   Finland identifies four key sources in agriculture in its list of key sources in 2002 (4.A Enteric Fermentation – CH_4, 4.B Manure management – N_2O, 4.D Agricultural soils –Direct N_2O and 4.D Agricultural soils – Indirect N_2O). CO_2 emissions from agricultural soils (reported under Agriculture and accounting for 2.5 per cent of total national emissions) are not included in the list (NIR table 4, p. 12) but are one of the key sources identified by the secretariat.

B. Key sources

4.A Enteric fermentation – CH_4

47.   The tier 2 method is used for enteric fermentation in cattle and the tier 1 method is used for other livestock, which is in accordance with the IPCC good practice guidance. The tier 2 EFs are derived in accordance with the IPCC methods for dairy cattle and other cattle, with the latter being treated in four separate categories. Populations, milk production and other major inputs are obtained from the Ministry of Agriculture and Forestry. The type of animal census is not specified and it is not clear whether Finland applies three-year averaging of annual statistics as recommended by the IPCC Guidelines. The country-specific values for 2002 were 115.2 kg/head and 42.35 kg/head for dairy cattle and other cattle, respectively. CH_4 emissions from enteric fermentation of reindeer have been calculated on the basis of the Finnish scientific literature but further documentation is needed.

4.B Manure management – N_2O

48.   Detailed reporting of livestock numbers for each age/sex class for non-dairy cattle in the NIR would assist replication of nitrogen (N) excretion data and support the information in table 4.B(b). The percentage of N excretion under each animal waste management system (AWMS) for dairy cows does not agree with the percentages of AWMS in table 4.B(a). There is no information in the NIR to indicate that cattle in different AWMS have different N excretion rates.

49.   The N excretion rates for non-diary cattle and swine (35 and 10 kg/head, respectively) appear low compared to the IPCC defaults and values reported by most other Parties. In its response to the 2004 S&A report Finland states that these values will be re-examined. From table D4-2 of the methodologies report (Pipatti, 2001) it appears that data on N excretion are only available for 1990 and 1995, and data are interpolated for the intermediate years. There is no explanation for the fact that N excretion rates decrease after 1995. Though Finland responded to this finding during the 2001 in-country review, no documentation was provided on this issue.

4.D.1 Agricultural soils – direct N_2O

50.   The values of F_{SN} and F_{AW} reported in table 4.D can be fully traced using the information on fertilizer use and N excretion by AWMS given in table 4.B(b) and the values of $Frac_{GRAZ}$, $Frac_{FUEL}$, $Frac_{GASF}$ and $Frac_{GASM}$. The country-specific value of 0.006 used for $Frac_{GASF}$ is an order of magnitude lower than the IPCC default and $Frac_{GASM}$ is 50 per cent higher than the IPCC default. Although some documentation is referenced, Finland should provide pertinent information in the NIR to support the

values chosen for these parameters, such as the ammonia (NH_3) emissions summary relating to synthetic fertilizers and AWMS in agriculture. A very low value of $Frac_{GASF}$ may lead to N_2O emissions being overestimated. The figures on the use of synthetic fertilizers indicated in table 4.D are generally consistent with those given by the Food and Agriculture Organization of the United Nations (FAO).

51.   The estimation of N_2O emissions from N-fixing crops and crop residues is based on the tier 1a methodology using country-specific values of $Frac_{NCRBF}$ and $Frac_{NCRO}$ and the results are correctly reported in table 4.D. The methodologies report (Pipatti, 2001) provides good time-series information on production quantities of the crops that generate the residues and the associated parameters needed to estimate the N inputs to soils.

4.D.1 Agricultural soils – indirect N_2O

52.   The accounting of N inputs for indirect emissions is consistent with that in the estimation of direct emissions of N_2O from agricultural soils. The calculated N inputs from atmospheric deposition and leaching reported in table 4.D can be traced using the information on fertilizer use and N excretion by AWMS given in table 4.B(b) and the values of $Frac_{GASF}$, $Frac_{GASM}$ and $Frac_{LEACH}$.

53.   Finland uses a country-specific value of 0.15 for $Frac_{LEACH}$ which may mean that indirect N_2O emissions are underestimated. The source of this value is referenced in the NIR but no national circumstances are described to demonstrate that the value of 0.15 is more appropriate to Finland than the IPCC default value of 0.3.

4.D. Agricultural soils – CO_2

54.   Finland reports emissions of CO_2 from agricultural soils in this sector. The corresponding sectoral background data for this subcategory are included in CRF table 5.D. The reporting is complete and transparent. The relevant activities are liming of soils, cultivation of organic soils and carbon stock changes in mineral soils. The methods are as given by the IPCC Guidelines but, for mineral and organic soils, the EFs are taken from national studies and organic soils have been divided into peat soils and other organic soils. Net changes in mineral soil carbon take into account the land use change over 20 years for five classes of land-use change appropriate to Finnish circumstances. Annual emissions/removals are estimated as the mean change in carbon stocks (total change divided by 20).

55.   Emissions from limestone and dolomite application on soils are calculated separately using IPCC EFs on the assumption that all carbon in these products is released. Some briquette lime, containing both limestone and dolomite, is also used in Finland and the EF is weighted according to composition.

C. **Non-key sources**

4.B Manure management – CH_4

56.   Finland apparently uses a value of 1.0 for the methane correction factor (MCF) for liquid slurry (Pipatti, 2001). This MCF was the default value from the IPCC Guidelines for cool regions. This default value was revised in the IPCC good practice guidance (table 4.10) to 0.39. Finland should explain why the value of 0.39 is not used.

57.   The percentage of each AWMS reported in CRF table 4.B(a) for dairy cattle (28.1 per cent under pasture range and paddock) is not consistent with the length of time dairy cattle are at pasture (120 days) according to the methodologies report (Pipatti, 2001).

V. **LAND-USE CHANGE AND FORESTRY**

A. **Sector overview**

58.   The LUCF sector constitutes a net sink of CO_2 which is very important in Finland. In the period 1990–2002 net CO_2 removals ranged from 23,798 to 18,010 Gg CO_2, offsetting 38 per cent and 26 per cent of Finland's total GHG emissions, respectively. A slight decreasing trend is observable with

significant inter-annual variations. According to the NIR these variations are explained by fluctuations in the rate of harvesting due to commercial demand for felling and the global timber market situation.

59.   Finland reports CO_2 emissions and removals under Boreal Forests in category 5.A Changes in Forest and Other Woody Biomass Stocks. The CO_2 emissions and removals associated with forest and grassland conversion and with abandonment of managed lands are stated to be indirectly included in the estimates for 5.A, and accordingly the notation "IE" appears under Boreal Forests in table 5. Emissions of the non-CO_2 gases under 5.B are not estimated. The notation "IE" also appears under CO_2 emissions and removals from the cultivation of mineral and organic soils and liming of agricultural soils in 5.D, as these estimates are included in category 4.D (see paragraph 54).

60.   Finland has used country-specific methods and national values of input parameters for LUCF, which are considered to give more accurate estimates of emissions and removals than the IPCC methodology. However, no detailed description of the methods and input parameters is provided in the NIR (a web site is referenced for more information on the methodologies). This basic information should be provided in the NIR, as an annex, for the sake of transparency and efficient review. AD are based on data sources from the Finnish Forest Research Institute.

B. Sink and source categories

5.A Changes in forest and other woody biomass stocks

61.   Finland provides CO_2 emissions and removals estimates for the category Changes in Forest and Other Woody Biomass Stocks in table 5. No data are provided in the sectoral background data table 5.A to support these estimates. The Party mentions that CO_2 emissions and removals from activities relevant to categories 5.B and 5.C, such as deforestation and natural regrowth of abandoned managed lands are indirectly included in category 5.A.

62.   Field measurement of increment in tree stem volume averaged over five years, along with national values of biomass expansion factor and carbon content, is the basis for the estimates of carbon uptake in forests. Averaging is needed to account for measurements in different years in different parts of the country. Finland plans to conduct an annual forest inventory from 2004. Commercial wood harvest is reliably known from forest industries and surveys are undertaken to quantify wood waste and household use of wood. The NIR gives no description of how these wood products are converted to carbon emissions.

63.   Much greater transparency is required in the reporting for LUCF categories 5.A, 5.B and 5.C. The contributions of the relevant activities to emissions and removals should be shown separately and data used should be shown in the NIR in tabular format similar to the sectoral background data tables. The NIR should summarize the basic input data and describe data collection and methodologies in more detail to facilitate assessment of the inventory. Estimates of non-CO_2 gas emissions should also be provided for category 5.B.

5.D Emissions and removals from soils – CO_2

64. CO_2 emissions and removals from soils are accounted in the Agriculture sector, and corresponding background data for this source are reported in table 5.D of the CRF.

65.   Finland mentioned that estimates of changes in the carbon content of forest soils will be reported by the end of 2005 in the LUCF sector, using a method under development.

VI. WASTE

A. Sector overview

66.   In the year 2002 the Waste sector contributed 3.6 per cent to the total GHG emissions of Finland. CH_4 from landfills is the most important GHG emitted in the sector, contributing 92.1 per cent to the total sectoral emissions. From 1990 to 2002 emissions in the sector decreased by 25.5 per cent, mainly

because of implementation of waste management regulations and methane recovery. The number of landfills with CH_4 recovery increased from 13 in 2001 to 26 in 2002. An explanation of the effect of this large increase on CH_4 recovery should be provided in the NIR.

67.   Finland's estimates in this sector are mostly complete as they cover all source categories and gases for the years 1990–2002 with full geographical coverage. Emissions from waste incineration are reported in the Energy sector. No recalculations have been performed.

B. Key sources

6.A Solid waste disposal on land – CH_4

68.   The IPCC tier 2 method is used for this key source, as recommended by the IPCC good practice guidance. The methodology and parameters used are clearly specified, but the ERT recommends that they be presented in more detail in the NIR, particularly the quantities of the different waste streams and their related degradable organic carbon (DOC) values and half-lives, to improve transparency and allow replication of the emissions estimates.

69.   Finland has made progress by using a value of 1 for the MCF instead of 0.994, as used in the 2001 inventory. This should trigger a recalculation for the whole time series. Finland has included three different half-lives (IPCC default: k1= 0.2, k2= 0.03, k3= 0.05) associated with the waste streams indicated. The ERT encourages Finland to update the DOC fraction in solid wastes (reported constant for the whole time series based in a 1990 study). Documentation on the reason for choosing the value 0.5 for degradable organic carbon assimilated (DOCf), the minimum value recommended by the IPCC good practice guidance, should be provided.

70.   References with regard to methodology and AD on landfilled wastes are provided in the NIR (a web link is referenced). Access to this information was not possible through the web page, but through a response provided by the Party. The web site has not been updated yet. The report was published in 2001 and provided information for the years 1990–1999 only. The ERT recommends Finland to update the web site referenced.

6.B Waste-water handling: human sewage – N_2O

71.   Finland indicates in the CRF that it has estimated N_2O emissions from human sewage using country-specific and default methodologies, but no description of the methodologies, their related AD or the EF has been provided. As stated in previous reviews, this information should be documented in the NIR, as this source has been identified as a key source using tier 2 level and trend assessments.

72. N_2O emissions from waste-water handling decreased from 0.34 Gg in 1990 to 0.27 Gg in 2002 while population and protein consumption increased (from 36 kg/person/yr in 1990 to 37.7 kg/person/yr in 2002) and the nitrogen fraction remained constant. The basis for the change in protein consumption should be explained.

C. Non-key sources

6.B Waste-water handling – CH_4

73.   The methodology used is the IPCC default based on chemical oxygen demand (COD) and biochemical oxygen demand (BOD). Only the sources of these parameters and other AD (collected from national statistics for industrial waste water and domestic and commercial waste water) are specified in the NIR, but it was not possible for the ERT to access them in order to cross-check. The calculation of the EF is based on the IPCC default methane-producing capacity (B_O) and a country-specific MCF. The rationale for using an MCF of 0.005 for industrial waste water and 0.01 for domestic waste water, and the value of 0.8547 for converting BOD_7 to BOD_5 based on expert judgement, should be provided in the NIR.

<u>6.C Waste incineration – CO_2, CH_4, N_2O</u>

74.   The notation key "IE" is used in CRF table 6.C. In the NIR it is noted that CO_2, CH_4 and N_2O emissions from incineration are reported in the Energy sector. However, there is no description in either the Energy sector or the Waste sector about the methodology and parameters used. The ERT recommends Finland to provide information on the methodology used as well as parameters and sufficient documentation on different types of waste incinerated (biogenic and non-biogenic), and to confirm that reallocation is correctly done.

75.   Finland should also explain the reasons for reporting the amount of wastes incinerated only for the years 1999–2002 and should attempt to include emissions estimates for waste incineration for all relevant years.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

2003 and 2004 Inventory submissions of Finland. 2004 submission including a set of CRF tables for 1990–2002 and an NIR as well as the reports "Finnish 2002 Inventory of HFC, PFC and SF_6 Emissions" and "Greenhouse Gas Emissions and Removals in Finland" (see section B below);

UNFCCC secretariat (2004). "Report of the individual review of the greenhouse gas inventory of Finland submitted in the year 2003 (Centralized review)." FCCC/WEB/IRI(3)/2003/FIN (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/finrep03.pdf>).

UNFCCC secretariat. "2004 Status report for Finland" (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/fin04.pdf>).

UNFCCC secretariat. "Synthesis and assessment report of the greenhouse gas inventories submitted in 2004. Part I." FCCC/WEB/SAI/2004 (available on the secretariat web site <http://unfccc.int/resource/webdocs/sai/2004.pdf>) and Part II – the section on *Finland*) (unpublished).

UNFCCC secretariat. Review findings for Finland (unpublished).

Finland's comments on the draft "Synthesis and assessment report of the greenhouse gas inventories submitted in 2004" (unpublished).

UNFCCC secretariat. "Handbook for review of national GHG inventories". Draft 2004 (unpublished).

UNFCCC secretariat. "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories", "Part II: UNFCCC reporting guidelines on national communications" and "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/1999/7 (available on the secretariat web site http://unfccc.int/resource/docs/cop5/07.pdf>).

UNFCCC secretariat. "Guidelines for the preparation of national communications by Parties included in
Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" and "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/2002/8 (available on the secretariat web site <http://unfccc.int/resource/docs/cop8/08.pdf>).

UNFCCC secretariat. Database search tool – *Locator* (unpublished).

IPCC. *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000* (available on the following web site: <http://www.ipcc-nggip.iges.or.jp/public/gp/english>).

IPCC/OECD/IEA. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, volumes 1–3, 1997* (available on the following web site: <http://www.ipcc-ggip.iges.or.jp/public/gl/invs1.htm>).

B. Additional materials

Responses to questions during the review were received from Ms. Mirja Kosonen (Statistics Finland) including additional material on the methodology and assumptions used.

Background data on waste for 1990–2002 (waste amount and DOC) (spreadsheet, unpublished).

Data on Iron and steel production 1990–2003) (spreadsheet, unpublished).

Monni, Syri (2003) and Monni (2004), reports on the uncertainty estimates of the inventory (available on the following web sites <http://www.vtt.fi/inf/pdf/tiedotteet/2003/T2209.pdf> (reference provided as part of the 2004 submission) and <http://www.vtt.fi/inf/pdf/workingpapers/2004/W5.pdf> (report referenced in response to the draft review report)).

Oinonen, T. (2004), Finnish 2002 inventory of HFC, PFC and SF_6 emissions, Finnish Environment
Institute, 2004 (report provided as part of the 2004 submission).

Pipatti, R. (2001), Greenhouse gas emissions and removals in Finland, VTT, Espoo, 2001 (report provided as part of the 2004 submission).

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