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REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY OF FINLAND SUBMITTED IN THE YEAR 2001[1]

(Desk review)

EXECUTIVE SUMMARY

1. This report contains the findings of the desk review of the greenhouse gas (GHG) inventory submitted by Finland for the year 2001. For this review, the expert review team (ERT) examined Finland's common reporting format (CRF) for 1990–1999, as well as Finland's national inventory report (NIR). Material prepared by the UNFCCC secretariat, including the draft synthesis and assessment (S&A) report, status report and the preliminary key source analysis, were also used.

2. Overall, Finland has provided a complete and well-documented inventory. The information available has enabled the ERT to perform a detailed review of the estimates. The inventory is complete and of high quality, and only small number of points have been identified for improvement by Finland. The ERT recommends that Finland expand its methodological description to provide more detail, particularly for key sources. Additional information on recalculations would also increase transparency. The ERT also recommends that Finland use higher tier methods for key sources, particularly for emissions from solid waste disposal sites in the waste sector, and that it provide more detailed documentation for its land-use change and forestry estimates.

I. OVERVIEW

A. Introduction

3. The Conference of the Parties (COP), at its fifth session, by its decision 6/CP.5, requested the secretariat to conduct, during the trial period, individual reviews of GHG inventories for a limited number of Parties included in Annex I to the Convention (Annex I Parties) on a voluntary basis, according to the UNFCCC guidelines for the technical review of GHG inventories from Annex I Parties, hereinafter referred to as the review guidelines.[2] The secretariat was requested to coordinate the technical reviews and to use different approaches to individual reviews, including desk reviews, centralized reviews and in-country reviews.

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1 In the symbol for this document, 2001 refers to the year in which the inventory was submitted, and not to the year of publication. The number (1) indicates that for Finland this is a desk review report.

2 For the UNFCCC review guidelines and decision 6/CP.5, see document FCCC/CP/1999/7, pages 109 to 114 and 121 to 122, respectively.

4. The review of Finland took place from 14 November 2001 to 8 March 2002. The desk review was carried out by a team of nominated experts from the roster of experts. Experts participating in the review were Ms. Dina Kruger (Generalist, United States), Mr. Javier Hanna Figueroa (Energy, Bolivia), Dr. Hugh Saddler (Energy, Australia), Ms. Irina B. Yesserkepova (Industrial Processes, Kazakhstan), Mr. William Kojo Ageymang Bonsu (Industrial Processes, Ghana), Mr. Luis Gerardo Ruiz Suarez (Agriculture, Mexico), Ms. Pascale Collas (Land-Use Change and Forestry, Canada), Mr. Francois Wencelius (LUCF, France), Ms. Maria Paz Cigaran (Waste, Peru), and Mr. Charles Russell (Waste, New Zealand). The review was coordinated by Ms. Astrid Olsson (UNFCCC secretariat). Ms. Dina Kruger and Ms. Irina B. Yesserkepova were lead-authors of this report.

5. In accordance with the UNFCCC review guidelines, 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

6. Finland submitted a comprehensive NIR in 2001.

7. In its 2001 submission, Finland submitted CRF tables for the time series 1990–1999.

8. Finland did not submit any other sources of inventory information for the purposes of review. The ERT used the draft S&A report 2001, the preliminary key source analysis[3] and the status report prepared by the secretariat. The ERT also referred to Finland's response to the draft S&A report 2001.

9. Other sources of information used during the review include: the preliminary guidance for experts participating in the individual review of GHG inventories, the UNFCCC reporting guidelines[4] and the review guidelines.

C. Emission profile, trends and key sources

1. Emission profile

10. Finland has a fairly typical emission profile for an Annex I Party. The most important GHG is CO_2 (carbon dioxide), which in 1999 accounted for 84.3% of total emissions,[5] followed by N_2O (nitrous oxide) at 10.4%, and CH_4 (methane) at 5.3%. While Finland's proportion of CO_2 emissions is typical, it is one of the few Annex I Parties in which N_2O emissions exceed

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[3] The UNFCCC secretariat had identified, for each individual Party, those source categories that 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 and Uncertainty Management in National Greenhouse Gas Inventories (hereinafter referred to as the IPCC good practice guidance). Key sources according to the tier 1 trend assessment were also identified for those Parties which providing full CRF for the year 1990. The key sources presented in this report are based on the secretariat's preliminary key sources assessment. They might differ from the key sources identified by the Party itself.

[4] The guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories (FCCC/CP/1999/7), are referred to in this report as the UNFCCC reporting guidelines.

[5] In this report, the term "total emissions" refers to the aggregate national emissions based on CO_2 equivalents excluding LUCF, unless otherwise specified. Finland includes CO_2 emissions from agricultural soils in the agriculture sector, and for purposes of comparison with other countries, these emissions are also excluded in these percentages.

CH_4 emissions. By sector, energy accounted for 82.8% of total emissions, agriculture 6.2%, industrial processes 2.5% and waste 2.3%.

2. Emission trends

11. Finland's emission trends are summarized by sector and GHG in tables 1 and 2. Finland's emissions decreased by approximately 850 Gg CO_2 equivalents (1.2%) between 1990 and 1999. The emission trend over this period was variable; emissions dropped initially, and then increased between 1994–1997, before falling again. By gas, CO_2 emissions increased by 2.9% over the period, while both CH_4 and N_2O emissions fell. By sector, energy emissions increased by 6.2% over the period and agriculture emissions fell by 2.5%. Industrial emissions fell initially and have been gradually increasing in recent years.

Table 1. GHG emissions by gas, 1990–1999 (Gg CO_2 equivalent)

GHGs	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)									
Net CO_2 emissions/ removals	38,668	22,864	26,777	30,056	48,208	47,996	47,098	54,274	54,888	53,365
CO_2 emissions (without LUCF[(a)])	62,466	61,071	58,670	59,172	65,468	62,684	68,130	66,911	64,601	64,186
CH_4	6,141	5,778	5,378	4,988	4,658	4,644	4,466	4,283	4,061	3,931
N_2O	8,414	7,911	7,287	7,480	7,591	7,796	7,847	8,067	7,912	7,749
HFCs	0	0	0	0	7	30	78	168	246	317
PFCs	1	1	1	1	1	1	1	1	1	29
SF_6	71	48	32	26	26	14	14	16	12	32
Total (with net CO_2 emissions/ removals)	53,295	36,602	39,475	42,551	60,492	60,481	59,503	66,809	67,120	65,422
Total (without CO_2 from LUCF[(a)])	77,093	74,809	71,369	71,667	77,751	75,168	80,536	79,446	76,833	76,243

[(a)] LUCF = land use change and forestry

Table 2. GHG emissions by sector 1990–1999 (Gg CO_2 equivalent)

GHG SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)									
1. Energy	59,584	58,783	56,837	57,680	64,059	61,863	67,391	66,277	63,901	63,268
2. Industrial processes	2,852	2,497	2,235	2,137	2,233	2,290	2,364	2,548	2,516	2,832
3. Solvent and other product use	62	62	62	62	62	62	62	62	62	62
4. Agriculture	10,165	9,324	8,392	8,383	8,206	7,820	7,795	7,972	7,793	7,594
5. LUCF	-23,798	-38,207	-31,894	-29,116	-17,259	-14,687	-21,032	-12,637	-9,713	-10,821
6. Waste	3,790	3,529	3,236	2,849	2,500	2,435	2,225	2,030	1,840	1,737
7. Other	640	615	608	556	692	699	698	558	720	750

3. Key sources

12. Finland conducted both a tier 1 and a tier 2 key source analysis as part of its 2001 submission. In the energy sector, the tier 1 method identified 12 key sources and the tier 2 method identified 11 key sources. The same five sources were identified in the agriculture sector using both the tier 1 and the tier 2 methods. In the industrial sector, five key sources were

identified using the tier 1 method and two using the tier 2 method. The waste sector has one key source using both methods. Table 3 lists the key sources in Finland's inventory, as identified by the secretariat.

Table 3. Key sources Finland, 1999: Level and trend assessment (UNFCCC secretariat)[(a)]

Key source	Gas	Level assessment %	Cumulative total %	Contribution to trend %
Stationary combustion - oil	CO_2	18.7	19	3.4
Stationary combustion - coal	CO_2	18.5	37	10.4
Mobile combustion - road vehicles	CO_2	14.3	51	0.8
Stationary combustion - gas	CO_2	10.4	62	19.9
Stationary combustion - other fuels	CO_2	10.2	72	15.1
Other (fugitive emissions from solid fuels)	CO_2	4.6	77	
Direct N_2O emissions from agricultural soils	N_2O	3.4	80	5.1
Agricultural soils	CO_2	2.6	83	8.0
Solid waste disposal sites	CH_4	2.1	85	13.6
Enteric fermentation in domestic livestock	CH_4	2.0	87	1.7
Nitric acid production	N_2O	1.7	89	1.7
Other	CO_2	1.0	90	0.8
Other transportation	CO_2	1.0	91	1.3
Cement production	CO_2	0.8	91	1.0
Non CO_2 stationary combustion – biomass	N_2O	0.8	93	3.0
Mobile combustion-road vehicles	N_2O	0.7	94	0.9
Mobile combustion - waterborne navigation	CO_2	0.7	94	1.9
Lime production	CO_2	0.7	95	
Non CO_2 stationary combustion – other fuels	N_2O			1.5
Manure management	N_2O			1.0

(a) See footnote 2 of this report.

D. General assessment of the inventory

1. Completeness of reporting and conformity with guidelines

13. Finland provided a complete CRF for the period 1990–1999, with all required tables, in its 2001 submission.

14. Finland submitted a detailed NIR as part of its 2001 submission. Overall, the ERT noted that the NIR was complete and of high quality.

Conformity with the UNFCCC reporting guidelines

15. The national inventory submitted by Finland is in conformity with the UNFCCC reporting guidelines.

Conformity with the IPCC Guidelines

16. Finland is in conformity with the IPCC Guidelines and good practices. In its NIR, Finland indicated that it had begun to implement the IPCC good practice guidance.

2. Cross-cutting issues

Verification and quality assurance/quality control (QA/QC) approaches

17. Finland indicated that its QA/QC procedures are under development. The ERT notes that Finland's detailed documentation and careful references form a good basis for developing an archive of inventory-related materials.

Recalculations

18. Recalculation information was provided in table 8. An expanded discussion of recalculations in the NIR would be helpful, however, because it was not always clear why certain recalculations were performed, why they occurred in some years and not others, and so on. The following sectoral discussions provide specific examples of areas where more detailed information would be useful.

Uncertainties

19. In its NIR, Finland states that it has relied on expert judgement in assessing the uncertainty of its 1999 inventory. It reports a preliminary uncertainty assessment of 7% in 1999. Finland has indicated that it plans to develop better quantitative estimates in the future.

Use of notation keys

20. For the most part, Finland used notation keys in accordance with the UNFCCC reporting guidelines. In a few instances, however, notation keys were not used correctly. For example, non-standard notation keys, such as the notation nearly zero ("NZ") were used in table 9 (completeness) as well as in other CRF tables, particularly in the agriculture, industrial processes and energy sectors. The ERT recommends that in its future submissions Finland use the notation keys in a manner consistent with the guidelines.

E. Areas for further improvement

1. Issues identified by the Party

21. In its NIR, Finland indicated several areas which had been improved in its 2001 submission and identifies areas for additional improvement in the future, including:

(a) Quantitative uncertainty estimates;

(b) A QA/QC system;

(c) Using the results of the key source analysis to focus source category improvement onto the most important areas.

22. In its NIR, Finland also outlined a number of sectoral improvements, which are discussed in the following sections.

2. Issues identified by the ERT

23. The ERT found that the actions identified by Finland will be very helpful in improving the quality of the inventory. The ERT concurs with Finland's intention to improve its QA/QC system and to use the key source analysis to guide future inventory improvement. The ERT also identified some specific areas for improvement at the sectoral level, as discussed below:

Energy

24. Detailed information on the methodologies used (particularly for the country-specific methods used for CO_2, CH_4 and N_2O estimates), underlying assumptions and emission trends should be provided to allow future ERTs to replicate inventory calculations and assess results in greater depth. This is particularly important for the stationary combustion of coal, oil and gas, and the mobile combustion - road vehicles subsectors, which are the largest sources in the energy sector and in the inventory as a whole.

Industrial processes

25. Some relatively minor activities would improve the industrial processes sector estimates. The ERT recommends that Finland provide more detailed explanations of some of its emission factors, particularly where they are significantly different from those of other Parties. It also appears that some information provided about cement emission factors and the lime production activity data should be checked and possibly corrected. Finally, Finland should examine the ratio of potential to actual SF_6 emissions to ensure that it has been accurately reported.

Agriculture

26. The ERT found estimates in this sector to be of high quality and well documented. For enteric fermentation in livestock (cattle), the ERT suggests that additional information could be provided with regard to the way changes in performance parameters propagate through the gross energy intake equation. For both direct N_2O emissions from agricultural soils and indirect N_2O emissions, there were a few values in table D5-3 (annex D in the NIR) that could be better documented.

LUCF

27. The main improvements required include the provision of more detailed data on actual land-use changes, the provision of improved methodological explanations on how data on forest area are compiled and used, and explanation of the main trends and annual variations reported for CO_2 emissions and removals in the forestry sector.

Waste

28. The ERT recommends that Finland should use the tier 2 method for estimating methane emissions from solid waste disposal sites, and document its estimate of gas recovery. An explanation of institutional arrangements for developing estimates in this sector is also recommended. In addition, the methane correction factor (MCF) for domestic and industrial wastewater should be checked because the figures for emissions from this sector are low in comparison to other countries. CH_4 recovery in this source category should be clearly documented, and supporting information should be provided on the emission factors used.

II. ENERGY

A. Sector overview

29. The energy sector accounted for 82.8% of Finland's total GHG emissions in 1999 (not including the LUCF sector) and comprised 94.0% of total CO_2 emissions, with absolute emissions of 60,305.8 Gg. This sector includes 11 key source categories determined by a level assessment, 80.3% of total emissions: CO_2 from oil, coal and gas stationary combustion, CO_2 from other fuels stationary combustion, CO_2 from mobile combustion - road vehicles, CO_2 from fugitive emissions from preparation of soils for peat production , CO_2 from other transportation - off-road machinery, N_2O from biomass stationary combustion, N_2O from mobile combustion - road vehicles, CO_2 from mobile combustion - waterborne domestic navigation and CO_2 from mobile combustion - aircraft. At the same time, the Party has reported 17 energy-related key sources using the tier 2 methodology recommended by the IPCC good practice guidance.

30. During the period 1990–1999, total GHG emissions from energy increased by 6.2%. CO_2 emissions increased by 5.0%, CH_4 by 15.6% and N_2O by 43.5%. The CO_2 emission growth was driven mainly by an emission growth of 13.6% in the energy industries sector and an emission growth of 10.4% in the manufacturing industries and construction sector. Emissions from the transport sector fluctuated during the period, but grew overall by 2.1%. Emissions from the remaining subsectors decreased, excluding fugitive emissions from solid fuels, which did not change significantly.

1. Completeness

31. The CRF included estimates of all gases and sources of emissions from the energy sector, as recommended by the IPCC Guidelines, with a few exceptions. Fugitive emissions of CO_2 and CH_4 from oil and natural gas activities were only partially estimated, and fugitive emissions of N_2O from these activities were not estimated. In addition, fugitive emissions of N_2O from extraction and handling of peat were not estimated. The CRF included all tables requested, and the NIR described the methods, activity data and emission factors used to compile the inventory.

2. Transparency and use of notation keys

32. The information presented in both the CRF and the NIR was transparent, although some inconsistencies were found in the information provided in the CRF and the NIR. Notation keys were widely used and generally followed the guidelines. The ERT notes that in some cells of CRF table 1.B.2 (fugitive emissions from oil and natural gas) the notation not estimated/nearly zero ("NE"/"NZ") is used. The notation "NZ" is not included in the guidelines and the ERT recommends that Finland use only notation keys from the guidelines in future submissions.

3. Methodologies, active data and emission factors

33. To estimate CO_2, CH_4 and N_2O emissions from this sector a country-specific methodology was used (the ILMARI calculation system of Statistics Finland). This system uses tier 2/tier 1 methods and national models.

34. The main data sources used by the system mentioned were the Regional Environment Centres' VAHTI database, energy statistics and the Technical Research Centre of Finland's LIPASTO and TYKO calculation models and other sub-models. Activity data were converted to energy units using net calorific values.

35. Emission factors used for CO_2, CH_4 and N_2O were mainly country-specific and plant-specific (for the transport sector model emission factors were used). IPCC default values were used to a lesser degree. The CO_2 emission factors were based mainly on IPCC default values; however, national values were used for some fuels. CH_4 and N_2O emission factors were based mainly on national research.

4. Recalculations

36. Recalculations were provided for the 1990 and 1998 inventories. The CRF presented the corresponding tables and explanatory information, and referred to the use of slightly revised emission factors and improved activity data. The recalculations resulted in marginal changes in emissions of CO_2 (0.01% in 1990), increased emissions of CH_4 (0.2% in 1990 and 1.7% in 1998) and decreased emissions of N_2O (-0.3% in 1990 and -0.02% in 1998).

5. Uncertainties

37. Finland provided preliminary uncertainty estimates, which were very simple and pragmatic and based entirely on expert judgement, following the tier 1 method as described in the IPCC good practice guidance. For CO_2 estimates, uncertainties were in a range of 1-5% in sectoral activity data and even smaller in emission factors. Uncertainties in emission factors for N_2O and CH_4 estimates are much larger, in the order of 30-100%. Uncertainties in the activity data are small across the whole of the energy sector.

B. Reference and sectoral approaches

38. GHG emissions from Finland's energy sector were estimated using both the reference and the sectoral approaches. The emissions were estimated by applying emission factors to energy activity data (fuel consumption) following IPCC Guidelines and using country-specific methodology (as described above).

39. CO_2 emissions obtained using the reference approach and the sectoral approach differed by 0.1% and the energy consumption differed by 2.6% for 1999. Explanations were provided in the documentation box of table 1.A(c) of the CRF.

1. Comparison with international data

40. The reference approach energy data for 1999 were 3.4% lower than the International Energy Agency (IEA) data. The CRF reported data were 6.4% lower for liquid fuels. Specific differences from international data identified in the draft S&A report 2001 include: liquid fuel imports in the CRF were 26,790 TJ lower, there was a difference of 7,097 TJ for crude oil, total liquid fuel exports were 6,434 TJ lower in the CRF, and stock changes for crude oil were -17,063 TJ while the IEA showed -19,963 TJ. Most of these differences were also applicable to 1990 data, where CRF data were 3.7% higher than IEA data. The growth rate of overall apparent consumption between 1990 and 1999 in the CRF was -0.1% and in the IEA statistics was 7.2%. Finland provided explanations for these differences and their possible reasons in the comments to the draft S&A report.

Accounting for military use of fuels

41. The CRF reported accounting of military fuel use under the other sources not elsewhere specified category.

Issues identified during previous reviews

42. The S&A report 2000 noted practically the same issues in comparison of the reference approach with international data as did the draft S&A report 2001. Finland did not provide explanations for the inconsistencies found.

2. Treatment of feedstocks and non-energy use of fuels

43. Feedstocks and non-energy use of fuels were accounted for in the reference and sectoral approaches following the IPCC Guidelines. Additional information was provided in the documentation box of table 1.A(d) of the CRF.

3. International bunker fuels

44. International bunkers were accounted for following the IPCC Guidelines. Additional information was provided in the documentation box of table 1.C (international bunkers and multilateral operations) of the CRF.

C. Key sources

1. Stationary combustion: oil, coal, gas and other fuels – CO_2

45. Emissions of CO_2 from the stationary combustion of oil, coal, gas and other fuels represented 57.8% of total national emissions in 1999 (18.7%, 18.5%, 10.4% and 10.2%, respectively).

Trends

46. Emissions of CO_2 from these sources increased by 6.4% between 1990 and 1999.

Completeness

47. The CRF included estimates for all gases from all sectors of this key source, as recommended by the IPCC Guidelines. All sectors had disaggregated information by subsectors.

Methodologies, activity data and emission factors

48. To estimate CO_2 emissions (as well as CH_4 and N_2O) from this sector a country-specific, tier 2/tier 1 method was used (the ILMARI calculation system of Statistics Finland). In estimating emissions from stationary combustion, emissions from mobile sources in the agriculture/forestry/fishing subsectors were clearly separated.

49. The main data sources used by the above-mentioned system were the Regional Environment Centres' VAHTI database and energy statistics. Activity data were converted to energy units using net calorific values.

50. Mainly country-specific and plant-specific emission factors were used. However, IPCC default values were used to a lesser degree. The CO_2 emission factors were based mainly on IPCC default values; however, national values were used for some fuels. It is noted that all CO_2 emissions arising from the oxidation of coke in the course of iron and steel production were included in fuel combustion 1.A.2, manufacturing industries and construction.

51. For the energy industries subsector, the draft S&A report 2001 noted that the value of the CO_2 implied emissions factor (IEF) for liquid fuels decreased by 8% from 1990 to 1992 and then gradually increased by 9.9 % until 1999, the value of the CO_2 IEF for solid fuels for the category manufacture of solid fuels and other energy industries in 1999 (39.7 t/TJ) was among the lowest across the reporting Parties, and the value of the CO_2 IEF for other fuels for the category public electricity and heat production in 1999 (102.9 t/TJ) was the second highest across the reporting Parties.

52. In its response to the draft S&A report 2001, Finland provided explanations for these findings. For liquid fuels, Finland explained that the problem was in the category of petroleum refining, and involved some not-yet-updated plant emission factors in the time series 1992–1994. These factors will be updated in the next submission. For solid fuels, the low IEF was due to the inclusion in this category of only coke oven gas (originating from solid fuel), which has relatively low CO_2 emission factor. For other fuels, the high IEF was due to the inclusion in this category of peat and other fuels, which have relatively high CO_2 emission factors.

53. For the manufacturing industries and construction subsector, the draft S&A report 2001 noted that the value of the CO_2 IEF for solid fuels decreased by 20% from 1990 to 1994 and then increased by 24.9% up to 1999. The value of the CO_2 IEF for other fuels in 1999 (102.9 t/TJ) was one of the highest across the reporting Parties.

54. For the other sectors, the draft S&A report 2001 noted that the value of the CO_2 IEF in 1999 for other fuels for the category commercial/institutional (105.2 t/TJ) and for the categories residential and agriculture/forestry/fisheries (104.9 t/TJ) were the highest across the reporting Parties.

55. Finland explained these findings as well. For solid fuels, the probable reason was the inconsistent allocation of fuels (blast furnace gas) between solid/gaseous in some years, particularly, 1992 and 1993, which will be checked with plant-level data in the next submission. It should also be noted that for all other years Finland has used a simplified energy accounting approach, which estimates CO_2 emissions from the complete oxidation of coke, and ignores the intermediate step of blast furnace gas. For other fuels (manufacturing industries and construction subsector and other sectors) the reason was the same as given above (the inclusion in this category of peat and other fuels, which have a relatively high CO_2 emission factor).

2. Mobile combustion: road vehicles – CO_2 and N_2O

56. CO_2 road transportation emissions contributed 14.3% to total national emissions, and N_2O road transportation emissions contributed 0.7%.

Trends

57. Emissions of CO_2 decreased by 2.1% and emissions of N_2O increased by 30.5% from 1990 to 1999, with fluctuations in emissions of both gases during the period.

Completeness

58. The CRF included estimates of all gases by fuel for this key source. The CRF reported disaggregated activity data by fuels for this subsector, as recommended in the IPCC Guidelines.

Methodologies, activity data and emission factors

59. To estimate CO_2 and N_2O emissions from this subsector, a country-specific method was used (the ILMARI calculation system of Statistics Finland), using the Technical Research Centre of Finland's (VTT) LIPASTO and LIISA models. CH_4 and N_2O emission calculations were included only in the LIISA sub-model. The models use detailed information on transportation operation, performance and fuel and energy use and other relevant technical data in estimating energy consumption. The method was consistent with the tier 2 method in the IPCC Guidelines and largely consistent with the IPCC good practice guidance.

60. The main data sources used by the system mentioned were energy statistics and the Finnish Road Administration. Activity data were converted to energy units using net calorific values.

61. Emission factors used for CO_2, CH_4 and N_2O were country-specific and contained in the above-mentioned models. CO_2 calculations were based on fuel consumption and emission coefficients, while CH_4 and N_2O calculations were based on vehicle mileages of different vehicle types on different road types and emission coefficients determined per kilometre driven. In the selection of emission factors for different years, technological changes were taken into account. As described in the NIR, emission factors for N_2O were adjusted to account for the indirect emissions arising from atmospheric nitrogen deposition caused by NO_X emissions in the energy sector. This adjustment was made in CRF table 1; so emissions for N_2O reported in this table were not consistent with those reported in the sectoral background table for energy combustion.

62. For this key source, the draft S&A report 2001 noted that the value of the CO_2 IEF for gasoline in 1999 (72.8 t/TJ) was one of the highest across the reporting Parties, and the value of the N_2O IEF for gasoline in 1999 (12.6 t/TJ) increased by 230% compared to its 1990 level (3.8 kg/TJ).

63. In its response to the draft S&A report 2001, Finland indicated that the country-specific emissions factor for CO_2 would be rechecked and that the use of catalytic converters was the reason for the increase in N_2O levels. In 1990, 5% of personal cars were equipped with these converters, while by 1999 the proportion had increased to 47%.

3. Fugitive emissions: preparation of soils for peat production – CO_2

64. Preparation and profiling of soils for peat production, stockpiling of peat, and arable land reserved for peat production gave rise to fugitive emissions, which contributed 4.6 % to total national emissions of CO_2.

Trends

65. Emissions of CO_2 from this source did not change between 1990 and 1999 (3,500 Gg).

Completeness

66. The CRF included estimates of CO_2 emissions from this source. The estimates did not include emissions from ditching nor from the first phase of site preparation, due to a lack of experimental data.

Methodologies, activity data and emission factors

67. The emission estimates from peat production use country-specific methods and emission factors based on measurements in the Finnish Research Programme on Climate Change and other national research. The method was well explained in the NIR. The CRF did not report activity data because these were not applicable.

4. Mobile combustion: other transportation – CO_2

68. CO_2 emissions from other transportation (off-road machinery) contributed 1.0% of total national emissions in 1999. The relatively large uncertainties in the activity data make this sector a key source.

Trends

69. Emissions of CO_2 decreased by 4.5% from 1990 to 1999.

Completeness

70. The CRF included emission estimates for all gases by fuel from this key source. The CRF reported disaggregated activity data by fuel, as recommended in the IPCC Guidelines.

Methodologies, activity data and emission factors

71. To estimate CO_2 emissions, a country-specific method was used (the ILMARI calculation system of Statistics Finland), using the Technical Research Centre of Finland's LIPASTO and TYKO models. Emission estimates in the TYKO model were based on the work done (kWh) by the machines and emission factors (g/kWh) which were based on average emissions per working hour.

72. The main data sources were the Association of Technical Trade for annual sales statistics and information collected by Puranen (1992, et. al. 1993, 1994 and et. al. 1995) for the machine database. For some machines, the sales figures used were based on expert judgement. Decommissioning was based on the United States Energy EPA method, adapted to Finnish circumstances.

73. Emission factors used and classification in the TYKO database were taken from the *EMEP/CORINAIR Emissions Inventory Guidebook* (1996) and Andrias et al. (1994) with minor changes.

5. Stationary combustion: biomass – N_2O

74. Emissions of N_2O from stationary biomass combustion represented 0.8% of total national emissions. The large uncertainties in the emission factors made this sector a key source.

Trends

75. Emissions of N_2O from this source increased by 397.9% between 1990 and 1999.

Completeness

76. The CRF included emission estimates from all sectors of this key source, as recommended in the IPCC Guidelines. All sectors had disaggregated information by subsectors.

Methodologies, activity data and emission factors

77. To estimate N_2O emissions from this sector, a country-specific method was used (the ILMARI calculation system of Statistics Finland), which used tier 2/tier 1 methods consistent with IPCC Guidelines methods.

78. The main data sources used by the system mentioned were the Regional Environment Centres' VAHTI database and energy statistics. Activity data were converted to energy units using net calorific values.

79. Emission factors used for N_2O estimations were country-specific and plant-specific. N_2O emission factors were based mainly on national research, taking into account process or technology type.

80. The draft S&A report 2001 noted for the energy industries subsector that the value of the N_2O IEF for biomass in 1999 (22.0 kg/TJ) was the highest across the reporting Parties, having increased significantly compared to its 1990 level (7.8 kg/TJ). For the manufacturing industries and construction subsector, the draft S&A report 2001 noted that the value of the N_2O IEF from biomass in 1999 (6.5 kg/TJ) had increased by 130% from its value in 1990 (2.83 kg/TJ).

81. In its response to the draft S&A report 2001, Finland explained that changes in the N_2O IEFs were due to significant changes in combustion technology over the period. Finland states that in future submissions it will use new data now available on N_2O emission factors, because it seems that current emission factors were overestimated.

6. Mobile combustion: waterborne domestic navigation – CO_2

82. Emissions of CO_2 from waterborne domestic navigation contributed 0.7% to total emissions. The relatively large uncertainties in the activity data make this sector a key source.

Trends

83. Emissions of CO_2 increased by 121.2% from 1990 to 1999.

Completeness

84. The CRF included emission estimates of all gases by fuel type. The CRF reports disaggregated activity data by fuels for this subsector, as recommended by the IPCC Guidelines. The calculation system included sea and inland water traffic, leisure boating and fishing, and icebreaker traffic. Vessels of the Finnish army were not included. The NIR reported large uncertainties due to poor data on the fuel use of small ships and leisure boats.

Methodologies, activity data and emission factors

85. To estimate CO_2 emissions from this sector a country-specific methodology was used (the ILMARI calculation system of Statistics Finland), using the Technical Research Centre of Finland's LIPASTO and MEERI models. The models used detailed information on transportation operation, performance, fuel and energy use and other relevant technical data in estimating energy consumption. The method was consistent with the tier 2 method in the IPCC Guidelines and largely consistent with the IPCC good practice guidance.

86. The main data sources used by the system mentioned are the energy statistics and the Finnish Maritime Administration. Activity data were converted to energy units using net calorific values.

87. Emission factors used for CO_2 are country-specific and contained in the above-mentioned models. Emission calculations were based on port traffic service data considering type of ship, traffic service area, origin and tonnage. In the selection of emission factors for different years, the technological changes were taken into account. Emission factors for CH_4 and N_2O are less detailed, and partly national and partly IPCC default.

88. In table 1.A(a)s3, it was noted that gasoline used in waterborne navigation was reported as other fuel, because of the structure of the CRF tables. This resulted in a misallocation of the fuels, and their associated emissions.

89. For this key source, the draft S&A report 2001 noted that the activity data for gas/diesel oil reported in the CRF are lower in comparison to the IEA data (25%). In its response, Finland indicated that more recent data were used for the inventory than were provided to the IEA.

7. Mobile combustion: aircraft – CO_2

90. CO_2 emissions from domestic aircraft contributed 0.6% to national emissions.

Trends

91. Emissions of CO_2 increased by 14.7% from 1990 to 1999.

Completeness

92. The CRF included emission estimates for all gases by fuel type. The CRF reports disaggregated activity data by fuel for this subsector, as recommended in the IPCC Guidelines. The calculation system considered each operation of domestic civil aviation within Finnish flight information regions (FIRs). Each operation was divided into the following segments: taxi, take-off, climb-out, cruise, descent, approach, taxi. Helicopters were not included in the calculations due to the small number of flights and the lack of emission factors.

Methodologies, activity data and emission factors

93. To estimate CO_2 emissions from this sector, a country-specific method was used (the ILMARI calculation system of Statistics Finland), using the Technical Research Centre of Finland's LIPASTO and ILMI models. The method was based on traffic statistics, aircraft performance data and engine emission factors from the International Civil Aviation Organization (ICAO) database and assessed emissions of jet and turboprop-powered aircraft. The method for assessing emissions from piston-engine aircraft was based on annually published statistics of total flight hours for single and multi-engined piston aircraft, and the results were not as reliable as those for turbine-engined aircraft.

94. The main data source was the Finnish Civil Aviation Administration (CAA) and the data include aircraft type, carrier, departure and landing airport, total flight time, flight time inside Finnish FIRs and the number of similar flights between airports. Activity data were converted to energy units using net calorific values.

95. Emission factors used for CH_4 and N_2O are partly national and partly IPCC default.

96. For this key source, the draft S&A report 2001 noted that the activity data for aviation fuel in the domestic civil aviation subsector, as reported in the CRF, were 17.1% lower than data published by the IEA. In its response to the draft S&A report 2001, Finland indicated that the differences were most likely caused by different conversion factors and rounding.

D. Non-key sources

97. The method used for estimating emissions from energy non-key sources was a country-specific method (the ILMARI calculation system of Statistics Finland), which uses tier 2/tier 1 methods and national models. The main data sources used by the system mentioned were the Regional Environment Centres' VAHTI database, energy statistics and the technical research centre of Finland's LIPASTO and TYKO calculation models and other sub-models.

98. Emission factors used were mainly country-specific and plant-specific. IPCC default values were used to a lesser degree. The CO_2 emission factors were based mainly on IPCC default values; national values were, however, used for some fuels. CH_4 and N_2O emission factors were based mainly on national research.

99. The draft S&A report 2001 noted for the energy industries subsector that the value of the CH_4 IEF from biomass in 1999 (14.4 kg/TJ) decreased significantly compared to its value in 1990 (25.8 kg/TJ); the value of the CH_4 IEF from other fuels in 1999 (3.4 kg/TJ) decreased significantly compared to its value in 1990 (6.6 kg/TJ); and the value of the N_2O IEF for other fuels in 1999 (15.8 kg/TJ) was the second highest across the reporting Parties.

100. For the manufacturing industries and construction subsector, the draft S&A report 2001 noted that the value of the N_2O IEF for other fuels in 1999 (21.0 kg/TJ) was the highest across the reporting Parties, having almost doubled compared to its 1990 level (11.8 kg/TJ), the value of the N_2O IEF from liquid fuels in 1999 (7.9 kg/TJ) increased by 70% from its value in 1998 (4.7 kg/TJ), and the value of the N_2O IEF from solid fuels in 1999 (6.2 kg/TJ) increased by 63% from its value in 1998 (3.8 kg/TJ).

101. In its response, Finland explained that the changes in the N_2O IEF were due to a significant change in combustion technology over this period. In future submissions and for recalculations, Finland plans to use new data now available on N_2O emission factors, which seems were overestimated. For the CH_4 IEF, Finland indicated that no reason was found for the differences and that the data would be checked. For liquid fuels, the inconsistencies were due to the use of the TYKO model, which was used in the 1999 inventory only. Finland indicated that it would be recalculating estimates for previous years in its next submission. For the N_2O IEF from solid fuels, Finland explained that no reason was found for the differences and that the data would be checked.

102. The draft S&A report 2001 also noted that the value of CH_4 IEFs (1000 kg/t, about 1,900,000 kg/PJ) lies outside the IPCC default emission factor range (175,000–384,000 kg/PJ). Finland did not provide an explanation for this inconsistency.

E. Areas for further improvement

1. Issues identified by the Party

103. The NIR identified several areas where Finland is planning to improve its inventory estimates through the use of better methods and data (including methods of data collection and the updating of models) and updated emission factors (specially for non-CO_2 emissions), taking

into account developments in the IPCC methodologies and guidance and UNFCCC reporting requirements. These changes and improvement will result in recalculations and revision of estimates on historical inventory data in order to maintain consistency in the time series and a broad use of the IPCC good practice guidance, specially with reference to QA/QC procedures, which are currently under development. Updates and recalculations for years other than 1990 and 1998 are currently under way.

2. Issues identified by the ERT

104. Energy is the most important emission source in Finland, and detailed information on the methods used, underlying assumptions and emission trends were provided to allow the ERT to review the inventory calculations fully.

105. Some inconsistencies have been found, however, in the information provided in the CRF and the NIR. For example, N_2O emissions in the sectoral report for energy buyer - CRF table 1 - are not consistent with the sectoral background data for energy – CRF table 1.A(a). The ERT notes, however, that annex B of the NIR provides an explanation for this inconsistency. In addition, emissions from mobile combustion: road vehicles, as reported in table A-4: uncertainty estimates for the year 1999 of the NIR (annex A), are not consistent with the CRF and the draft S&A report 2001. For example, fuel used in waterborne navigation was reported as other fuel in the table 1.A(a)s3.

106. The ERT suggests that rapid introduction of independent review and QA/QC procedures will help to address inconsistencies and enhance reporting. Completeness of reporting may be improved by strengthening of the current institutional framework and enhancing data collection systems. Finally, the ERT notes that some findings from the draft S&A report 2001 need further clarification and consideration.

III. INDUSTRIAL PROCESSES

A. <u>Sector overview</u>

107. Finland provided an NIR and CRF tables for the period 1990–1999, including sectoral report and background tables for industrial processes and solvents. In 1999, emissions from the industrial processes and solvent use sectors were 2,893.8 Gg of CO_2 equivalent, which is 4.4% of total emissions.

108. Finland conducted a preliminary key source assessment, including both level and trend assessments, using tier 1 and tier 2 methods. Three key sources in the industrial processes sector were identified by the secretariat according to the level assessment. The key source analysis is based on these three key sources.

109. Table 10 of the CRF demonstrated the trends in GHG emissions for the years 1990–1999. Large fluctuations were observed in CO_2 emissions in the industrial sector, with overall CO_2 emissions for the period 1990 to 1999 declining. However, within the period there were both increases and decreases. In 1993, CO_2 emissions in the industrial sector were 32.5% lower than in 1990, but they increased gradually from 1994–1999. As a result, industrial CO_2 emissions were 5% lower in 1999 than their level in 1990. Emissions from the whole sector were essentially stable, with a small decrease of 0.7% from 1990 to 1999.

1. Completeness

110. This sector was estimated completely in terms of IPCC source categories and GHGs. All the sectoral tables and information on completeness (tables 7 and 9) were provided. Information was reported for all available categories by using standard notation keys where no numerical data was provided. In table 9, the notation key nearly zero ("NZ") was used for estimating categories 2.A, B and D, which is not consistent with the UNFCCC reporting guidelines.

2. Recalculations

111. All recalculations for this sector, including all source categories, were well documented, and explanatory information was provided in CRF tables 8(a) and (b) for the years 1990 and 1998. The main reasons for recalculation were: improved activity data, elaboration of IPCC methods, updated IPCC default emission factors or new country-specific emission factors. Recalculations were methodologically consistent.

3. Transparency

112. The reporting of this sector was quite transparent. The information provided in the NIR was sufficient to support the data provided in the CRF. No inconsistencies were found between the CRF and the NIR. In the 2000 submission, the activity data on SF_6 consumption were not shown because of their confidentiality. In 2001, any problems with confidential data were not mentioned. Confidential figures for domestic refrigeration and fire extinguishers were aggregated with the data on the refrigeration and air conditioning source categories. In the notes on the semiconductor source category, Finland indicated that confidential data for magnesium have been aggregated with SF_6 data.

4. Methodologies, emission factors and activity data

113. Predominantly default methods and emission factors were used for this sector. National emission factors were used when available. For solvents, country-specific emission factors were applied. National activity data were reported in sectoral background tables and obtained mainly from manufacturing industry statistics, and in some cases directly from plants.

114. Finland used the IPCC Guidelines for the industrial sector, and the IPCC good practice guidance for HFC emissions from domestic refrigeration and mobile air conditioning. In particular, for HFC emissions (table 9s1) the top-down method for commercial refrigeration described in the IPCC good practice guidance was used. It was indicated in the notes to the refrigeration and air conditioning equipment source category that domestic refrigeration and mobile air conditioning were calculated using the bottom-up method from the IPCC good practice guidance (p. 3.100 and 3.107). The top-down method from the IPCC good practice guidance (p. 3.100) was used for all other refrigeration and air conditioning source categories (resulting in entries of not applicable ("NA")). Also, confidential figures for domestic refrigeration and fire extinguishers were aggregated with this data.

5. Uncertainty estimates

115. Finland provided preliminary estimates of uncertainty, relying primarily on expert judgement, for each source category. Uncertainty was assessed qualitatively and explained in the documentation box of the overview table 7. Quality thresholds were taken from combined

uncertainties. A qualitative discussion of contributors to uncertainty was not provided, but Finland indicated that this was an area for future improvement.

B. Key sources

1. 2.B.2 Nitric acid production – N_2O

116. Nitric acid was the largest emission source in the industrial processes sector, and represented 46.8% of the sector's emissions in 1999. In the draft S&A report 2001 (section I), the same figure for the N_2O share of this category was mistakenly indicated for both the level and the trend assessment. The percentage of the national total is 2.1% in the level assessment and 1.7% in the trend assessment.

Completeness

117. According to table 7, all sources were estimated for all years in the time series. Activity data were not confidential.

Trends

118. N_2O emissions reduced slightly during the period 1990–1999. Emissions declined from year to year for the whole period and decreased by 16.9% from 1990 to 1999. A decrease of 12.2% was observed for 1990 to 1991 and of 10.5% for 1991 to 1992, while from 1992 to 1999 emissions fluctuated less from year to year (0 to 6%). In its response to the draft S&A report 2001, Finland explained that this trend occurred because one plant was gradually closed down between 1990 and 1992.

Methodologies, activity data and emission factors

119. As was noted in the draft S&A report (section II), Finland had an IEF for N_2O equal to 0.0094 t/t, which was the highest emission factor value amongst the Parties and is slightly higher than the IPCC default range of 0.002-0.009 t/t. Finland uses plant-specific emission factors, obtained on the basis of measurements at two plants. The method used is the IPCC default. The measured data, emission factors and production data were well documented in the NIR (table C-3).

2. 2.A.1 Cement production – CO_2

120. Cement production contributes 21.8% to emissions from the whole sector. It represents 1% of total emissions according to the level assessment and 0.8% of total emissions according to the trend assessment.

Trends

121. CO_2 emissions decreased by 49% from 1990 to 1993 because some plants closed. Since 1994, emissions have increased, but in 1999 they were still 1% below 1990 levels.

Methodologies, activity data and emission factors

122. The IPCC default method was used to estimate emissions. The reported activity data in the CRF (1309.94 Gg) were higher than the United Nations cement data (1164 Gg). The emission factor for CO_2 (0.47t/t) was low compared to other countries and it was slightly lower than the IPCC default value for cement (0.499 t/t), although the value was consistent from 1990 to 1999. In the NIR, Finland reported that the IPCC default value emission factor was used

although this does not appear to have been the case. In its comments on the draft S&A report 2001, Finland explained that a national emission factor was used.

3. Lime production – CO_2

123. The share of this source is 0.7% of the national total as defined in the trend key source analysis. It contributes 17.5% to emissions from the industrial sector.

Methodologies, activity data, and emission factors

124. The IPCC default method was used. The activity data were reported in sectoral background table 2(I).A-G as 631.95 Gg. The information on activity data reported in the NIR should be checked because the same clause repeated in the paragraph on cement production and it is not quite clear whether it is related to the lime production or to cement production. Finland used the lowest value from the IPCC default emission factor (0.79 t/t from 0.79-0.91 t/t).

C. Non-key sources

125. The share of the remaining source categories of the industrial sector is 13.9%, which means that they are non-key sources according to the key source analysis. There are four smaller sources that can be reviewed in detail.

1. Consumption of halocarbons and SF_6

126. The NIR indicated that PFCs, HFCs, and SF_6 consumed in Finland are imported. Hence, FC-23, which is a by-product of HCFC-22 manufacturing, is not emitted in Finland. Actual emissions of SF_6 declined by 54% from 1990 to 1999, with the highest annual decline occurring from 1994 to 1995 (46.9%).

127. In 1999, the ratio of potential to actual SF_6 emissions (P/A ratio) was the second lowest across the Parties (0.9). However, the P/A ratio varied significantly over the period. It was 0.25 in 1990, 9.23 in 1995, and reached 10.32 in 1997.

128. There was a significant increase in PFC emissions from 1998 to 1999 (0.9 to 28.55 Gg CO_2 equivalent) due to emissions from consumption relating to refrigeration and air conditioning equipment and from semiconductor manufacturing. Both these sources were reported as not occurring (“NO”) prior to 1999.

2. Iron and steel production – CH_4

129. It was observed from the CRF table that Finland provided activity data for sinter and pig iron from 1992 to 1998, but no activity data were provided in 1999 (notation key “NA” was reported).

3. 2.C Metal production – CO_2

130. Emissions from iron and steel production and ferro-alloy production were reported as “IE” and included in the energy sector in order to prevent double counting. In the CRF it was noted that since the calculation method gives more accurate total CO_2 emissions compared to a more or less arbitrary allocation of coke and BF gases between energy use and process use, emissions have been included in the energy sector.

D. Solvent and other product use

131. No activity data or emissions of N_2O were reported relating to the use of N_2O in fire extinguishers, aerosol cans and other uses. The notation key "IE" was used but not referenced in table 9s1.

E. Areas for further improvement

1. Issues identified by the Party

132. Finland indicated that the sources of industrial emissions of CH_4, particularly regarding emission factors, are being studied.

2. Issues identified by the ERT

133. Overall, Finland provided transparent and high-quality emission estimates for this sector; some relatively minor activities would, however, improve the industrial processes sector estimates. The ERT recommends that Finland provide more detailed explanations of some of its emission factors, particularly where they are significantly different from those of other Parties. It also appears that some information provided about cement emission factors and lime production activity data should be checked and possibly corrected. Finally, Finland should examine the ratio of potential to actual SF_6 emissions to ensure that it has been accurately reported. Because of confidentiality, some activity data were aggregated, which reduced transparency.

IV. AGRICULTURE

A. Sector overview

134. Emissions from the agriculture sector (without considering CO_2 emissions from agricultural soils) were 7,000 Gg CO_2 equivalent in 1990 and fell to 5,600 Gg in 1999. This represents a 20% decrease in emissions, which is attributed to structural changes in the sector after Finland joined the European Union.

135. In the 1990 inventory, the agriculture sector was responsible for four key sources, representing 8.5% of total national emissions in CO_2 equivalent. In 1999, the sector was responsible for three key sources, representing only 6.2% of total emissions. The 1999 key sources are: direct N_2O emissions from agricultural soils, CH_4 from enteric fermentation in domestic livestock, and indirect N_2O emissions from nitrogen used in agriculture. In the key source assessment carried out by the secretariat, N_2O emissions from manure management was also a key source when a trend assessment is applied. Finland also reports this as a key source.

1. Completeness

136. Emissions from field burning of agriculture residues is negligible and were reported as nearly zero ("NZ") instead of 0. Rice cultivation and savanna burning do not occur in Finland. All sources and all of the country were covered by the inventory.

2. Transparency

137. The inventory was supported by many references to country-specific research or sources such as trade associations and expert opinion. The NIR provided (in annex D) a comprehensive and well-documented description of the methods and raw data used.

3. Methodologies, emission factors and activity data

138. In most cases, the IPCC Guidelines and good practice guidance were followed. Emission factors were obtained using default and country-specific values or expert opinion, where available. Activity data were obtained from national statistics, surveys and trade associations. Annex D in the NIR provided well-documented tables on emission factors and activity data.

139. The livestock population characterization was consistent for the source categories that share the same basic activity data: CH_4 from enteric fermentation and manure management and N_2O from manure management and from manure applied to agricultural soils.

4. Recalculations

140. In comparison with Finland's 2000 submission, the implementation of good practices led to changes in the way gross energy intakes were estimated. Emission factors for enteric fermentation and manure management were changed accordingly. For N_2O, no changes in the method were made, but improved data were used. Recalculation for the complete time series 1990–1999 was performed.

5. Uncertainty estimates

141. Overall, the estimates are considered to be of medium quality (±30% uncertainty), although the uncertainty related to activity data was considered to be smaller (±10%) for livestock-relating emissions. For N_2O, uncertainty was considered to be high, due mostly to uncertainties in the emission factors.

B. Key sources

1. 4. A Enteric fermentation – CH_4

142. In 1990, methane emissions from this source were 1,824.9 Gg CO_2 equivalent, of which 95.6% were due to cattle. Emissions from cattle were estimated using a tier 2 method, while for other livestock species tier 1 was used. By 1999, emissions were 1,554 Gg CO_2 equivalent, of which 1,474.2 Gg (or 94.9%) were due to cattle.

143. Finland answered questions raised in the draft S&A report 2001 by explaining changes in production methods and structural changes that have occurred since Finland joined the European Union.

Trends and completeness

144. A consistent time series was reported for 1990 to 1999. There was a consistent decreasing trend during the period, most of it due to changes in cattle emissions. The overall change in emissions was a 14.8% reduction.

Methodologies, activity data and emission factors

145. The methods from the Revised 1996 IPCC Guidelines were used to estimate emissions. The IPCC good practice guidance formulae for estimating gross energy intake were used. Default values in the IPCC good practice guidance were used instead of those provided in the revised guidelines, except when national values were available. These were well-documented in annex D of the NIR. Activity data were presented in easy-to-use tables and well-documented in annex D of the NIR.

146. The draft S&A report 2001 found higher emission factors for dairy cattle and lower emission factors for non-dairy cattle than the default values for Western Europe. In its response, Finland stated that the differences for dairy cattle were due to high fat content and intensive production methods and that differences for non-dairy cattle were due to slaughter at an early age. Because performance factors combine in a non-linear way in the gross energy intake equation, the ERT notes that it would be helpful if Finland provided information about how changes in performance parameters propagate through the equations to the calculated emission factor.

2. Direct N_2O emissions from agricultural soils

Trends and completeness

147. A consistent time series was reported for 1990–1999.

148. There was a consistent decreasing trend during the period. In 1990, N_2O emissions from this source category were 3,388.3 Gg CO_2 equivalent. By 1999, emissions were 2,610.2 Gg CO_2 equivalent. In its response to the draft S&A report 2001, Finland explained that this trend was related to country-specific conditions and farming practices.

Methodologies, activity data and emission factors

149. Methods from the IPCC Guidelines and the IPCC good practice guidance were applied to estimate emissions from the sector. Activity data were presented in easy-to-use tables and well-documented in annex D of the NIR.

150. Default values for $Frac_{NCRO}$ provided in the IPCC good practice guidance were used. For $Frac_{NCRO}$, values for crops which appear in both table D5-3 (annex D in the NIR) and table 4.16 (IPCC good practice guidance) were the same rounded to the third significant digit in table D5-3. Therefore, the reason for the corresponding comment in the draft S&A report 2001 is not clear. However, some values in table D5-3 (annex D in the NIR) which were not present in table 4.16 IPCC (good practice guidance) were not documented (unless crop names not familiar to the reviewer were used).

3. Indirect N_2O emissions from nitrogen used in agriculture

Trends and completeness

151. A consistent time series was reported for 1990 to 1999, and there was a small but consistent decreasing trend in this source category. In 1990, N_2O emissions from this source were 762.6 Gg CO_2 equivalent. By 1999, emissions from this source were 589 Gg CO_2 equivalent. In its response to the draft S&A report 2001, Finland explained this trend as being related to country-specific conditions and farming practices.

Methodologies, activity data and emission factors

152. Methods from the IPCC Guidelines and the IPCC good practice guidance were used for this source category. Activity data were presented in easy-to-use tables and well documented in annex D of the NIR.

153. Default values for $Frac_{NCRO}$ provided in the IPCC good practice guidance were used. However, some values in table D5-3 (annex D in the NIR) which were not present in table 4.16 (IPCC good practice guidance) were not documented (unless crop names not familiar to the

reviewer were used). A country-specific factor for leaching was used, supported by references: one technical report and one peer-reviewed paper.

4. N_2O emissions from manure management

154. This source category was identified as a trend key source by the secretariat and as a level and trend key source by Finland.

Trends and completeness

155. A consistent time series was reported for 1990 to 1999. However, this time series rests heavily on extrapolated data. There was a consistent decreasing trend during the period, mainly from solid storage systems. In 1990, N_2O emissions from this source were 762.6 Gg CO_2 equivalent, including emissions from pasture, slurry and solid storage. By 1999, emissions from this source were 601.4 Gg CO_2 equivalent. Most of the reduction was from solid storage systems. The change was due mainly to changes in the N balance in the diet of the animals.

Methodologies, activity data and emission factors

156. The methods from the IPCC Guidelines and the IPCC good practice guidance were applied to estimate emissions from the sector. Active data were presented in easy-to-use tables and well-documented in annex D of the NIR. Country-specific data on the N content of manure were used but supported with actual data for 1990 only (table D4-2 in annex D in the NIR). For the rest of the time series, values were extrapolated. Measurements are not needed for every year, but further support is recommended for this data set.

C. Non-key sources

1. 4.B Manure management – CH_4

157. In 1990, methane emissions from this source were 9.5 Gg; of these, 4.8 Gg (50.7%) were from cattle. Swine were responsible for another 3.9 Gg (41.1%). By 1999, emissions from this source were 10 Gg, 4.4 Gg (44.5%) of which were due to cattle, and 4.6 Gg (46%) of which were due to pigs.

Trends and completeness

158. A consistent time series was reported for 1990–1999, but there was no apparent trend in the emissions from this source category. If anything, it was upset by a field survey on manure management systems carried out in 1995, although it was well within the reported uncertainty for the source.

Methodologies, emission factors and activity data

159. The IPCC Guidelines were applied to estimate emissions from the sector. Default values in the IPCC good practice guidance were used instead of those provided in the revised guidelines, except when national values were available. These are well documented in annex D of the NIR. Active data were presented in easy-to-use tables and well documented in annex D of the NIR. IEFs were lower due to the high proportion of solid storage manure management system in comparison to slurry systems. In 1995, there was a field survey on the use of manure management systems, which led to a change in the systems distribution used in the inventory calculations.

D. Areas for further improvement

1. Issues identified by the Party

160. Finland is exploring the use of averaged information on feed intake instead of using the energy balance approach provided by the revised 1996 IPCC methodology for a tier 2 calculation. This will affect CH_4 emission estimates for enteric fermentation and manure management as well as N_2O emissions from manure.

161. Research supported by the Finnish Global Research Programme is under way to improve knowledge of N_2O emission factors.

2. Issues identified by the ERT

162. The ERT found estimates in this sector to be of high quality and well documented. For enteric fermentation in livestock (cattle), the ERT suggests that additional information could be provided regarding the way changes in performance parameters propagate through the gross energy intake equation. For both direct N_2O emissions from agricultural soils and indirect N_2O emissions, there were a few values in table D5-3 (annex D in the NIR) that could have been better documented.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

1. Completeness

163. The sector was covered completely in terms of IPCC source/sink categories regarding CO_2 emissions and removals, except for forest soils. A complete time series was provided for the reported IPCC source/sink categories. The coverage, however, was neither detailed enough nor presented in a country-specific way. Detailed data were not provided on afforestation and deforestation in general, and on forest and grassland conversion (table 5.B) and abandonment of managed lands (table 5.C) in particular. CO_2 emissions and removals resulting from these changes in land use were included in the overall assessment of changes in forest and other woody biomass stocks, which was carried out according to country-specific methods. In addition, estimates for non-forest trees, such as agricultural woodlots and urban forestry, were not provided.

164. CO_2 emissions and removals from agricultural soils were documented under table 5.D but reported in the agriculture sector, as allowed by the IPCC Guidelines. Currently, CO_2 emissions and removals from forest soils are not reported; however, a realistic indication was given that changes in carbon stocks in forest soils are slow at the country level. Emissions of non-CO_2 gases were not covered and no explanation was provided for their exclusion.

2. Transparency

165. The NIR was transparent in most methodological aspects. However, detailed data were missing regarding land-use changes (see paragraph 164 above) and the methodological discussions were not detailed enough regarding the annual estimate of forest cover (see paragraph 167 below).

3. Methodology, emission factor and activity data

166. Country-specific methods were used to estimate CO_2 emissions and removals from the forestry sector. Data on harvested wood were based on annual statistics from the wood industry and household surveys on domestic wood consumption; cutting waste estimates came from extensive field studies, and natural losses were estimated on the basis of recent scientific studies. A specific method for estimating CO_2 removals from forests was designed to make the most of the national forest inventory (NFI) system; it provided reliable data on the overall increment of the growing stock in Finnish forests. The NIR provided a detailed account of (i) the NFI scheme and methods of providing the most reliable data on increment from a forest inventory carried out nationwide over a 5-year rotation period, and (ii) the conversion equation and factors used to derive the corresponding CO_2 uptake. However, the NIR provided only limited information on how data on forest areas are computed and updated. Relevant methods for quantifying CO_2 emissions and removals from forest soils with accuracy were being developed.

167. The IPCC default method was used to estimate CO_2 emissions and removals from agricultural soils. A combination of country-specific and default emission factors was used. Results were reported in the agriculture sector so that CO_2 emissions from agriculture were treated in parallel with N_2O emissions from agriculture. Finland used a country-specific classification system for organic soils, with associated emission factors slightly higher than the default IPCC factors for a cool temperate climate.

4. Recalculations

168. In the 2001 submission, CO_2 emissions and removals from agricultural soils were recalculated for 1990 and 1998, resulting in increases of about 100% and 50%, respectively. It is unclear why recalculations were not prepared for the entire time series. The NIR indicated that removals from mineral soils were reported for the first time in the 2001 submission and that improved activity data and emission factors were used for organic soils.

5. Uncertainty estimates

169. The NIR indicated a low level of uncertainty regarding the stock increment data and the statistics on industrial harvesting. However, the quantified reliability of the estimate for total emissions was not available, and the final reliability of the estimate for total removals in category 5.A is medium since the reliability of the conversion factors remains unknown. The level of reliability of the agricultural soils emission estimates was not indicated.

B. Sinks and sources

1. Forest biomass

170. The forestry sector was a key sink in Finland. However, net removals decreased by 55% from 1990 (23.8 $MtCO_2$) to 1999 (10.8 $MtCO_2$) with some very large annual changes. This results, on the one hand, from a low (5.6%) and steady increase in the annual increment of the growing stock of Finnish forests and, on the other hand, from a significant increase (25.4%) in annual removal of biomass from those forests, which was affected by significant annual changes, ranging from -18.7% to 14.5%.

2. 4.D Agricultural soils

171. Agricultural soils were also a key source. However, the emission level has decreased by 37% from 1990 (3.2 $MtCO_2$) to 1999 (2.0 $MtCO_2$), mainly during the 1990–1994 period. Changes in C stocks in mineral soils from cultivation resulted in net emissions of 971 Gg CO_2 in 1990 and 286 Gg CO_2 in 1999 (a 70% decrease), with substantial fluctuations in the annual rate of decrease. As far as emissions from organic soils are concerned, there was a 15% decrease in emissions from 1995 compared to 1990–1994 due to a reduction in the area cultivated (on average about 348 kha during 1990–1994 versus only 308 kha during 1995–1999).

C. Areas for further improvement

1. Issues identified by the Party

172. Finland did not provide much information in its NIR nor in its response to the draft S&A report 2001 regarding planned improvement in this sector. One area that was mentioned, however, was the development of age structure-dependent factors.

2. Issues identified by the ERT

173. The main areas for further improvement, derived from the above considerations, are:

(a) The provision of more detailed data on actual land use changes;

(b) The provision of complementary methodological explanations on how data on forest areas are computed and updated;

(c) The provision of some explanations regarding the main trends and annual variations reported for CO_2 emissions and removals in the forestry sector.

VI. WASTE

A. Sector overview

174. Emissions from the waste sector represented around 2.3% of Finland's total GHG emissions and 41% of total CH_4 emissions in 1999. This sector presented one key source (by level assessment): CH_4 emissions from solid waste disposal sites (SWDS), which accounted for 2.1% of national emissions in 1999.

1. Completeness

175. All CRF tables for the waste sector were completed with the exception of background table 6.C (amount of incinerated waste). Emissions from waste incineration were reported under the energy sector, because almost all such incineration is for energy purposes.

2. Transparency

176. The information provided in the NIR broadly supported the data reported in the CRF. The ERT recommends including additional information in the NIR regarding data that are based on assumptions or expert judgement.

3. Methodologies, emission factors and activity data

177. Default IPCC methods were used to estimate CH_4 emissions from SWDS and wastewater handling. Default and country-specific emission factors were used. The activity data were obtained from local databases, national and international studies and expert knowledge, as available. N_2O emissions from sewage and fish farming were based on N input to waterways and not based on population as stated in the IPCC default method.

4. Recalculations

178. Recalculations were made for CH_4 emissions from SWDS for 1999, due to the improvement of activity data and revised DOC. A change of -6.5% was presented, but the consistency of the time series was not altered. More information about the exact changes should have been specified in the NIR, to increase transparency.

5. Uncertainty estimates

179. A tier 1 uncertainty analysis was done. The uncertainties provided for the key source were very high (30% for the activity data and 40% for the emission factors).

B. Key sources

1. Solid waste disposal sites (SWDS) – CH_4

Trends

180. CH_4 emissions per capita from SWDS decreased by about 57% between 1990 and 1999, due to the application of a new waste law (minimization of waste generation, recycling, reuse and alternative methods have been applied) and the growth of landfill gas recovery (estimated to be 0 in 1990 and 9 Gg in 1999).

Methodologies, activity data and emission factors

181. All categories and gases were estimated using the IPCC default method (tier 1). Data on landfilled waste of different types and years were taken from the Regional Environment Centres VAHTI database, the Register of Landfill Sites (Finnish Environment Institute), Statistics Finland and national studies. The amount of gas recovery was based on data collected by the Finnish Biogas Plant Association. The DOC content of waste was estimated for different types of waste based on IPCC default values and national research data (e.g. Pipatti et. al. 1996 and Pipatti & Savolainen 1996). The methane correction factor (MCF = 0.7) was based on an average of managed and unmanaged waste disposal sites (Pipatti & Wihersaari 1998). The value of DOC_f (0.5) was chosen based on the fact that conditions at Finnish landfills are not optimal for degradation (Vaisaenen 1997). The choice of an oxidation factor of 10% was based on international literature (Oonk & Boom 1995), and the fraction of methane of landfill gas was the IPCC default value (0.5).

C. Non-key sources

1. 6.B Wastewater handling

182. CH_4 emissions from wastewater treatment were calculated using a national method which is consistent with the IPCC Guidelines. Emissions from sludge disposal on land were estimated in the SWDS category.

183. The ERT notes that more clarification is needed on the sources of activity data, which are reported to come from wastewater treatment facilities biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Emission factors are based on default IPCC values (B_o=0.25kg CH_4/kg BOD or COD) and expert knowledge (MCF for municipal - 0.025 - and industrial - 0.005 - wastewater).

184. Emissions from this source category are very low in comparison with those of other Parties, as reported in the draft S&A report 2001. Finland noted that all treatment systems include complete methane recovery and that wastewater treatment in rural areas, which would have higher emission factors, was not included.

D. Areas for further improvement

1. Issues identified by the Party

185. Finland described in its NIR several areas for improvement. For SWDS, it noted that activity data and emission factors needed to be checked, as well as waste composition data. Finland also noted that the method for estimating emissions from this source was under review. For wastewater handling, Finland noted that emission factors needed to be checked for municipal wastewater, and that improved emission factors and activity data needed to be developed for industrial wastewater.

2. Issues identified by the ERT

186. Finland has developed a very detailed, structured and transparent inventory. In order to improve it, the following should be addressed:

(a) The ERT encourages Finland to provide a brief description of the institutional arrangements that are in place for compiling and estimating emissions from the waste sector. A special explanation on how the VAHTI database and other national sources of information are compiled, verified and used for emission estimates would improve transparency. The additional explanation should focus on both sources of data (emission factors and activity data) and on its origin (measurements, sampling, surveys or specific studies);

(b) For CH_4 emissions from SWDS, the ERT recommends that Finland use a tier 2 (first order decay) method, in accordance with the IPCC good practice guidance. The ERT encourages Finland to review the MCF (0.7) and DOC (0.20), as it has already been identified in the NIR. In addition, the causes of the significant decrease in CH_4 emissions from SWDS since 1990 should be clearly documented, including the provision of references to studies or other sources backing up the data.

For the wastewater handling source category, the following should be addressed:

(c) MCFs from domestic (0.025) and industrial wastewater (0.005) should be revised and cross-checked with other countries, and methane recovery should be documented. The percentage of aerobic and anaerobic wastewater and sludge treatments should be clearly documented and consistent with the MCFs applied;

(d) Even though the reported emissions on wastewater handling would not change, the ERT encourages Finland to follow the IPCC Good Practice Guidance differentiating B_o for BOD (0.6) and COD (0.25);

(e) Finally, Finland is encouraged to report in table 6.B of the CRF the amount of waste incinerated, even though its emissions are reported under the energy sector.

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