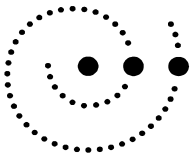

MINISTRY OF THE ENVIRONMENT

FINLAND'S NATIONAL INVENTORY REPORT ON GREENHOUSE GASES

to the UN's Framework Convention on Climate Change

Common Reporting Formats (CRF): 1990 - 2000

Summary

Helsinki 22nd March 2002

PREFACE

Finland's National Inventory Report under the UN/FCCC contains the following three parts:

Part 1 Summary describing the organization of the national greenhouse gas inventory, methods used in calculation of the year 2000 emissions and exceptions to the previous inventories and a summarizing table of the emission data for 1990 - 2000,
Part 2 CRF (common reporting format) tables of Finland's greenhouse gas emission inventories for the years 1990 - 2000 and
Part 3 Reports on the Methodology: Greenhouse gas emissions and removals in Finland

The above mentioned information is also available on Finland's National Greenhouse Gas Inventory website at URL: http://www.vyh.fi/eng/environ/state/air/emis/ghg/ghg.htm. The website will be updated with the latest information by 15th April 2002 .

According to the provisions of the COP/SBSTA/SBI decisions Finland is carrying out the GHG reporting in consultation with the relevant ministries, institutes and experts. The Ministry of the Environment has set an inter-ministrial working group to assist in reporting greenhouse gases and their sinks. Facilitation and guidance of the work was chaired by the Ministry of the Environment.

The inventory report was in practice compiled by the Finnish Environment Institute (FEI) from material provided by the institutes and ministries mentioned below. The inventory was prepared by Statistics Finland, the Finnish Environment Institute, the Technical Research Centre of Finland (VTT), Agrifood Research Finland (MTT), Finnish Forest Research Institute (METLA) and the Ministry of the Environment. The structure and contents of the National Inventory Report will be further developed in the near future to better meet the UNFCCC reporting requirements.

An in-depth review of our Second National Communication by the UNFCCC review team took place in May 1998 and a voluntary pilot review on inventories by the UNFCCC expert review team in November 2001. Their observations and comments with regard to our inventory have been taken into account as much as possible at this stage, further comments will be taken into account in the next inventories. Methodological improvements in accordance with the Revised (1996) IPCC Guidelines for National Greenhouse Gas Inventories and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) have been implemented as far as possible.

The reporting methodology and practices are continuously being improved, which in many cases means that more data of better quality and fulfilment of data gaps have come true since the previous reporting. The work is ongoing next year.

We are also currently in the process of developing the quality management system and quality plan for the greenhouse gas inventory.

Ministry of the Environment

CONTENTS

1 INTRODUCTION

The report gives a short summary of the methods and basic data used to produce the inventory to the UNFCCC Secretariat and the European Union Commission using categorically the Common Reporting Format order. The report presents also the current responsibilities of the organizations participating in the inventory work. The report will be annually updated to give a consistent picture on the development of the National Systems in Finland.

1.1 Methods

In this report, compilation of the year 2000 inventory is described more closely while compilation of the 1990 - 1999 inventories is presented at a general level. More detailed description of the methodologies is presented in the annexed report Greenhouse Gas Emissions and Removals in Finland.

The calculation methods are described as follows:

Emission sources	Emission sources for greenhouse gases that are included in the 2000 inventory are listed. Potential sources that are not listed, will be associated with an explanation, e.g. the activity does not exist in Finland.
Activity data	List of the activity data for used in the inventory.
Emission factors	Indication of whether the emission factors are IPCC defaults or national emission factors.
Methods	A general description of the calculation methods used is presented. The data systems for emission calculations are described in the annexed report Greenhouse Gas Emissions and Removals in Finland.
Exceptions to the IPCC methodology	Reasons for not using the IPCC methodology are listed.
Recalculations to the previous inventories	Type and influence of the methods or basic data that have been changed from the previous year.
Difficulties met in the inventory	Major difficulties that affect the inventory qualitatively or quantitatively are described.
Future needs	Improvements in data or methods that will be needed or anticipated are listed.

Descriptions of the calculation models and data systems is also presented in the annexed report Greenhouse Gas Emissions and Removals in Finland.

1.2 Emission Trends and Key Sources

Information on emission trends and key sources is presented in the report Greenhouse Gas Emissions and Removals in Finland (available from website at URL: http://www.vyh.fi/eng/environ/state/air/emis/ghg/ghg.htm). Key source identification has been carried out in the 1999 inventory.

1.3 Quality Assurance and Quality Control

The quality management system for the national greenhouse gas inventory is currently under development and will be implemented in the inventory of the year 2002 emissions. The present inventory of the year 2000 emissions is not verified by a third party.

1.4 Documentation and Archiving of the inventory

The annually reported CRF tables are archived both at the Finnish Environment Institute and Statistics Finland. The method descriptions with documents of the original data sources are archived at the Finnish Environment Institute with the exception of confidential activity data that is archived at Statistics Finland.

1.5 Participating Organizations in the 2000 Inventory

The Finnish 2000 Greenhouse Gas Inventory to the EU Commission and the UNFCCC Secretariat was carried out by the following organizations:

CRF category	**Organization responsible for the inventory data in the year 2000 report to the EU Commission**
1A	Statistics Finland
1B	Statistics Finland, Ministry of the Environment, Finnish Environment Institute (FEI)
2 (I)	Statistics Finland, Technical Research Centre of Finland (VTT), Finnish Environment Institute (FEI)
2 (II)	Finnish Environment Institute (FEI)
3	Finnish Environment Institute (FEI)
4	Technical Research Centre of Finland (VTT) and Agrifood Research Finland (MTT)
5	Finnish Forest Research Institute (METLA)
6	Finnish Environment Institute (FEI)
7	Statistics Finland
International bunkers	Statistics Finland

1.6 Remarks and Abbreviations

Complete CRF tables are provided for all years out of which only years 1997 and 1999 include recalculations to previous years. Therefore also the recalculation tables of the years 1997 and 1999 are included in the reporting.

The figures in the CRF tables are given at the calculation accuracy that the CRF programme uses (2 decimals). The actual emission estimates are not that accurate.

The inventory includes emissions from the autonomic territory of Åland (Ahvenanmaa).

Non-fuel based industrial SO_2 emissions previously included in the energy sector (CRF 1) are now removed to the industrial sectors (CRF 2).

A new time series for the NMVOC emissions has been prepared. The new estimates reported also to the UNECE CLRTAP are based on the calculation model developed at the Finnish Environment Institute. The model uses bottom-up data from Regional Environment Centres database and industrial associations where possible. Only year 2000 updated NMVOC data are included in the present inventory. The whole time series will be included in the next submission to the UNFCCC in April 2002.

A more systematic calculation system for the CRF category 4 Agriculture is under development. It will also provide closer studies in some areas.

Abbreviations:

CS	country specific	L	low (confidence), uc > 40 %
D	IPCC default	M	medium (confidence), 10 % < uc > 40 %
DC	degradable components	NE	not estimated
H	high (confidence), combined uncertainty of the activity data and emission factor, uc < 10 %	NO	not occurring
		O	source estimated to be zero
IE	included elsewhere	PS	plant specific

2 SUMMARY OF FINLAND'S GREENHOUSE GAS EMISSION DATA FOR 1990 -2000

Summary (million tonnes of CO_2 eq)	1990 (Base year)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2											
fuel combustion	53.9	53.1	51.3	52.0	58.3	55.9	61.2	59.8	57.4	56.8	54.9
fugitive emissions fuels (peat, oil and natural gas)	3.5	3.5	3.5	3.6	3.5	3.5	3.5	3.5	3.5	3.5	3.5
industrial processes	1.2	1.0	0.9	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.1
agricultural soils	3.2	2.8	2.3	2.2	2.1	1.7	1.8	2.1	2.0	2.0	2.0
others	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.6	0.7	0.8	0.7
CH_4	6.1	5.8	5.4	5.0	4.7	4.6	4.5	4.3	4.1	3.9	3.9
N_2O	8.4	7.9	7.3	7.5	7.6	7.8	7.8	8.1	7.9	7.7	7.2
SF_6, HFCs, PFCs	0.07	0.05	0.03	0.03	0.03	0.04	0.09	0.19	0.26	0.38	0.54
Total	**77.1**	**74.8**	**71.4**	**71.7**	**77.8**	**75.2**	**80.5**	**79.4**	**76.8**	**76.1**	**74.0**
Land-use change and forestry (removals)	-23.8	-38.2	-31.9	-29.1	-17.3	-14.7	-21.0	-12.6	-9.7	-10.8	-12.0

CALCULATION METHODS FOR THE YEAR 2000

CRF 1 ENERGY

CRF 1A Fuel Combustion

General description of the method used for the CRF tables in the categories 1 and 2

All emissions from fuel combustion are calculated with Statistics Finland's ILMARI calculation system which follows mostly the Tier 2 method in the IPCC Guidelines. The ILMARI calculation system has been used for national emission calculations of CO_2, SO_2, NO_2, CO, CH_4, N_2O, NMVOC and PM emissions of fuel combustion from the year 1992. Also the year 1990 emissions have now been calculated by ILMARI. The CRF tables for the year 1991 are produced by top-down estimates based on data for 1990 and 1992.

ILMARI combines three types of source data:

1 Detailed bottom up data for point sources covers approximately 2/3 of the total annual fuel combustion (collected from the Regional Environment Centres' VAHTI data system, Electricity Statistics, District Heating Statistics and Manufacturing Industry Statistics. The total fuel consumption data as well as some aggregate sectoral or sub-sectoral fuel data are from the national Energy Statistics).

2 Aggregate transport and off-road vehicle data is originally calculated by the detailed calculation model LIPASTO and TYKO of the Technical Research Centre of Finland (VTT) and they cover approximately 1/6 of the total fuel combustion.

3 Aggregate sectoral (sub-sectoral) data for other sources (small combustion, residential and others) covers approximately the rest 1/6 of the total fuel combustion.

CRF 1A1 Energy industries and
CRF 1A2 Manufacturing Industries and Construction

Emission sources

All point sources (power plants and boilers (P_{fuel} > 5 MW) and industrial plants; total number of plants approximately 1000 including 2000 boilers or industrial processes) cover together 2/3 of the total annual fuel combustion.

Activity data

Fuel consumption by boilers/processes and by fuel types. The basic data source is the VAHTI data system which is complemented and cross-checked against other fuel data sources mentioned above.

The time series for the NMVOC emissions from residential fuel combustion is not constant due to changes in the activity data and emission factors. The time series will be updated in the future inventories. This applies also partly to CH_4, N_2O and CO emissions.

Emission factors The emission factors are either IPCC defaults, country or plant specific.

CO_2	PS/CS/D
CH_4	PS/CS
N_2O	PS/CS
SO_x	Plant specific reported emission data (permitted installations' annual reports) or CS for fuel specific emission factors.
NO_2	Plant specific reported emission data (permitted installations' annual reports) or CS for fuel specific emission factors.
CO, NMVOC	CS

Methods

CO_2 CS: (Tier 2, Revised (1996) Guidelines) CO_2 emissions are calculated using detailed activity (fuel consumption) data and fuel specific emission factors.

CO_2 emissions from coke and residual fuel oil used in the blast furnaces in iron and steel industry have been allocated to 1A2a Fuel consumption in Manufacturing Industry instead of 2C Industrial Processes. There are two reasons for this: firstly, coke has usually been treated as energy producing material in the Finnish Energy Statistics. Secondly, the calculation of emissions is more accurate from the total coke consumption than from partly coke and partly blast furnace gases. The amount of CO_2 emissions from coke and residual fuel oil used in the blast furnaces is approximately 5 Gg (of 53 - 62 Gg CO_2 from the total fuel combustion). Other, non-energy based emissions have been allocated to the CRF category 2G Industrial processes.

SO_2 and NO_2 PS/CS: The reported SO_x and NO_2 emissions of the plants are allocated to fuel based emissions (CRF 1) by each fuel and non-fuel-based (process) (CRF 2) emissions.

CH_4, N_2O, CO, NMVOC CS: (Tier 2, Revised (1996) Guidelines) The emissions are calculated using detailed activity data and technology based emission factors for each boiler or process type (emission factors are available for approximately 250 categories of boilers and processes).

Exceptions to the IPCC methodology Calculation of the indirect N_2O emissions from NO_x deposition

The Guidelines give in the Agriculture sector (page 4.105 in the Guidelines) a method and an emission factor for estimation of indirect N_2O emissions due to atmospheric deposition of NO_x emissions. In the Finnish inventory these emissions are calculated also for energy-related and industrial NO_x emissions using the methodology and the IPCC default emission factor (0.0125 kg N_2O-N/kg NO_x-N emitted). The indirect N_2O emissions caused by nitrogen deposition due to NO_x emissions in the energy sector are included in the emission estimates for the relevant sectors. The share of indirect emissions is approximately 20 - 25 % of the total N_2O emissions of fuel combustion.

The indirect N_2O emissions from NO_x deposition are added to the direct N_2O emissions in Table 1 sectoral report for energy as well as all summary tables (1A, 1B, 2). However, they are not included in the sectoral background data tables for energy (1Aa).

Recalculations to the previous inventories -

Difficulties met in the inventory When preparing the CRF tables for 1990 some differences between the total emissions of SO_2 and NO_2 were noticed compared to the previously published official time series. These differences will be checked in the future.

REMARK concerning allocation of the emissions between the categories 1A1 Energy and 1A2 Manufacturing Industries and Construction: In Finland there are a lot of CHP power plants that produce electricity and steam to the manufacturing industry, especially to pulp and paper plants. Usually these power plants are economically part of the industrial sectors themselves, and in this case, the power plants are regarded as 'autoproducers' according to the IEA definitions. In the CRF tables these autoproducer power plants are allocated to the corresponding industrial sectors. However, there is a growing number of former autoproducer power plants that have been sold to the energy companies (i.e. companies, the primary activity of which is to produce and sell electricity and heat to the market). By definition, these plants should be allocated to the energy sector (CRF 1A1). In the Finnish inventories these former autoproducers are treated as if they still were autoproducers. This applies also to some new power plants which have been built by the energy companies to serve the manufacturing industry. This allocation is used in cases where there is a direct connection (steam pipe) between the power plant and the industrial plant and the industrial plant uses most of the energy (usually steam) produced by the power plant.

Future needs Some minor updates for the years 1992-1994 will be made in the future.

Activity data There are some ongoing research activities for producing better data from residential, service sector and off-road machinery fuel consumption. The changes in the activity data should not affect the total CO_2 emissions but the sectoral breakdowns may change.

Emissions for the year 1991 are not calculated with the same model. There are estimates of total sectoral emissions in Table 10, but these may be revised in the future.

There has been progress in the harmonisation of emissions from domestic air and water transport between the ILMARI and LIPASTO calculation models. However, the new results have not yet been updated to the CRF tables. This will be done as soon as possible. At the moment, there are some differences in the activity data, which need to be checked.

Emission factors The CO_2 emission factor for municipal solid waste needs to be revised.

The non-CO_2 emission factors used in ILMARI are based on research data from the beginning of the 1990's and appropriate for emission calculations for that period. Since then, however, the combustion conditions and fuel mixes have changed, and an update of the emission factors based on research and measurements under current conditions is needed. This is especially needed for N_2O emissions from fluidized bed combustion due to its growing importance for the Finnish inventory.

In addition to measurements, the IPCC default emission factors and international research carried out after 1990 on the CH_4 and N_2O emissions from combustion should be evaluated and used when updating the emission factors. The N_2O and CH_4 emissions are very much dependent on both the fuel type and combustion conditions. This should be taken into consideration when deciding if and how the new data should be applied.

Results from new measurements on CH_4 and N_2O emission factors of certain boiler types have been used in the year 2000 inventory. As expected, the results showed that the N_2O emission factors for fluidized bed combustion were overestimated. The time series will be updated in the future inventories.

The oxidation factor of peat combustion has been changed from 0.98 to 0.99 (IPCC default). However, this correction has not yet been made to years 1992-1994. There are also some other minor corrections for these years which will be made in the future.

CRF 1A3 Transport

Emission sources CO_2, CH_4, N_2O, CO, NO_x, SO_2 and NMVOC from road transport, civil aviation, railways, navigation and other transportation.

Activity data

Road transport — In the ILMARI calculation system road transport activity data covers diesel oil and motor gasoline consumption in road transport vehicles. Fuel consumption data is compared to the total diesel oil and motor gasoline consumption from the Energy Statistics (fuel sales). Road transport covers almost 100 % of these fuels. Natural gas in road transport has been included in the 1999 inventory.

Civil aviation, railways, navigation, other transport — The activity data (fuel consumption) for other transport sectors than road transport follows the data in the Energy Statistics. Part of the data is obtained directly from companies, another part is coming from national authorities, and the rest have been estimated with the LIPASTO and TYKO models.

Off-road machinery — The ILMARI fuel consumption for off-road machinery is allocated according to the Energy statistics which leads to the following division in the CRFs: the emissions fall into CRF categories 1A3 Other Transportation, CRF 1A4c Agriculture / Forestry / Fisheries and CRF 1A2f Other / Construction.

Emission factors

Road transport — CS: In the ILMARI system aggregate emission factors for diesel oil and motor gasoline are used. The emissions are originally calculated by the very detailed Technical Research Centre of Finland's LIPASTO model. In the LIPASTO calculation model the emission factors have been adjusted to the Finnish car population.

Civil aviation, railways, navigation, other transport — CS: See the references mentioned in Boström (1994) Greenhouse Gas Inventory, Finland 1990
In the 1999 and 2000 inventories the emission factors are mostly taken from the LIPASTO and TYKO models, completed with some IPCC 1996 default emission factors CH_4 and N_2O.

Method

Road transport — CS: The LIISA sub-model of the LIPASTO calculation model calculates all emissions for road transport for the years 1980 - 2018. The aggregate results of LIISA are taken into the ILMARI system.

Off-road — NMVOC emission estimates from other transportation (other off-road machinery) have increased compared to the previous years due to the new off-road machinery calculation system (TYKO) of the Technical Research Centre of Finland (VTT).

Exceptions to the IPCC methodology -

Recalculations to the previous inventories -

Difficulties met in the inventory -

Future needs

Civil aviation, railways, navigation, Other transport	There are differences in the domestic aviation activity data between the LIPASTO calculation model and the Energy statistics. The differences have to be checked to enable the results to be used in the ILMARI system.
Off-road machinery	The estimated emissions from off-road machinery (machinery used in construction, agriculture and other applications) have been included in the inventories and reported under relevant emission sectors. The activity and emission factor data for off-road machinery are, however, among the most uncertain within the energy sector. The results of the Technical Research Center of Finland's (VTT) new off-road machinery model (TYKO model) have been used in the ILMARI 1999 and 2000 data.

CRF 1A4 Other sectors and
CRF 1A5 Other

Emission sources All the remaining fuel combustion activities that are not covered by the CRF categories 1A1 - 1A3.

Activity data Energy statistics

Emission factors ILMARI (see CRF 1A1 - 1A2 for further information)

Method ILMARI (see CRF 1A1 - 1A2 for further information)

Exceptions to the IPCC methodology -

Recalculations to the previous inventories -

Difficulties met in the inventory Although the total fuel sales for most fuels are quite well known, there are difficulties in allocation of some fuels. The most difficult fuels to allocate are gasoil, which is used in space heating, off-road machinery, water transport etc., as well as residual fuel oil, which is used in steam/heat production, industrial processes and space heating. There are large uncertainties in the fuel consumption data within these sectors (1A4 and 1A5). The errors made in the allocation do not affect the total CO_2 emissions, but might cause relatively high errors in other emissions, because the emission factors vary a lot depending on the type of technology (for example NO_x emissions from space heating compared to NO_x emissions from diesel engines).

Future needs More detailed data is needed on the allocation of gasoil and residual fuel oil to different sectors and types of use. Emission factors for small combustion of wood need to be studied further to achieve better annual comparability. Recalculation of time series for all non-point sources is underway. The results of the recalculation will be updated to the CRF tables as soon as possible.

CRF 1B Fugitive emissions from fuels

CRF 1B1 Fugitive emissions from solid fuels (CRF 1B1)

Emission sources

In Finland, fugitive CO_2 and CH_4 emissions arise particularly from peat production (preparation and profiling of peat soils and stockpiling of peat). The current inventory includes emissions from the production areas (surface emissions and emissions from stockpiles and ditches) and from arable Pentland classified as reservoirs for future peat production. The areas and emission factors used in the inventory are uncertain and the calculated emissions have therefore been rounded to the nearest integer expressed in Tg CO_2. The same emission estimates have been used for all years in the inventory (1990-2000). Efforts to improve the estimates are underway.

There are no coal mines in Finland.

Activity data

The peat production area in Finland is around 50 000 - 60 000 ha (e.g. Selin 1999) and the arable Pentland classified as peat production reservoirs are estimated to be approximately 100 000 - 150 000 ha (Laine et al. 1998).

Emission factors

CS: The CO_2 emissions from peat production sites are approximately 1100 g CO_2 m^{-2} a^{-1} (Nykänen et al 1996). The emission factor for cultivated Pentland that are classified as peatland reservoirs is approximately 450 g C m^{-2} a^{-1}.

Method

Peat	CS
Other solid fuels	Other fugitive emissions from solid fuels are estimated negligible.

Exceptions to the IPCC methodology

-

Recalculations to the previous inventories

-

Difficulties met in the inventory

The emission estimate is made for the year 1990 and no update of activity data has been made since.

The activity data on cultivated Pentland classified as reservoirs for future peat production are uncertain and under review, as well as the allocation of the emissions (Energy, Agricultural or LUCF sector).

Future needs

Calculation of the emissions for the whole period since 1990 will be made when improved data on areas of Pentland and the emission factors is available.

CRF 1B2 Fugitive emission from oil and natural gas

Emission sources

CO_2	Venting and flaring from oil refineries are included in CRF 1B2c.i Venting. Only CO_2 emissions are reported, other emissions are estimated to be negligible.
CH_4	Methane emissions in CRF 1B2b.iii Other Leakage include emissions from emptying of natural gas pipelines for extension work. Other leakages from the pipelines are estimated to be negligible as the pipelines are relatively new and only 5 % of the natural gas is distributed via local networks to small consumers (households, restaurants, greenhouses etc.)
NMVOC	NMVOC emissions originate from oil refineries and storage of chemicals at the refineries, road traffic evaporative emissions from cars, petrol distribution chain and refuelling of cars, ships and aircraft.
	There is no exploration or production of oil and natural gas in Finland.

Activity data, Emission factors and Methods

CO_2, CH_4	CS: The emission estimates are based on plant specific information.
NMVOC	NMVOC calculation model at the FEI: CS: Emission data from theRegional Environmental Centres' VAHTI database. The LIISA sub-model of the LIPASTO calculation model calculates all emissions for road transport for the years 1980-2018.Evaporative emissions from cars is based on expert estimation at the VTT and emissions from petrol distribution chain and refuelling of vehicles on expert estimation of Finnish Gas and Oil Federation.

Exceptions to the IPCC methodology -

Recalculations to the previous inventories -

Difficulties met in the inventory -

Future needs The results of the NMVOC calculation model of the FEI have to be updated into the ILMARI model to years 1990 - 1999. Calculation of the fugitive emissions from distribution of oil and natural gas (which were estimated to be negligible) will be carried out according to the IPCC default methodology in the following inventories.

CRF 2 INDUSTRIAL PROCESSES

CRF 2A Mineral Products

Emission sources

CO_2	At the moment the most important non-energy industrial process for non-energy CO_2 emission sources are cement and lime production. Estimates of CO_2 emissions from cement and lime production are included. Lime production includes production in steel industry.
NMVOC	Emissions from road paving are included. Asphalt roofing is included in road paving.
SO_2	Emissions are not split between fuel based and non-fuel based. All SO_2 emissions are reported under CRF 1A2f.

Activity data

CO_2	Activity data for cement and lime production is obtained from the Manufacturing Industry Statistics as well as from the industrial plants directly.
NMVOC	CS: Industrial Production Statistics of the Statistics Finland

Emission factors

CO_2	D
NMVOC	Fortum Oil and Gas (Blomberg, 1996)

Methods

CO_2	D
NMVOC	CS: NMVOC calculation model at the FEI

Exceptions to the IPCC methodology	-
Recalculations to the previous inventories	-
Difficulties met in the inventory	-
Future needs	Industrial emission sources for CH_4 and the suitability of the IPCC default emission factors should be studied further.

CRF 2B Chemical Industry

Emission sources

CO_2	All ammonia currently used in Finland is imported from other countries. In 1990-1993 small amounts (30 kt to 4 kt per year) were produced using mainly peat and saw dust as raw material. The CO_2 emissions from these processes have not been estimated and included in the inventory.
CH_4	Ethylene production in Finland has fluctuated from about 180 to 260 Gg ethylene per year between 1990 and 2000.
N_2O	Nitric acid is produced at two sites (in 1990 - 1992 at three sites) in Finland. The production has varied from about 430 to 550 Gg nitric acid per year. Adipic acid is not produced in Finland.
NMVOC	Emission sources include chemical industry and storage of chemicals at the sites.

Activity data

CH_4	Annual ethylene production figures have been obtained from production plants and manufacturing statistics.
N_2O	Annual nitric acid production figures have been obtained from production plants.

Emission factors

CH_4	D: The emissions have been calculated with the IPCC default emission factor 1 g CH_4 / kg ethylene produced.
N_2O	PS: The emission factors are based on measurements carried out at the factories in 1999. More measurements are carried out currently, and this may lead to adjustments in the emission factors used.

Methods	D: ethylene production
N_2O	CS: nitric acid, based on measurements
NMVOC	NMVOC calculation model at the FEI: Emission data from the Regional Environment Centres' VAHTI database
Exceptions to the IPCC methodology	-
Recalculations to the previous inventories	-
Difficulties met in the inventory	Suitability of the IPCC default factors for ethylene production in Finland is unknown.
Future needs	-

CRF 2C Metal Production

Emissions

CH_4	Emissions from coke production are included in the inventory.
NMVOC	Emission sources include iron and steel production and secondary aluminium production. Degreasing and painting are included in CRF 3B.

Activity data

CH_4	Coke production data is obtained from the Energy Statistics.
NMVOC	Emission data from the Regional Environment Centres' VAHTI database The Finnish Metal Industries Federation

Emission factors

CH_4	D: (IPCC 1995)
NMVOC	The EMEP/Corinair Atmospheric Inventory Guidebook

Methods

CH_4	D
NMVOC	NMVOC calculation model at the FEI

Exceptions to the IPCC methodology	CO_2 emissions from coke and residual fuel oil used in blast furnaces in metal production industry are included in the energy sector CRF 1A.
Recalculations to the previous inventories	In earlier inventories also CH_4 emissions from pig iron and sinter production were reported. Based on the IPCC 1996 Revised Guidelines and measurements carried out at the Finnish plants, these emissions are now considered to be negligible and omitted from the inventory.
Difficulties met in the inventory	-
Future needs	-

CRF 2D Other Production

Emission sources

CO_2	Non-fuel based emissions from pulp and paper industry as well as glass production are estimated to be negligible.
N_2O	Catalytic cracking of oil is identified as a possible source in the IPCC Guidelines but no method or default emission factors are given. Catalytic cracking of oil is carried out at the refineries and, thus, this might be a possible emission source in Finland, too.
NMVOC	Emissions from forest and food industry are included.
NO_2	All emissions from pulp and paper industry are reported as fuel based emissions under CRF 1.
SO_2	All emissions of different sulphur compounds are calculated as SO_2 equivalents.

Activity data

NMVOC	Forest industries: The Finnish Forest Industries Federation Food industries: The Industrial Production Statistics of Statistics Finland

Emission factors and methods

NMVOC	NMVOC calculation modet at the FEI: Food industries: NPI Environment Australia November 1999, EMEP/Corinair Atmospheric Inventory Guidebook Forest industries: The Finnish Forest Industries Federation, Report August 1996**,** The Finnish Forest Industries Federation, Annual report 2000, Sawmills and board production**,** Emission data from the Regional Environment Centres' VAHTI database

Exceptions to the IPCC methodology -

Recalculations to the previous inventories -

Difficulties met in the inventory -

Future needs Emission from pulp and paper sector as well as from mechanical wood processing will be estimated in the future inventories.

CRF 2E Production of Halocarbons and SF_6

Emission sources These gases are not produced in Finland.

CRF 2F Consumption of Halocarbons and SF_6

The base year for halocarbons' and SF_6 emissions is 1990.

Emission sources Refrigeration and air conditioning systems, aerosols, foam blowing, electrical equipment, fixed fire fighting systems, electronics manufacturing.

Activity data

Potential emissions

1. Import and export data collected from member companies of the Association of Finnish Technical Traders (AFTT) and other non-member companies that import HFCs, PFCs and SF_6 in bulk. Data on imports and exports of HFCs, PFCs and SF_6 contained in products were obtained using a number of surveys (see below).
2. As data on thermal destruction from Ekokem Ltd had previously indicated that no significant amounts of fluorocarbons had been destructed, the company was not asked to provide data this year. Survey of refrigeration and air conditioning companies (see below) covered this aspect as well and indicated that no significant quantities had been delivered for destruction in 2000.

Actual emissions

1. Questionnaires to importers: companies importing mobile air conditioning devices and other refrigerant containing equipment; companies importing aerosols and one component polyurethane foam, companies importing polyurethane foam products and extruded polystyrene foam products, companies importing SF_6 containing electrical equipment, companies importing specialty gases for electronics manufacturing.
2. Questionnaires to manufacturers: domestic and other refrigeration appliances, polyurethane and extruded polystyrene thermal insulation foams, electronics, SF_6 insulated electrical equipment, die cast magnesium products.

Emission factors

Potential emissions Emission factors are not required for calculation of potential emissions.

Actual emissions

D/CS: The following emissions factors were used (only those sectors mentioned in which the methodology is based on the use of emission factors):

Source	Emission factors (%)			Notes
	Manu-facturing	Use	Disposal	
Electrical equipment	15 (prior to 1995) 6 (1995 onwards)	5 (prior to 1996) 1 (1996 onwards)	0	Emission factors 15% and 6% refer to install-ing of electrical equipment [Good Practice Guidance 2000], default assumed for leakage and near zero emissions for disposal
Fixed fire fighting systems	3	1	0	National factors
Foam blowing	7.5 - 95	0.5 - 3	0	Foam type specific factors from Good Practice Guidance (2000)

Methods

Potential emissions D: Tier 1a and 1b (IPCC 1997).

Actual emissions D/CS: Tier 2 (IPCC 1997) and Good Practice Guidance (IPCC 2000).

Exceptions to the IPCC methodology

There were no exceptions to the IPCC methodology. A comparison of 1999 and 2000 data showed that the previously used method for refrigeration and air conditioning equipment gives results equal to the top-down Good Practice method, and thus recalculation is not necessary.

Recalculations to the previous inventories

No recalculations were carried out.

Difficulties met in the inventory

It is difficult to ensure that surveys cover all importers of HFCs, PFCs and SF_6 contained in products. Confidentiality due to small number of actors in some of the sectors also prevents fully transparent documenting of the HFC, PFC and SF_6 inventory.

Future needs

Good Practice Guidance was implemented with respect to the calculation methods. Future needs of the inventory include improved documentation, uncertainty assessment and QA/QC.

CRF 2G Other

Emission sources

No emission sources included in this sector.

CRF 3 Solvent and other product use

Emission sources

Use of N_2O		In Finland N_2O is used in medical applications, as well as in some other specific applications, e.g. in industry. All used N_2O is imported to (three importers).
Emission sources for NMVOC compounds		Solvent and other product use:
	3A	Paint application
	3B	Degreasing and dry cleaning
	3C	Chemical products, manufacture and processing: pharmaceutical industry, leather industry, plastic industry, textile industry, rubber conversion, manufacture of paints etc.
	3D	Other solvent use: printing industry, preservation of wood, use of pesticides, glass and mineral wool enduction, domestic solvent use, vehicles dewaxing

Activity data

N_2O	Sales data from AGA Of, Messer Suomi Of and Woikoski Of for the years 1990 and 1998. The data are preliminary.
NMVOC	NMVOC calculation model at the FEI: 3C and 3D: Emission data from the Regional Environment Centres' VAHTI database, Database at the Finnish Environment Institute Chemicals Division 3B Customs Statistics and expert estimation 3A Association of Finnish Paint Industry

Emission factors

N_2O use	All used N_2O is assumed to be emitted to atmosphere the same year it is used.
NMVOC	CS: Finnish Environment Institute Chemicals Division (expert estimation)

Methods CS: (Tier 2)

N_2O	CS: See Emission factors above
NMVOC	CS: NMVOC calculation model at the FEI: Emission estimations from Finnish Cosmetic, Toiletry and Detergent Association and Association of Finnish Paint Industry

Exceptions to the IPCC methodology -

Recalculations to the previous inventories	-
Difficulties met in the inventory	-
NMVOC	Lack of consumption data on solvents in plastic manufacturing
N_2O	Only activity data for the years 1990 and 1998 have been available and the emissions for the years 1991 - 1997 are interpolated.
Future needs	Calculation model for NMVOC compound emissions will be developed. The quality of the activity data for N_2O emission inventory will be improved.

CRF 4 Agriculture

CRF 4A Enteric Fermentation

Emission sources Domestic animals

Activity data Annual agricultural statistics (animal numbers, milk production for dairy cows) and surveys (monthly and yearly publications by the Information Centre of the Ministry of Agriculture and Forestry) and agricultural experts.

Emission factors CS/D: see Methods below for more information

Methods CS: CH_4 from enteric fermentation for cattle have been estimated using the Tier 2 methodology in the Revised (1996) Guidelines as elaborated by the Good Practice Guidance (2000). The average daily feed intake has been calculated from data on animal weight, daily weight gain etc. These input data have been obtained from agricultural experts. The method and the activity data acquisition is described in more detail in the references (Pipatti 2000; Pipatti 1997; Pipatti et al. 1996; and Savolainen et al. 1996).

D: For other animal types the Tier 1 method and default values given in the IPCC Guidelines have been used.

Exceptions to the IPCC methodology -

Recalculations to the previous inventories -

Difficulties met in the inventory All input data are not found in agricultural statistics or surveys and are therefore based on expert knowledge.

Future needs An idea of changing the method so that it would be based on the feed consumption of cattle instead of estimating this indirectly from the data on animal weight, daily weight gain etc. has been put forward. The availability of data for this approach, as the impact on the accuracy of the method, will be examined.

CRF 4B Manure Management

Emission sources Manure of domestic animals

Activity data Annual agricultural statistics (animal numbers, milk production for dairy cows) and surveys, agricultural experts.

Emission factors CS/D: see Methods below

Methods CS: Tier 2 methodology for all animal types. Data on manure management is based on surveys (MKL 1993; Seppänen & Matinlassi 1998). CS values for cattle have been

calculated from feed intake values obtained from the calculations on emissions from enteric fermentation. Other input data used are the IPCC default values. The method and activity data acquisition is described in more detail in the references (Pipatti 2000; Pipatti 1997; Pipatti et al. 1996; Pipatti 1994).

Exceptions to the IPCC methodology -

Recalculations to the previous inventories -

Difficulties met in the inventory All activity data is not collected annually.

Future needs Annual or periodic data collection on e.g. manure management systems need to be developed. Some of the input parameters in the calculation may need fine-tuning.

CRF 4C Rice cultivation

Emission sources NO

CRF 4D Agricultural Soils

Emission sources

CO_2 Emissions from organic soils and liming are included. Estimates on the changes in carbon stocks in mineral soils due to land use changes are also presented.

N_2O Nitrogen fertilization by use of mineral N fertilisers, manure and sludges, as well as from biological nitrogen fixation and crop residues, is included in the inventory. Both direct and indirect emissions are estimated.

Activity data

Annual agricultural statistics (The Ministry of Agriculture: Information Centre of the Ministry of Agriculture and Forestry)

Finnish Liming Society

Regional Environment Centres' VAHTI database: sludge spreading

Rural Advisory Centres (Maaseutukeskusten liitto): N excretion by animal types (see e.g. Grönroos et al. 1998)

Rural Advisory Centres (Maaseutukeskusten liitto 1993; Seppänen & Matinlassi 1998): data on AWMS

State Technical Research Centre of Finland (VTT) Energy model for ammonia emission estimation (Savolainen et al. 1996)

Agricultural experts

Area of organic soils is based on analyses of soil testing results (Viljavuuspalvelu, MTT)

The area of soil types has been calculated according to the unpublished statistics of the Finnish Soil Analysis Service (Nykänen *et al* (1995), Berglund (1989))

Emission factors

CS/D

CS:

- $Frac_{leach}$ for which the default was estimated to lead to an overestimation of the emissions by a factor of 2; support for the value used can be found in e.g Rekolainen & al. (1995)
- Emission factor for N_2O emissions from cultivation of histosols; used emission factor 8 kg N/ha/year (see Klemedtsson et al. 1999)
- Emission factor for CO_2 emissions from the organic soils
- Emission factors [Mg/ha/a] for organic soils:

Soil organic matter content > 40 % (w)	
Pasture	2
Upland crops	4
Soil organic matter content 20 - 40 % (w)	
Pasture	0.5
Upland crops	1

Methods

D

Exceptions to the IPCC methodology

-

Recalculations to the previous inventories

The change in carbon stocks in mineral soils was not reported in the previous submission.

N_2O

The time series on nitrogen content in animal manure has been revised.

CO_2

CO_2 emissions from organic soils are based on improved activity data and emission factors.

The estimates on CO_2 from mineral soils are reported in the inventory for the first time.

Difficulties met in the inventory

The suitability of the IPCC default factors for the Finnish conditions is questioned as the climatic conditions and agricultural practices differ very much from those from which the default values have been derived. Country specific emission factors are used in the estimates to a certain extent but more research is still needed.

The current guidelines are not considered logically or scientifically correct in all aspects considering the estimation of N_2O emissions.

Future needs Research on a national emission factor is under way.

CRF 4E Burning of savannas

Emission sources NO

CRF 4F Field Burning of Agricultural Residues

Emission sources Field burning of agricultural residues is taking place in Finland only occasionally on small scale and the emissions from this source are estimated to be negligible.

CRF 5 Land-use change and forestry

CRF 5A Changes in Forest and Other Woody Biomass Stocks

Emission sources

Emissions are supposed to be caused by tree fellings and unrecovered natural losses, uptakes are caused by tree growth.

Activity data

Cutting statistics are collected by the Finnish Forest Research Institute, volume increment statistics are based on the figures by the Finnish National Forest Inventory (the Finnish Forest Research Institute).

Emission factors

CS: see Methods below

Methods

CS: The total annual drain estimates of forests are based on the statistics of cutting removals reported by the forest industry companies and collected by the Finnish Forest Research Institute, the estimates of household use of timber is based on enquires, the estimate of cutting waste is based on an extensive field study by the Finnish Forest Research Institute. The volume of natural losses is estimated in a study by the Finnish National Forest Inventory (Finnish Statistical Yearbook of Forestry 1999, Finnish Forest Research Institute).

The volume increment of the growing stock of trees is estimated using field measurements on sample plots of the Finnish National Forest Inventory (FNFI). The increment figures concern increment of the tree stem volume. An average increment of five years preceding the measurement time is applied. The FNFI progresses by regions and thus the data for the whole country comes from different years for different parts of the country (see Tomppo 1999 and Tomppo 2000, Tomppo et al 1997 and 1998). Conversion factors are applied for converting tree stem volume for whole tree biomass and carbon content (Karjalainen and Kellomäki 1996).

Exceptions to the IPCC methodology

A national method which gives more accurate figures than the IPCC methodology, is applied.

Recalculations to the previous inventories

The figures are updated annually.

Difficulties met in the inventory

Total drain figures (corresponding emissions of CO_2) are estimated annually and are considered to be very accurate. Total increment figures (corresponding uptake of CO_2) are updated annually but the figures for different parts of the country come from different years. The averages of increments of five years preceding the measurement year are applied. This is a commonly used practice in forest inventories. The reliability figures can be assessed by means of statistical methods (Tomppo 1999, 2000).

Future needs

Either the IPCC practice of the use of annual figures must be changed or a method to produce annual increment figures must be developed. This is very much a question of measurement costs. One should also note that the real annual variation of the increment of trees is of a magnitude plus minus 20 %. It is caused by climatic variation and biological cycles of trees. The use of five years instead of one reduces this variation which is not essential for the carbon balance budgeting.

RF 5B Forest and Grassland Conversion

Emission sources	Deforestation, afforestation, reforestation
Activity data	Figures are indirectly included in the forest tree biomass change figures given by the Finnish Forest Research Institute[1] and the Finnish National Forest Inventory (the Finnish Forest Research Institute).
Emission factors	CS: See Changes in Forest and Other Woody Biomass Stocks.
Methods	CS: See Changes in Forest and Other Woody Biomass Stocks.
Exceptions to the IPCC methodology	-
Recalculations to the previous inventories	-
Difficulties met in the inventory	-
Future needs	-

CRF 5C Abandonment of Managed Lands

Emission sources	Afforestation, reforestation
Activity data	Figures are indirectly included in the forest tree biomass change figures given by the Finnish Forest Research Institute[1] and the Finnish National Forest Inventory (the Finnish Forest Research Institute).
Emission factors	CS: See Changes in Forest and Other Woody Biomass Stocks.
Methods	CS: See Changes in Forest and Other Woody Biomass Stocks.
Exceptions to the IPCC methodology	-
Recalculations to the previous inventories	-
Difficulties met in the inventory	-
Future needs	-

CRF 5D CO_2 Emissions and Removals from Soil

Emission sources	Emission sources include forest soil; for agricultural soils, see Chapter 4D.
Activity data	Emissions or removals from forest soils are not reported at the moment. The changes in the carbon content of the forest soil are slow. Many factors, both human induced and not human induced, affect the changes. Several studies have been reviewed but a unique method covering both mineral soils and peatland soils does not exist.
Emission factors	See Methods below.
Methods	CS: A method to estimate changes in the carbon content of forest soil is under development at the Finnish Forest Research Institute.
Exceptions to the IPCC methodology	Annual changes in the carbon content of forest soil are very small and their estimates may be unreliable. The estimates of the annual changes are not necessarily due to the slow processes, either.
Recalculations to the previous inventories	-
Difficulties met in the inventory	-
Future needs	-

CRF 5E Other

Emission sources	NO.

CRF 6 Waste

CRF 6A Solid Waste Disposal on Land

Emission sources

CH_4	Solid waste disposal sites including solid municipal, industrial, construction and demolition wastes and municipal (domestic) and industrial sludges.
NMVOC	Waste disposal emissions are included.

Activity data

Landfilled waste: Finnish Environment Institute /VAHTI database; Finnish Environment Institute/Register of Landfill Sites; and Statistics Finland
Landfill gas recovery: Finnish Biogas Plant Register

Emission factors

D/CS	Methane correction factor (MCF) 0.7 (mean value: Managed SWDS / Unmanaged shallow)
CS	Degradable organic carbon in municipal solid waste (DOC) 0.20 (based on waste composition in 1990)
CS	Expert knowledge. Fraction of DOC dissimilated, DOC_f = 0.50 (mean temperature in landfills 10 - 15 ^{0}C)
D	Fraction of methane in landfill gas, F = 0.5
CS	Expert knowledge: Oxidation factor (OX) 0.1

Methods

	D:	CH_4 emissions from solid waste disposal on land have been calculated using the default methodology given in the Revised (1996)
CH_4		Guidelines (mass balance methodology) and using national and IPCC emission factors.
NMVOC	CS	Expert estimation and CRF 3 reference Arnold et al. (1998).

Exceptions to the IPCC methodology

No exceptions. Some changes in emission factors (see above).

Recalculations to the previous inventories

-

Difficulties met in the inventory

The uncertainties in the estimates on CH_4 emissions from waste are large. The data on composition and amount of waste landfilled is still often based on rough estimates and, when looking at the past composition and amount of waste landfilled, the lack of data is even greater. Statistics on both municipal and industrial waste management are currently improving, and future emissions will at least to some extent be based on more reliable data. The improved statistics are assumed to improve the estimation accuracy of the emissions for the years from 1997 onwards. Furthermore, the categories of solid waste disposal sites (Managed/Unmanaged) are very uncertain and the mean value of MCF is used in the inventory.

Future needs

Activity data and emission factors (especially the methane correction factor) need to be checked. The waste composition data needs to be reviewed. Change of methodology is also under review. The work for checking the methane correction factor is almost complete and the new values are implemented in the next inventory.

CRF 6B Wastewater Handling

Emission sources

CH_4	Municipal (Domestic) and industrial wastewater handling (not including uncollected domestic waste waters).
N_2O	Nitrogen input of fish farming as well as domestic and industrial wastewaters into waterways.
NMVOC	Wastewater handling emissions are included.

Activity data

Municipal (domestic) wastewaters, BOD in wastewater: Finnish Environment Institute /VAHTI database and Finnish Environment Institute / The Water and Sewage Works Register.

Industrial wastewaters, COD in wastewater: Finnish Environment Institute / VAHTI database and Finnish Environment Institute / Register for industrial Water Pollution Control. Estimates are based on expert knowledge.

Emission factors

Municipal (domestic) wastewaters:

D	Maximum methane producing capacity B_o = 0.25 kg CH_4 / kg BOD
CS	Expert knowledge. Methane conversion factor MCF = 0.025

Industrial wastewaters:

D	Maximum methane producing capacity B_o = 0.25 kg CH_4 / kg COD
CS	Expert knowledge. Methane conversion factor MCF = 0.005

Methods

CH_4	D: National methodology that corresponds to the methodology given in the Revised (1996) Guidelines is used. The emissions from municipal wastewater treatment are based on the BOD load of the wastewaters. The emissions from industrial wastewater treatment are based on the COD load. These DC values of wastewaters with shared methane conversion factors have been used for both wastewater and sludge handling. The emission estimate is very uncertain as many of the input parameters are based on expert opinions.
NMVOC	CS: Expert estimation and CRF 3 reference Arnold et al. (1998).

Exceptions to the IPCC methodology

N_2O	In the Revised (1996) Guidelines a methodology to calculate the N_2O emissions from sewage is given in the Agriculture sector. The methodology is very rough and the N input into waterways is based on population data. In Finland, the N input from fish farming and from municipal and industrial wastewaters into the waterways is collected in the VAHTI database.

Recalculations to the previous inventories

-

Difficulties met in the inventory

The IPCC Guidelines have only two default values for the methane conversion factor (0 for aerobic systems and 1 for anaerobic ones). Real processes are seldom completely aerobic or anaerobic. There are no plant specific measurements for the degradable organic component of the sludge in Finland. Especially for domestic wastewater there are good measurement results for DC of wastewaters in Finland. DC values of wastewaters with shared methane conversion factors have been used for both wastewater and sludge handling. The estimated methane conversion factors for collected wastewater handling systems (industrial and domestic) are low in Finland because the handling systems included in the inventory are either aerobic or anaerobic with complete methane recovery. The emission factors mainly illustrate exceptional operation conditions.

Future needs

Emission factor data for municipal waste waters has to be checked as well as activity and emission factor data for industrial waste waters improved. A new calculation system for uncollected domestic waste waters has to be developed.

Wastewater treatment causes also N_2O emissions, although their importance is minor. In emission inventories the emissions have been estimated to be negligible. This assumption should be confirmed and the international development of the estimation methods for these emissions should be followed.

CRF 6C Waste Incineration

Emission sources

Emissions of greenhouse gases CO_2, N_2O and CH_4 from Waste Incineration are reported in the energy sector.

CRF 6D Other

Emission sources

NO.

CRF 7 Other

Emission sources	CO_2 emissions from non-energy use of oil products and natural gas.
Activity data	Energy statistics
Emission factors	D
Methods	D
Exceptions to the IPCC methodology	-
Recalculations to the previous inventories	-
Difficulties met in the inventory	-
Future needs	The fractions of carbon stored (and carbon released) need to be checked. There is a possiblity of double counting in the present inventory. The whole category will be checked and moved to the Industrial Processes in the future inventories.

INTERNATIONAL BUNKERS

Emission sources	International aviation and navigation
Activity data	Fuel consumption by transport mode from the Energy statistics; fuel sales to ships and planes going abroad.
Emission factors	CS. The emission factors used are the same as for domestic transport.
Methods	CS: ILMARI of Statistics Finland (see CRF 1A)
Exceptions to the IPCC methodology	The case of Åland could be seen as an exception to the IPCC definitions. In the present inventory all trips going to Sweden via Åland are treated as international, because hardly any passengers (or cargo) leave or enter the ships in Åland. According to the IPCC methodology, the trip should be divided into domestic and international parts.
Recalculations to the previous inventories	-
Difficulties met the inventory	There are differences in the definitions of international transportation (international bunker emissions) in the Technical Research Centre of Finland's LIPASTO model and in the ILMARI system.
Future needs	Harmonisation of emission factors in the ILMARI and LIPASTO calculation models is underway. The results will be updated to the CRF tables as soon as possible.

4 UNCERTAINTY ESTIMATES

The IPCC report on Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories was finalised in spring 2000. Its use in the compilation of national inventories is encouraged already in the submission of the 1999 inventory in 2001. Finland has started incorporating the use of the Good Practice Guidance (2000) into the compilation of its annual inventories. Many aspects of the report have, however, not yet been implemented due to the limited resources and time that has been available since the approval of the Good Practice Guidance (2000) Report.

Chapter 6 in the Good Practice Guidance (2000) describes good practice in estimating and reporting uncertainties associated with both annual estimates of emissions, and emission trends over time. The approach to estimate the uncertainties of the Finnish inventory is up to date very simple and pragmatic, and based entirely on expert judgement. The procedures for expert elicitation and methods for encoding expert judgement described in chapter 6 have not yet been implemented. Also the level of desegregation in estimating the uncertainties and the methods used in combining them may need further consideration and improvement. The uncertainty estimates given in Table 7 should therefore to be considered as preliminary. The quality of the estimates is considered to be high if the uncertainty is less than 10 %, low if the uncertainty is more than 40 % and medium for values in between. The uncertainty estimates are based on combined uncertainty of activity data and emissions factors.

More information on estimation of uncertainty at the source category level is presented in the annexed report Greenhouse Gas Emissions and Removals in Finland.

A key source identification was carried out in the 1999 inventory .

5 CALCULATION METHODS FOR THE YEARS 1990 - 1999

The essential differences in the calculation methods used for the years 1990 - 1999 compared to the year 2000 are listed below. Changes in emission factors and activity data are not accounted.

CRF 1A	None. (1991 emissions are not calculated with the ILMARI calculation system.) Calculation of the years 1990 and 1992 is based on top-down estimates. Reallocation of non-fuel based SO_2 emissions to CRF 2 categories (years 1990-99)
CRF 1B	NMVOC estimates for 1999 are updated according to the results from the Finnish NMVOC calculation model at the FEI. The whole time series will be updated in the next submission.
CRF 2 (I)	1991 emissions are not calculated with the ILMARI calculation syste.) Calculation of the years 1990 and 1992 is based on top-down estimates. NMVOC estimates for 1999 are updated according to the results from the Finnish NMVOC calculation model at the FEI. The whole time series will be updated in the next submission.
CRF 2 (II)	Years 1994, 1996 and 1997: Calculation method see year 1999 Year 1995: Interpolated figure with assumed composition of chemical species Prior to 1994: Nearly zero use of HFCs compounds.
CRF 3	NMVOC estimates for 1999 are updated according to the results from the Finnish NMVOC calculation model at the FEI. The whole time series will be updated in the next submission.
CRF 5	None.
CRF 6	None.
CRF 7	None.
International bunkers	None.

6 REFERENCES

CRF 1 and CRF 2

Boström S. (1994). Greenhouse Gas Inventory, Finland 1990. Energy and Industry.

Boström S., Bachman R. and Hupa M. (1992). Greenhouse Gas Emissions in Finland 1988 and 1990; Energy, Industrial and Transport Activities. Turku, Finland. Insinööritoimisto Prosessikemia Ky. Prepared for the Ministry of Trade and Industry and the Ministry of the Environment.

FEI (2000) Calculation model for Finnish NMVOC emissions

Laine K.I., Selin P. and Nypönen T. (1998) The role of peat and peat utilization in carbon balance. Peat memorandum. 11 p. (Not published)

Mäkelä K., Kanner H. and Laurikko J. (1995) LIISA 93 Computing of Air Emissions from Road Transport. Technical Research Centre of Finland. (In Finnish)

Nykänen H., Silvola J., Alm J. and Martikainen P. (1996) Fluxes of greenhouse gases CH_4, CO_2 and N_2O on some peat mining areas in Finland. In: Laiho R., Laine J. and Vasander H. (eds.) (1996) Northern Pentland in global climate change. Helsinki: The Academy of Finland, pp. 141-147. (Proceedings of the International Workshop held in Hyytiälä, Finland, 8-12 October 1995, The Finnish Research Programme on Climate Change - SILMU)

Selin P. (1999) Industrial use of peatland and the re-use of cut-away areas in Finland (Thesis). Jyväskylä. University of Jyväskylä. 239 p.

Statistics Finland (1998). The development program of energy statistics. Final Report. Statistics Finland Reviews 1988:11. Helsinki. (In Finnish with English summary)

Statistics Finland (2001). Energy Statistics, 2000. Series: Official Statistics of Finland (SVT) Energy 2001:2. 149 p.

CRF 3

FEI (2000) Calculation model for Finnish NMVOC emissions. 32 p.

CRF 4

Berglund K. (1989). Ytsänkning på mosstorvjord. Sveriges Lantbruksuniversitet. Institutionen för markvetenskap. Avdelningsmeddelande 89:3.

Grönroos J., Nikander A., Syri S., Rekolainen S. and Ekqvist M. (1998). Agricultural ammonia emissions in Finland. The Finnish Environment 206. 65 p. Finnish Environment Institute. (In Finnish).

Klemedtsson L., Klemedtsson Å.K., Esala M. and Kulmala A. (1999). Inventory of N_2O emissions from farmed European Pentland. In: Freibauer A. and Kaltschimtt M. (eds.) (1998). Approaches to greenhouse gas inventories of biogenic sources in agriculture. Proceedings of the Workshop at Lökeberg, Sweden, 9 B 10.7.1998, pp. 79 B 94. (EU consorted action FAIR3 - CT96 - 1877 “Biogenic emissions of greenhouse gases caused by arable and animal agriculture”. Band 53, Stuttgart, Universität Stuttgart/IER).

Kuusisto E., Kauppi L. and Heikinheimo P. (eds.) (1996). Climate Change and Finland. Finnish Global Change Research Program (SILMU). 265 p. (In Finnish).

Lehtilä A. and Tuhkanen S. (1999). Integrated cost-effectiveness analysis of greenhouse gas emission abatement. VTT Publications 374. 114 p + app. 15 p. Technical Research Centre of Finland.

Maljanen M., Silvola J., Hytönen J. and Martikainen P. (1999) Greenhouse gas emissions from cultivated and afforested organic soils. 30 p. Kuopio University. (In Finnish).

Maaseutukeskusten liitto (1993) (Rural Advisory Centres). Environmental care programs 1990 B 1992. 11 p. (In Finnish).

Nykänen H., Alm J., Lång K., Silvola J. and Martikainen P.J. (1995). Emissions of CH_4, N_2O and CO_2 from a virgin fen and a fen drained for grassland in Finland. Journal of Biogeography 22: 351-357.

Pipatti R. (2000). Finnish agricultural greenhouse gas emissions, potential and cost-effectiveness of emission reduction. VTT Publications - In press. 64 p. Technical Research Centre of Finland. (In Finnish).

Pipatti R. (1997). Potential and cost-effectiveness of reducing methane and nitrous oxide emissions in Finland VTT Research Notes 1835. 62 p. + app. 4 p. Technical Research Centre of Finland. (In Finnish).

Pipatti R. (1994). Estimates, scenarios and reduction potential for methane and nitrous oxide emissions in Finland. VTT Research Notes 1548. 68 p. Technical Research Centre of Finland. (In Finnish).

Rekolainen S., Pitkänen H., Bleeker A. and Felix S. (1995). Nitrogen and phosphorus fluxes from Finnish agricultural areas to the Baltic Sea. Nordic Hydrology 26: 55 B 72.

Savolainen I., Tähtinen M., Wistbacka M., Pipatti R. and Lehtilä A. (1996). Economic reduction of acidifying deposition by decreasing emissions in Finland, Estonia and Russia. VTT Research Notes 1744. 60 p. Technical Research Centre of Finland. 60 p. (In Finnish).

Seppänen H. and Matinlassi T. (1998). Environmental care programs at Finnish farms 1995 B 1997. Maaseutu-keskusten liitto (Rural Advisory Centres). 19 p. (In Finnish).

CRF 5

Karjalainen T. and Kellomäki S. (1996). Greenhouse gas inventory for land use changes and forestry in Finland based on international guidelines. Mitigation and Adaptation Strategies for Global Climate 1: 51-71.

Tomppo E. (1999). Carbon sequestrations and releases by tree of Finnish forests in 1995, 1996, 1997 1998. A report. Finnish Forest Research Institute.

Tomppo E. (2000). Annual inventory and reporting practice on land use change and forestry for the Climate Convention (Ilmastosopimuksen mukainen vuosittainen maankäytön muutoksiin ja metsiin liittyvä inventointi- ja raportintikäytäntö). In: Ilmastosopimuksen ja Kioton pöytäkirjan metsien hiilivarastoja ja nieluja käsittelevän työryhmän muistio. Työryhmämuistio 2000:5. The Ministry of Agriculture and Forestry. (In Finnish)

Tomppo E., Varjo J., Korhonen K., Ahola A., Ihalainen A., Heikkinen J., Hirvelä H., Mikkelä H., Mikkola E., Salminen S. and Tuomainen T. (1997). Country report for Finland. In: Study on European Forestry Information and Communication Systems. Reports on forestry inventory and survey systems. Vol. 1. European Commission, pp. 145-226. ISBN 92-827-9847-X.

Tomppo E., Henttonen H., Korhonen K.T., Aarnio A., Ahola A., Heikkinen J., Ihalainen A. Mikkelä H., Tonteri T. and Tuomainen T. (1998). Forest resources of Forestry Centre Etelä-Pohjanmaa and their changes in 1968-97 (Etelä-Pohjanmaan metsäkeskuksen alueen metsävarat ja niiden kehitys 1968B97). Folia Forestalia 1998 (2B): 293-374. (In Finnish)

Tomppo E. (2000) National Forest Inventory of Finland and its role in estimating the carbon balance forests. Biotechnol. Agron. Soc. Environ. 4(4): 281-284.

CRF 6

Advisory board for Waste Management (1992). Development programme on municipal waste management 2000. Ministry of the Environment, Environmental Protection Department Report 1992 (106). 55 p.

Isaksson K.-E. (1993) Wastes from construction. Talonrakennustoiminnan jätteet. Official Statistics of Finland, Environment 1993 (7). 55 p. (In Finnish)

Isännäinen S. (1994) Utilization of wastewater sludge. Jätevesilietteistä ja niiden hyötykäytöstä. In: Seminaariesitelmiä: Vesiensuojelu. Ympäristönsuojelutekniikan julkaisuja 1994(4):19-39. Helsinki University of Technology. Laboratory of Environmental Pollution Prevention Technology. (In Finnish)

Leinonen S. and Kuittinen V. (1999) The Finnish Biogas Plant Register. Suomen Biokaasulaitosrekisteri II. Tiedot vuosilta 1996-1998. University of Joensuu. Karelian Institute. Working Papers 1999 (1). 54 p. (In Finnish)

Perälä A.-L. and Nippala E. (1998) Utilization of wastes from construction. Rakentamisen jätteet ja niiden hyötykäyttö. State Technical Research Centre of Finland, Research Notes 1936. 67 p. (In Finnish)

Pipatti R., Hänninen K., Vesterinen R., Wihersaari M. and Savolainen I. (1996) Impact of waste management alternatives on greenhouse gas emissions. Jätteiden käsittelyvaihtoehtojen vaikutus kasvihuonekaasupäästöihin. VTT Publications 811. Technical Research Centre of Finland. 85 p. (In Finnish)

Statistics Finland (1995) Wastes from Manufacturing and Related Industries 1992. Official Statistics of Finland, Environment 1995 (7). 162 p.